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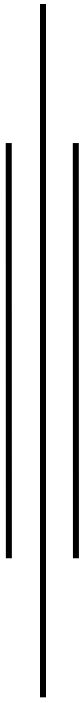
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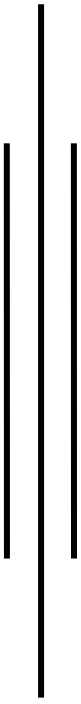
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Sustainable luxury consumption: Investigating consumer perceptions and willingness to purchase luxury brands in emerging markets

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Keywords
luxury consumption, luxury brand price perception, consumer attitudes, attraction toward luxury brands, willingness to buy, emerging markets

Abstract

This study investigates how luxury brand price perception and attraction toward luxury brands influence consumer attitudes and willingness to buy luxury brands in emerging markets amid increasing sustainability considerations. A conceptual model was developed to examine the relationships among luxury brand price perception, attraction toward luxury brands, consumer attitudes, and willingness to buy luxury brands. Using a quantitative research design, data were collected through an online structured questionnaire from 267 luxury brand consumers in South Africa using convenience sampling. Multiple regression analysis was employed to test the proposed relationships. The findings reveal that luxury brand price perception positively and significantly influences attraction toward luxury brands, consumer attitudes, and willingness to buy luxury brands. Attraction toward luxury brands also positively influences consumer attitudes and willingness to buy, while consumer attitudes exert the strongest effect on purchase willingness. These findings confirm the central role of consumer attitudes in translating luxury-related perceptions into purchase intentions. The study contributes to luxury consumption literature by providing empirical evidence from an emerging market and offers managerial insights for positioning premium pricing and enhancing brand attractiveness to strengthen positive consumer attitudes and increase consumers' willingness to buy luxury brands.

Introduction

Luxury consumption has traditionally been associated with exclusivity, prestige, superior quality, rarity, hedonism and symbolic status (Atkinson & Kang, 2022; Rowens, 2023). Within consumer behaviour research, luxury brands are understood not merely as functional products but as symbolic assets that enable consumers to communicate identity, achievement, and social positioning. The present study therefore aims to understand the extent to which luxury brand price perception and attraction toward luxury brands would influence consumer attitudes and willingness to buy luxury brands within emerging market contexts. This is partly motivated by the increase in luxury brands withing developing countries (Paul & Yao, 2022). Luxury goods therefore perform both utilitarian and symbolic roles, allowing consumers to express status, distinction, and aspirational identities through their consumption choices (Fuentes, Vera-Martinez & Kolbe, 2023; Siepmann, Holthoff & Kowalczuk, 2022). As a result, luxury consumption has long attracted scholarly attention due to its ability to reveal how individuals use brands to construct and communicate meaning within social contexts.

Prior research demonstrates that consumers' intentions to purchase luxury brands are shaped by a combination of social, personal, and functional value perceptions. These include conspicuousness, status signalling, hedonism, materialism, uniqueness seeking, and beliefs regarding the relationship between price and quality (Shukla, 2012; Wiedmann, Hennigs, & Siebels, 2009). Such value perceptions influence how consumers interpret the desirability of luxury brands and whether the perceived benefits justify their premium prices. Importantly, contemporary research suggests that luxury consumption motivations are multifaceted and context dependent, varying across cultural settings, consumer segments, and economic environments (Kapferer, & Michaut-Denizeau, 2019; Osburg, Yoganathan, Bartsch, Diallo, & Liu, 2024). As middle and upper income consumer segments expand in many emerging economies, luxury brands are increasingly viewed not only as symbols of prestige but also as markers of social mobility and global

lifestyle aspirations (Shukla, Banerjee, & Adidam, 2016). However, consumption patterns in these markets often differ from those observed in developed economies because they are shaped by distinct socio-economic structures, cultural values, and status signalling norms (Osburg et al., 2024).

Stemming from a managerial perspective, luxury brands provide firms with powerful opportunities to differentiate themselves in highly competitive markets. Luxury branding strategies often rely on carefully curated brand narratives, aesthetic design, heritage storytelling, and premium pricing structures to create perceptions of exclusivity and desirability (Kapferer & Bastien, 2012). Through these strategies, marketers aim to construct brand identities that resonate with consumers' aspirations and symbolic self-concepts. Substantial marketing resources are therefore invested in building luxury brand imagery and cultivating emotional connections with consumers.

As for consumers, luxury brands often represent more than material possessions; they embody symbolic identities that individuals may seek to emulate or associate with. Consumers may be attracted to luxury brands because they convey prestige, social recognition, and personal gratification, making them particularly powerful tools for self-expression (Kapferer, & Michaut-Denizeau, 2019). Consequently, understanding why consumers develop favourable perceptions of luxury brands and how these perceptions translate into willingness to purchase remains a critical area of inquiry within consumer behaviour research (Kowalczyk & Mitchell, 2022; Kang, Koo, Han, & Yoo, 2022). Despite the extensive body of literature on luxury consumption, ongoing shifts in global markets and consumer expectations continue to reshape how luxury brands are perceived and evaluated. In particular, the interaction between perceived price signals, consumer attraction to luxury brands, and attitudes toward luxury consumption remains an area that warrants further empirical investigation, especially within emerging market contexts. Examining these relationships can provide valuable insights into the psychological mechanisms that influence consumers' willingness to purchase luxury brands and can help marketers design strategies that resonate more effectively with contemporary luxury consumers.

Research objectives

The objectives of the study are to investigate the following:

- The impact of luxury brand price perception on luxury brands attractiveness, consumer attitudes and willingness to buy luxury brands.
- The impact of luxury brands attractiveness on consumer attitudes and willingness to buy luxury brands.
- The impact of consumer attitudes towards luxury brands on the willingness to buy luxury brands.

Research Problem

Although luxury branding research is well established, much of the earlier literature has focused on traditional dimensions of luxury such as prestige, status, exclusivity, hedonism and quality (Wirtz, Holmqvist & Fritze, 2020). While these dimensions remain important, the market context has evolved significantly, with sustainability becoming increasingly salient in brand communication and consumer evaluation. However, it remains unclear whether sustainability meaningfully reshapes consumers' perceptions of luxury brands and whether these perceptions translate into a stronger willingness to purchase (Osburg, Yoganathan, Bartsch, Diallo & Liu, 2024). This could particularly be the case in emerging markets where luxury consumption is growing but remains contextually distinct from that in developed economies.

Theoretical Framework

This study explains sustainable luxury consumption in emerging markets using the theory of planned behaviour (TPB) as the primary intention mechanism, complemented by Signaling Theory (to theorise luxury price perception) and the Theory of Consumption Values (to theorize brand attraction as multi-dimensional value). Together, these lenses offer a parsimonious explanation of how consumer perceptions (price and attraction) shape attitudes and ultimately willingness to buy luxury brands under sustainability expectations. Sustainable luxury consumption is the purchase of luxury goods based on sustainability-related attributes (Agrawal, Rathi & Garg, 2022). These sustainability attributes could include ethical

sourcing, environmental responsibility, durability or circularity narratives. Recent syntheses reveal that sustainable luxury is discussed through multiple practice-based and communication-based perspectives such as materials, recycling, CSR or brand promise and advertising (Athwal, Wells, Carrigan & Henninger, 2019). The outcomes of these perspectives commonly include attitudes and purchase intention (Athwal et al., 2019). Empirical work such as Grauel, Burmann and Schade (2025) continues to report mixed pattern. For example, some affluent luxury consumers view sustainability as a hygiene factor and may show limited willingness to pay an additional premium for sustainability, even while expecting luxury firms to maintain high standards (Grauel et al., 2025). Given this tension, the theoretical framework integrates three theories, the TPB to explain intention formation through attitudes, the signaling theory to explain how price communicates unobservable luxury meanings, and the consumption values theory to explain how attraction emerges from multi-dimensional value perceptions that can include sustainability related value. The review of literature and development of hypotheses is provided in the section that follows.

Literature Review and Hypotheses Development

Sustainable Luxury Consumption

Luxury consumption has long been explained through symbolic and experiential value (Han, & Kim, 2020). In addition, consumers purchase luxury brands not only for superior product performance, but also for the social prestige, emotional gratification and identity expression attached to such brands (Nobre, Kumar, Kastanakis, & Paul, 2023). Jain (2021) showed that luxury purchase intentions are influenced by a combination of social, personal and functional value perceptions, including status, conspicuousness, hedonism, materialism, uniqueness and price-quality beliefs. This foundational view remains important because it explains why luxury brands continue to attract consumers despite high prices and restricted accessibility.

Sustainable luxury consumption and the emerging-market context

Sustainable luxury consumption is a well-documented phenomenon which has garner the instance of numerous scholars exploring its many facets. For instance, Pai, Laverie and Hass (2022) investigated how sustainability and craftsmanship lead to social-environmental well-being in relation to consumption of luxury brands (Pai, Laverie & Hass, 2022). luxury is often associated with excess, exclusivity, ostentation, and indulgence (Wang, Sung & Phau, 2022), while sustainability is commonly linked to moderation, ethics, and long-term societal/environmental welfare (Hirvilammi & Koch, 2020). In empirical work, this sustainability-luxury paradox is frequently framed as a compatibility problem that depends on how consumers define luxury. For example, whether luxury is understood primarily as exceptional quality and durability versus superficial status-signaling (Kapferer & Michaut-Denizeau, 2017).

The emerging-market context is central to this conversation because luxury demand has expanded alongside rising purchasing power, urbanization, and the growth of middle or upper consumer segments, while sustainability expectations are simultaneously intensifying (DeFraites, 2024). Evidence from emerging-market luxury research such as (Makhitha et al., 2024) shows that consumers' status and quality-oriented motives remain highly salient. For example, in a South African study of luxury clothing, status, perceived quality, and materialism significantly predicted luxury purchase intention (with status the strongest) (Makhitha et al., 2024). Recent sustainable luxury research (Aggarwal, Singh & Misra, 2024; Jain, 2019; Osburg, Yoganathan, Bartsch, Diallo & Liu, 2024) also suggests that sustainability features can elevate perceived value and behavioral intentions, but these effects vary by market and product positioning.

Hypotheses development aligned to the conceptual model

Price perception and willingness to buy luxury brands

In luxury markets, price commonly serves a dual role where it is a monetary sacrifice and also a cue that can validate exclusivity, status and expected quality (Shrivastava, Hernandez & Hernandaz, 2025). It is believed that many luxury consumers associate luxury with expensiveness and that luxury brands

strategically increase prices while relying on consumers' acceptance of such prices (Kapferer & Valette-Florence, 2021). In addition, luxury price levels can influence psychologically meaningful outcomes related to social image and purchase intention in luxury consumption contexts (Wei, Shen, & Lu, 2024). Under a signaling lens, favorable interpretations of high prices can strengthen consumers' willingness to purchase because the price is not merely paid, it is "used" socially as a signal (Berger, 2019; Zhang et al., 2026). Based on the evidence presented the following hypothesis is provided.

H1: Luxury brand price perception positively influences willingness to buy luxury brands.

Price perception and consumer attitudes toward luxury brands

The theory of planned behaviour argues that attitudes are formed from salient beliefs and evaluations of outcomes (Ajzen, 1991). In luxury settings, consumers' beliefs about whether the price is justified by durability, exclusivity or sustainability-related value shape their evaluative stance toward luxury purchase (Zhang, Aw & Phau, 2026). Sustainable luxury research also shows that sustainability-linked value perceptions can foster more favorable brand attitudes and downstream purchase intentions when consumers perceive credible value in the offering (Liu, Kim, & Lee, 2025). Therefore, when luxury brand prices are perceived as fair, prestige-consistent and value-justified, attitudes toward buying the brand should become more favourable (Jhamb, Aggarwal, Mittal & Paul, 2020; Yao, Hu & Du, 2023). The following hypothesis is provided based on the literature presented.

H2: Luxury brand price perception positively influences consumer attitudes toward luxury brands.

Price perception and attraction toward luxury brands

Brand attraction in luxury is frequently amplified by cues that communicate exclusivity and status, and price is one of the most prominent cues (Dion & Borraz, 2017; Fuentes et al., 2023). Costly signaling research supports the idea that luxury brand typically correlates with high price levels operating as costly signals that can yield tangible social benefits. (Berger2019). This therefore implies that higher or prestige-congruent prices can increase the psychological appeal of luxury brands for status-motivated consumers, a notion supported by Sestino (2024). Consistent with this, empirical work in luxury contexts shows price-related variables can meaningfully shape consumers' luxury purchase psychology and intention (Wei et al., 2024). Stemming from the above-mentioned literature, the following hypothesis is brought forward.

H3: Luxury brand price perception positively influences attraction toward luxury brands.

Attraction toward luxury brands and consumer attitudes

Within the context of the theory of planned behaviour, attraction can be positioned as an affectively charged belief in how desirable and appealing the brand is, ultimately shaping the consumers' overall attitude towards buying the luxury brand (Lau, Ng, Chan & Cheung, 2023). The theory of consumption values strengthens this argument in that perceived value combines functionality, social, emotional, uniqueness, and sustainability to evaluative orientations and intentions in sustainable luxury contexts (Yang, Su, & Shion, 2023). In green or luxury hybrid contexts, value-derived perceptions such as green perceived value can strengthen brand attitude, which supports the view that attraction or value functions upstream of evaluative stance (Liu et al., 2025). Based on the literature provided, the following hypothesis is presented.

H4: Attraction toward luxury brands positively influences consumer attitudes toward luxury brands.

Attraction toward luxury brands and willingness to buy luxury brands

Brand attractiveness has been treated as consequential within consumer-brand relationship formation and as predictor of consumer outcomes (Elbedweihy, Jayawardhena, Elsharnouby & Elsharnouby, 2016). In luxury fashion, brand attractiveness has also been seen to be positively associated with purchase intention in peer-reviewed work (Lau, Ng, Chan & Cheung, 2023). In line with a consumption values perspective involving luxury brands closes (generally associated with attraction), this could increase purchase intention, sometimes through relational constructs such as attachment (Petraviciute, Seinauskiene, Rutelione & Krukowski, 2021). Accordingly, consumers who feel stronger attraction toward

luxury brands should show stronger willingness to purchase them. The following hypothesis is thus proposed.

H5: Attraction toward luxury brands positively influences willingness to buy luxury brands.

Consumer attitudes and willingness to buy luxury brands

A central proposition of TPB is that attitudes toward a behaviour predict intention (Ajzen, 1991). This attitude-intention part pattern is also common in luxury purchase research, including developing-country settings where attitudes toward purchasing luxury products are explicitly modelled as influential for purchase intention (Makhitha, Khumalo & Sekhu, 2024). In sustainable luxury-linked luxury consumption, attitude-like brand evaluations such as brand attitude are empirically associated with purchase intention in consumer models where sustainability-derived value perceptions shape attitudes and downstream intentions (Liu, Kim & Lee, 2025). The following hypothesis is thus proposed.

H6: Consumer attitudes toward luxury brands positively influence willingness to buy luxury brands.

Figure 1: Conceptual Model

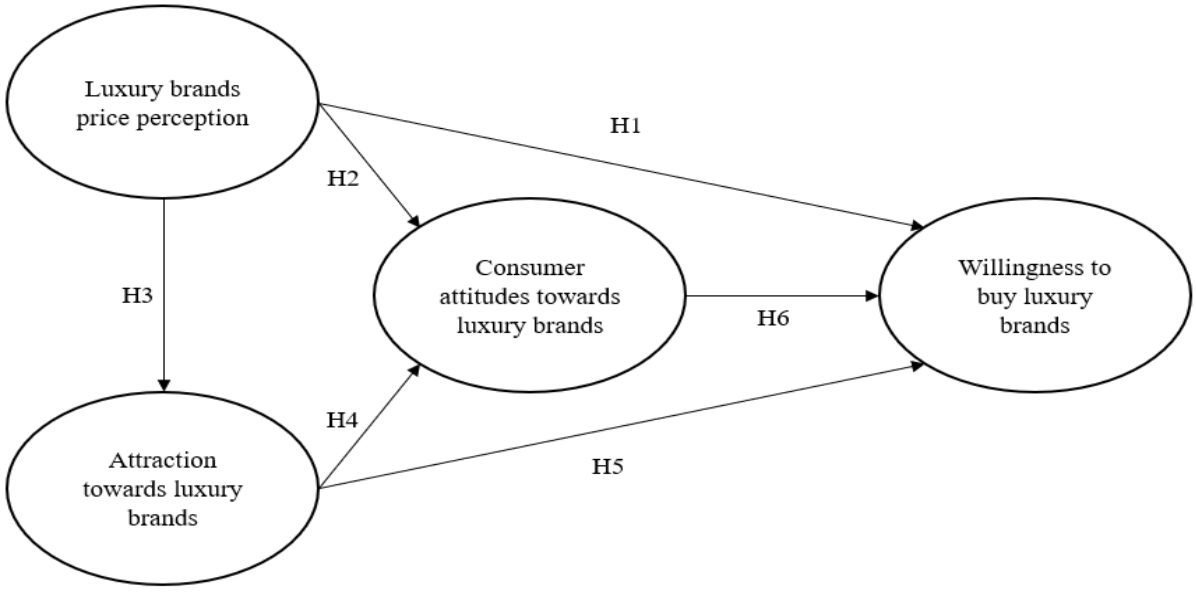


Figure 1 above shows the relationship among the proposed hypotheses, which luxury brands price perception serving as a predictor of attraction towards luxury brands, consumer attitudes and ultimately the willingness to buy luxury brands. Willingness to buy luxury brands is also depicted an outcome of attraction and attitudes towards luxury brands. The methodology adopted for the research is outlined in the section that follows.

Research Methodology

This study adopted a quantitative research design to examine the relationships between luxury brand price perception, attraction toward luxury brands, consumer attitudes toward luxury brands, and willingness to buy luxury brands. A survey method was used because it enables the collection of standardized data from a relatively large number of respondents and allows statistical testing of hypothesised relationships between constructs (Hair, Black, Babin & Anderson, 2019).

A structured questionnaire was developed to measure the constructs included in the conceptual model. The questionnaire consisted of two sections. The first section captured demographic information about respondents, while the second section measured the key study constructs using multi-item scales adapted from established studies in luxury consumption and consumer behaviour literature.

Sampling and data collection

Data were collected from consumers who regularly purchase or engage with luxury brands in South Africa, representing an emerging market context. A non-probability convenience sampling technique was used because it allowed access to respondents who were familiar with luxury brands and willing to

participate in the study. The questionnaire was distributed online using digital survey platforms and social media channels.

Participation was voluntary and respondents were informed about the purpose of the study before completing the survey. A total of 267 usable responses were obtained and retained for analysis after screening for completeness. The sample size is considered adequate for regression analysis, as recommended thresholds suggest a minimum sample size exceeding 50 + 8k observations, where k represents the number of predictors in the model (Hair et al., 2019).

Measurement scales

All constructs were measured using multi-item Likert-type scales, where respondents indicated their level of agreement with each statement on a five-point Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree). Luxury brand price perception was measured using items adapted from luxury branding and price perception literature examining how consumers interpret price as a signal of prestige, exclusivity, and quality (Kapferer & Valette-Florence, 2021). Attraction toward luxury brands was measured using items adapted from brand attractiveness and brand appeal literature, which capture the degree to which consumers perceive luxury brands as desirable and appealing (Elbedweihy et al., 2016). Consumer attitudes toward luxury brands were measured using attitude evaluation items grounded in consumer behaviour and behavioural intention research based on the Theory of Planned Behaviour framework (Ajzen, 1991). Willingness to buy luxury brands was measured using purchase intention items adapted from established consumer behaviour studies examining consumers' intentions to purchase branded products (Dodds et al., 1991). All measurement items were adapted to suit the context of luxury brand consumption in emerging markets.

Data analysis

Data analysis was conducted using IBM SPSS statistical software. The analysis followed a multi-step process. First, reliability analysis was conducted using Cronbach's alpha to assess the internal consistency of the measurement scales. All constructs demonstrated acceptable reliability levels consistent with recommended thresholds for exploratory research (Hair et al., 2019). Second, Pearson correlation analysis was performed to examine the relationships between the study variables and to ensure that the constructs were significantly associated in the expected directions. Third, multiple regression analysis was conducted to test the hypothesised relationships in the conceptual model. Regression analysis was used to determine the strength and significance of the relationships between luxury brand price perception, attraction toward luxury brands, consumer attitudes toward luxury brands, and willingness to buy luxury brands. The results of the regression analysis were used to evaluate the proposed hypotheses and determine whether the conceptual model was supported.

Results

This section presents findings from analysis. Starting with sample profile, followed reliability checks, correlation and multi regression analysis.

Sample profile

The sample comprised 267 respondents, with a relatively balanced gender distribution, consisting of 53.56% males and 46.07% females, while a very small proportion (0.37%) preferred not to disclose their gender. In terms of age, the majority of participants fell within the 20-25 age group (58.4%), followed by those aged 18-19 (33.7%), and a smaller segment aged 26 years and above (7.9%), indicating a predominantly young adult sample.

Regarding spending behaviour on luxury clothing, most respondents reported moderate expenditure levels, with 43.1% spending between R501 and R1000, followed by 27.3% spending between R250 and R500. A smaller proportion reported spending more than R1000 (19.9%), while only 9.4% spent less than R250. In terms of purchasing frequency, luxury clothing purchases were largely seasonal (52.1%), followed by annual purchases (20.2%) and monthly purchases (21.0%), while very few respondents reported weekly purchasing (3.7%) or other patterns (3.0%).

With respect to brand preference, Levi's emerged as the most preferred luxury clothing brand (42.7%), followed by Hugo Boss (28.8%), Guess (19.5%), and Kurt Geiger (8.6%), while Diesel accounted for a negligible proportion (0.4%). Overall, the profile suggests a young, moderately spending consumer segment with seasonal purchasing habits and a strong inclination toward globally recognised luxury brands. The reliability checks are presented in table 1 below.

Table 1: Reliability Checks

Construct	Alpha	Interpretation
LPP	0.616	Acceptable (exploratory research)
ATR	0.709	Good
ATT	0.746	Good
WTB	0.689	Acceptable

Key: LPP: Luxury brands price perception, ATT: Consumer attitudes towards luxury brands, ATR: Attraction towards luxury brands, WTB: Willingness to buy luxury brands

Reliability analysis was conducted to assess the internal consistency of the measurement scales. The Cronbach's alpha values ranged from 0.616 to 0.746, indicating acceptable reliability for exploratory research (Hair et al., 2019). Although the reliability of luxury brand price perception was slightly below the conventional 0.70 threshold, it exceeded the minimum acceptable level of 0.60, which is considered adequate for exploratory studies. To test for construct validity, inter-construct correlation analysis was conducted and outputs are presented in table 2.

Table 2: Correlation Analysis Interpretation

Relationship	R	Interpretation
LPP – ATR	0.400	Moderate positive
LPP – ATT	0.489	Moderate positive
LPP – WTB	0.440	Moderate positive
ATR – ATT	0.403	Moderate positive
ATR – WTB	0.315	Weak to moderate
ATT – WTB	0.653	Strong

Key: LPP: Luxury brands price perception, ATT: Consumer attitudes towards luxury brands, ATR: Attraction towards luxury brands, WTB: Willingness to buy luxury brands

Pearson correlation analysis was conducted to examine the relationships among the study variables. The results indicate that luxury brand price perception is positively associated with attraction toward luxury brands ($r = 0.400$, $p < 0.001$), consumer attitudes toward luxury brands ($r = 0.489$, $p < 0.001$), and willingness to buy luxury brands ($r = 0.440$, $p < 0.001$). Attraction toward luxury brands is also positively related to consumer attitudes ($r = 0.403$, $p < 0.001$) and willingness to buy luxury brands ($r = 0.315$, $p < 0.001$). The strongest correlation was observed between consumer attitudes toward luxury brands and willingness to buy luxury brands ($r = 0.653$, $p < 0.001$). These results provide preliminary support for the hypothesised relationships proposed in the conceptual model. Table 3 in the following section provides findings from hypothesis testing.

Table 3: Summary of hypothesis testing results

Hypothesis	Relationship	β	t-value	p-value	R^2	Result
H1	LPP to WTB	0.440	7.979	< 0.001	0.194	Supported
H2	LPP to ATT	0.489	9.115	< 0.001	0.239	Supported
H3	LPP to ATR	0.400	7.107	< 0.001	0.001	Supported
H4	ATR to ATT	0.403	7.163	< 0.001	0.162	Supported
H5	ATR to WTB	0.315	5.397	< 0.001	0.099	Supported
H6	ATT to WTB	0.653	14.023	< 0.001	0.426	Supported

Key: LPP: Luxury brands price perception, ATT: Consumer attitudes towards luxury brands, ATR: Attraction towards luxury brands, WTB: Willingness to buy luxury brands

Multiple regression analysis was used to test the hypothesised direct relationships among luxury brand price perception, attraction toward luxury brands, consumer attitudes toward luxury brands, and

willingness to buy luxury brands. The results showed that all six hypothesised paths were positive and statistically significant. Luxury brand price perception positively influenced willingness to buy luxury brands ($\beta = 0.440$, $t = 7.979$, $p < 0.001$), consumer attitudes toward luxury brands ($\beta = 0.489$, $t = 9.115$, $p < .001$), and attraction toward luxury brands ($\beta = 0.400$, $t = 7.107$, $p < 0.001$). Attraction toward luxury brands positively influenced consumer attitudes toward luxury brands ($\beta = 0.403$, $t = 7.163$, $p < .001$) and willingness to buy luxury brands ($\beta = 0.315$, $t = 5.397$, $p < 0.001$). Consumer attitudes toward luxury brands had the strongest positive effect on willingness to buy luxury brands ($\beta = 0.653$, $t = 14.023$, $p < 0.001$). These findings provide support for H1 to H6. The implications from the findings are presented in the following section.

Implications

Theoretical Implications

First, the study adds to the theory of planned behaviour by showing that attitude is the most powerful proximal predictor of willingness to buy luxury brands. This is especially important because it confirms that, even in a luxury context shaped by symbolism and prestige, consumers' evaluative attitudes remain central to intention formation. Second, the findings support Signaling Theory by demonstrating that luxury brand price perception is not merely a cost variable. Instead, price appears to function as a positive signal of prestige, exclusivity, and value, thereby influencing attraction, attitudes, and willingness to buy.

Third, the study adds to the Theory of Consumption Values by showing that attraction toward luxury brands plays a meaningful role in shaping both evaluative attitudes and buying willingness. This suggests that emotional and symbolic appeal remains highly relevant in sustainable luxury contexts, particularly in emerging markets. Fourth, the results contribute to the growing sustainable luxury literature by showing that traditional luxury cues, especially price and attraction, still matter strongly even when sustainability is part of the broader framing. In other words, sustainability does not replace core luxury mechanisms; rather, it seems to coexist with them.

Practical Implications

Luxury brand managers in emerging markets should recognise that price is part of the value proposition, not merely a financial barrier. Premium pricing can strengthen consumers' willingness to buy when they interpret high prices as signals of authenticity, prestige, and superior quality. Managers should also invest in strategies that enhance brand attraction, such as symbolic storytelling, aesthetic branding, exclusivity cues, heritage communication, and aspirational positioning. Since attraction significantly affects both attitudes and willingness to buy, it is a valuable lever for strengthening consumer response. The strongest effect was from attitude to willingness to buy, which means firms should actively cultivate favourable attitudes through integrated communication strategies. This can include highlighting craftsmanship, durability, ethical sourcing, sustainability credentials, and emotional brand meaning in a way that feels credible and consistent with luxury positioning. For emerging markets specifically, the findings suggest that consumers respond to a blend of status cues and perceived value. Luxury marketers should therefore avoid positioning sustainability as sacrifice or restraint. Instead, sustainability should be communicated as enhancing the luxury proposition through quality, longevity, responsibility, and refined exclusivity.

Conclusions

This study examined how luxury brand price perception and attraction toward luxury brands influence consumer attitudes and willingness to buy luxury brands in an emerging market context. The findings show that all hypothesised direct relationships are positive and significant. Most notably, consumer attitudes toward luxury brands emerged as the strongest predictor of willingness to buy, while luxury brand price perception and attraction also played important direct roles. The study therefore demonstrates that sustainable luxury consumption in emerging markets is shaped by both traditional luxury cues and consumer evaluations, offering useful insight into how consumers interpret and respond to luxury brands under changing market expectations.

Suggestions for Future Research

Future research could extend the present model by explicitly testing the mediating role of consumer attitudes between luxury brand price perception, attraction and willingness to buy. Since attitude showed the strongest direct effect on willingness to buy, a mediation model would likely provide richer theoretical insight. Additionally, future studies could also examine moderators such as materialism, status consumption orientation, sustainability consciousness, income level, age cohort, and brand familiarity. These variables may reveal when price and attraction become more or less influential. A further theoretical extension would be to compare this model across different emerging markets or between emerging and developed markets to assess the contextual boundary conditions of sustainable luxury consumption.

Stemming from a practical perspective, future research could test whether the same hypotheses of this study hold across different luxury categories, such as fashion, cosmetics, watches, hospitality and automobiles. Managers would benefit from knowing whether price and attraction operate similarly across product classes. Researchers could also compare offline versus online luxury environments, since digital platforms may alter how consumers interpret prestige, exclusivity, and sustainability cues. The study was limited in the sense that a quantitative survey was used to gather data whereas interviews would have obtained some nuances that may have been missed considering that closed-ended questions restrict the respondent. It would therefore be interested to find out what a qualitative or mixed method approach would archive on the same topic.

References

Agrawal, G., Rathi, R., & Garg, R. (2022). Luxury as a sustainable service: a push–pull–mooring perspective. Vision, 09722629221104201. https://doi.org/10.1177/09722629221104201

Aggarwal, E., Singh, A. B., & Misra, R. (2024). Does consumption values and ascribed responsibility predict attitudes towards sustainable luxury brands. Journal of Consumer Marketing, 41(2), 180-195. https://doi.org/10.1108/JCM-05-2023-6058

Ajzen, I. (1991). The theory of planned behavior. Organizational behavior and human decision processes, 50(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Athwal, N., Wells, V. K., Carrigan, M., & Henninger, C. E. (2019). Sustainable luxury marketing: A synthesis and research agenda. International Journal of Management Reviews, 21(4), 405-426. https://doi.org/10.1111/ijmr.12195

Atkinson, S. D., & Kang, J. (2022). New luxury: Defining and evaluating emerging luxury trends through the lenses of consumption and personal values. Journal of Product & Brand Management, 31(3), 377-393. https://doi.org/10.1108/JPBM-09-2020-3121

Berger, J. (2019). Signaling can increase consumers' willingness to pay for green products. Theoretical model and experimental evidence. Journal of consumer behaviour, 18(3), 233-246. https://doi.org/10.1002/cb.1760

Connelly, B. L., Certo, S. T., Ireland, R. D., & Reutzel, C. R. (2011). Signaling theory: A review and assessment. Journal of management, 37(1), 39-67. https://doi.org/10.1177/0149206310388419

DeFraites, L. (2024). Understanding sustainable consumption experiences among the new middle class in an emerging market: A social cognitive approach (Doctoral dissertation, Open Access Te Herenga Waka-Victoria University of Wellington).

Dion, D., & Borraz, S. (2017). Managing status: How luxury brands shape class subjectivities in the service encounter. Journal of marketing, 81(5), 67-85. https://doi.org/10.1509/jm.15.0291

Dodds, W. B., Monroe, K. B., & Grewal, D. (1991). Effects of price, brand, and store information on buyers' product evaluations. Journal of marketing research, 28(3), 307-319. https://doi.org/10.1177/002224379102800305

Elbedweihy, A. M., Jayawardhena, C., Elsharnouby, M. H., & Elsharnouby, T. H. (2016). Customer relationship building: The role of brand attractiveness and consumer–brand identification. Journal of Business Research, 69(8), 2901-2910. https://doi.org/10.1016/j.jbusres.2015.12.059

Fuentes, H., Vera-Martinez, J., & Kolbe, D. (2023). The role of intangible attributes of luxury brands for signalling status: A systematic literature review. International Journal of Consumer Studies, 47(6), 2747-2766. https://doi.org/10.1111/ijcs.12852

Grauel, C., Burmann, C., & Schade, M. (2025). Sustainability preferences of luxury consumers: Is all that glitters green?. Future Business Journal, 11(1), 1-17. https://doi.org/10.1186/s43093-025-00561-3

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). Multivariate data analysis (8th ed.). Cengage.

Han, S. L., & Kim, K. (2020). Role of consumption values in the luxury brand experience: Moderating effects of category and the generation gap. Journal of Retailing and Consumer Services, 57, 102249. https://doi.org/10.1016/j.jretconser.2020.102249

Hirvilammi, T., & Koch, M. (2020). Sustainable welfare beyond growth. Sustainability, 12(5), 1824. https://doi.org/10.3390/su12051824

Jain, S. (2019). Factors affecting sustainable luxury purchase behavior: A conceptual framework. Journal of International Consumer Marketing, 31(2), 130-146. https://doi.org/10.1080/08961530.2018.1498758

Jain, S. (2021). Role of conspicuous value in luxury purchase intention. Marketing Intelligence & Planning, 39(2), 169-185. https://doi.org/10.1108/MIP-03-2020-0102

Jhamb, D., Aggarwal, A., Mittal, A., & Paul, J. (2020). Experience and attitude towards luxury brands consumption in an emerging market. European Business Review, 32(5), 909-936. https://doi.org/10.1108/EBR-09-2019-0218

Kang, I., Koo, J., Han, J. H., & Yoo, S. (2022). Millennial consumers perceptions on luxury goods: Capturing antecedents for brand resonance in the emerging market context. Journal of International Consumer Marketing, 34(2), 214-230. https://doi.org/10.1080/08961530.2021.1944832

Kapferer, J. N., & Michaut-Denizeau, A. (2017). Is luxury compatible with sustainability? Luxury consumers' viewpoint. In Advances in luxury brand management (pp. 123-156). Cham: Springer International Publishing.

Kapferer, J. N., & Michaut-Denizeau, A. (2019). Are millennials really more sensitive to sustainable luxury? A cross-generational international comparison of sustainability consciousness when buying luxury. Journal of Brand Management, 27(2020), 35-47. https://doi.org/10.1057/s41262-019-00165-7

Kapferer, J. N., & Valette-Florence, P. (2018). The impact of brand penetration and awareness on luxury brand desirability: A cross country analysis of the relevance of the rarity principle. Journal of Business Research, 83, 38-50. https://doi.org/10.1016/j.jbusres.2017.09.025

Kapferer, J. N., & Valette-Florence, P. (2021). Which consumers believe luxury must be expensive and why? A cross-cultural comparison of motivations. Journal of Business Research, 132, 301-313. https://doi.org/10.1016/j.jbusres.2021.04.003

Kowalczyk, C. M., & Mitchell, N. A. (2022). Understanding the antecedents to luxury brand consumer behavior. Journal of Product & Brand Management, 31(3), 438-453. https://doi.org/10.1108/JPBM-09-2020-3126

Lau, M. M., Ng, P. M. L., Chan, E. A. H., & Cheung, C. T. Y. (2023). Examining purchase intention for luxury fashion: integrating theory of reasoned action, with affect-behavior-cognition (ABC) model, identity and social identity theories. Young Consumers, 24(1), 114-131. https://doi.org/10.1108/YC-07-2022-1557

Liu, X., Kim, T. H., & Lee, M. J. (2025). The impact of green perceived value through green new products on purchase intention: Brand attitudes, brand trust, and digital customer engagement. Sustainability, 17(9), 4106. https://doi.org/10.3390/su17094106

Makhitha, K. M., Khumalo, M., & Sekhu, T. (2024). The influence of emerging market consumers' purchase intention of luxury clothing on their purchase behaviour: A South African perspectives. International Journal of Research in Business and Social Science, 13(1), 75-86. https://doi.org/10.20525/ijrbs.v13i1.3023

Nobre, H., Kumar, A., Kastanakis, M. N., & Paul, J. (2023). Consumers' relationship with mass prestige brands and happiness. European Management Review, 20(2), 306-325. https://doi.org/10.1111/emre.12538

Osburg, V. S., Yoganathan, V., Bartsch, F., Diallo, M. F., & Liu, H. (2024). How sustainable luxury influences product value perceptions and behavioral intentions: a comparative study of emerging vs. developed markets. Journal of Business Ethics, 191(4), 713-738. https://doi.org/10.1007/s10551-024-05661-8

Pai, C. Y., Laverie, D., & Hass, A. (2022). Love luxury, love the earth: An empirical investigation on how sustainable luxury consumption contributes to social-environmental well-being. Journal of Macromarketing, 42(4), 640-654. https://doi.org/10.1177/02761467221125915

Paul, P., & Yao, A. (2022). Luxury from a developing country perspective and consumer well-being: A new agenda for academia and businesses. In The Rise of Positive Luxury (pp. 173-191). Routledge.

Petraviciute, K., Seinauskiene, B., Rutelione, A., & Krukowski, K. (2021). Linking luxury brand perceived value, brand attachment, and purchase intention: the role of consumer vanity. Sustainability, 13(12), 6912. https://doi.org/10.3390/su13126912

Rowens, K. S. (2023). Luxury consumption. In Economic policy of the People's Republic of China (pp. 117-139). Wiesbaden: Springer Fachmedien Wiesbaden.

Sestino, A. (2024). The challenge of integrating "intelligent" technologies in luxury shopping contexts: The role of brand personality appeal and consumers' status consumption orientation. Journal of Retailing and Consumer Services, 76, 103488. https://doi.org/10.1016/j.jretconser.2023.103488

Shrivastava, P., Hernandez, S. R., & Hernandaz, O. R. (2025). Sustainable consumption meets conspicuous leisure: a dual-theory exploration in luxury hospitality. Frontiers in Sustainable Tourism, 4, 1640400. https://doi.org/10.3389/frsut.2025.1640400

Siepmann, C., Holthoff, L. C., & Kowalczuk, P. (2022). Conspicuous consumption of luxury experiences: an experimental investigation of status perceptions on social media. Journal of Product & Brand Management, 31(3), 454-468. https://doi.org/10.1108/JPBM-08-2020-3047

Wang, X., Sung, B., & Phau, I. (2022). Examining the influences of perceived exclusivity and perceived rarity on consumers' perception of luxury. Journal of Fashion Marketing and Management: An International Journal, 26(2), 365-382. https://doi.org/10.1108/JFMM-12-2020-0254

Wei, J., Shen, H., & Lu, Z. (2024). A study on the purchase intention of luxury goods from the perspective of face perception and expected regret. Plos one, 19(3), e0297050. https://doi.org/10.1371/journal.pone.0297050

Wirtz, J., Holmqvist, J., & Fritze, M. P. (2020). Luxury services. Journal of Service Management, 31(4), 665-691. https://doi.org/10.1108/JOSM-11-2019-0342

Yang, H., Su, X., & Shion, K. (2023). Sustainable luxury purchase behavior in the Post-Pandemic Era: a grounded theory study in China. Frontiers in Psychology, 14, https://doi.org/10.3389/fpsyg.2023.1260537

Yao, Q., Hu, C., & Du, J. (2023). Influence of consumption resources on observers' attitudes towards luxury brands: the perspective of power distance belief. Journal of Product & Brand Management, 32(8), 1191-1206. https://doi.org/10.1108/JPBM-03-2022-3920

Zhang, X., Aw, E. C. X., & Phau, I. (2026). High Cost, High Cause: Understanding Willingness to Pay a Premium Price for Sustainable Luxury. Psychology & Marketing. (Ahead of Print) https://doi.org/10.1002/mar.70103

Climate change risk and financial sector development in the EMEA region: Evidence from the pooled mean group autoregressive distributed lag (PMG-ARDL) approach

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Keywords
Climate change risk; Financial sector development; Financial markets; Financial institutions; PMG-ARDL; EMEA; Sustainable finance

Abstract

This study examines the impact of climate change risk on financial sector development in selected Europe, Middle East and Africa (EMEA) countries. Specifically, it investigates the long-run and short-run effects of climate change risk on financial market and financial institution development while assessing regional heterogeneity across the EMEA region. The study employs annual panel data for selected EMEA countries obtained from the International Monetary Fund, World Bank, Notre Dame Global Adaptation Initiative (ND-GAIN), and other internationally recognised databases. Financial sector development is measured using the International Monetary Fund's Financial Development Index, while climate change risk is captured using a composite Climate Change Risk Index. The Pooled Mean Group Autoregressive Distributed Lag (PMG-ARDL) estimator is utilised to estimate both long-run and short-run relationships following panel unit root, cross-sectional dependence, multicollinearity, and cointegration diagnostics. The empirical findings indicate that climate change risk exerts heterogeneous effects on financial sector development across the EMEA region. In the long run, climate change risk positively influences financial market development in countries with advanced financial systems and strong climate finance mechanisms, particularly in Europe. Conversely, climate change risk adversely affects financial institution development in several African and Middle Eastern economies characterised by lower institutional resilience and regulatory capacity. The findings highlight the need for climate-responsive financial regulation, strengthened institutional resilience, expanded sustainable finance initiatives, and region-specific policy interventions to enhance financial sector sustainability under increasing climate uncertainty.

Introduction

Climate change has become one of the most significant threats to global economic and financial systems, extending beyond environmental degradation to influence macroeconomic stability, financial markets, and institutional resilience. Increasing temperatures, changing precipitation patterns, biodiversity loss, and the rising frequency of extreme weather events have intensified both physical and transition risks, creating substantial challenges for financial systems worldwide. Financial institutions, investors, regulators and governments are increasingly recognising climate change as a systemic source of financial risk that affects investment decisions, asset valuations, credit allocation and long-term economic development (Battiston et al., 2021; IMF, 2019; European Commission, 2024a). Recent evidence further indicates that climate-related economic losses continue to rise globally, reinforcing the urgency of integrating climate risk into financial sector policy and regulation.

Financial sector development plays a critical role in promoting sustainable economic growth through the mobilisation of savings, efficient allocation of capital, risk diversification and the provision of financial services. The World Bank's 4×2 Financial Development Framework conceptualises financial sector development along two broad dimensions inancial markets and financial institutions each measured through four key components: access, depth, efficiency and stability. This multidimensional framework provides a more comprehensive assessment of financial system performance than conventional single-indicator measures. However, climate change increasingly threatens these dimensions by disrupting

economic activity, increasing financial uncertainty, altering investment behaviour and exposing financial institutions to greater credit, market and operational risks. Consequently, climate change risk has become an important determinant of financial sector development rather than merely an environmental concern.

Climate change affects financial systems primarily through physical and transition risk channels (Takawira, et al 2026). Physical risks arise from climate-related disasters such as floods, droughts, storms, wildfires and heatwaves, which damage productive assets, reduce economic output and impair borrowers' repayment capacity. Transition risks emerge from policy reforms, technological innovation, carbon pricing mechanisms and changing investor preferences as economies move towards low-carbon development. These risks influence financial systems through declining asset values, increased default probabilities, higher insurance claims, changing portfolio allocations and increased financial market volatility (Fu et al., 2023; Grippa et al., 2019; Battiston et al., 2021). As climate-related risks intensify, regulators and central banks have increasingly advocated the incorporation of climate stress testing, scenario analysis and climate risk disclosure into prudential supervision to strengthen financial system resilience.

The importance of understanding these relationships is particularly evident within the Europe, Middle East and Africa (EMEA) region. EMEA comprises economies that differ substantially in terms of financial market maturity, institutional quality, regulatory capacity, climate vulnerability and economic development. European countries generally possess relatively sophisticated financial systems, stronger climate finance mechanisms and more advanced regulatory frameworks, whereas many African and Middle Eastern economies remain highly vulnerable to climate shocks while simultaneously facing weaker institutional capacity and limited climate adaptation finance. These structural differences imply that climate change risk is unlikely to affect financial sector development uniformly across the three regions, thereby necessitating comparative empirical investigation.

Review of Literature

The relationship between climate change risk and financial sector development has attracted increasing attention as climate-related physical and transition risks become more deeply embedded in financial markets and institutions. Climate change can affect the financial sector by damaging assets and infrastructure, reducing borrowers' repayment capacity, altering investment returns, increasing insurance claims and exposing financial institutions to credit, liquidity, market and operational risks . At the same time, financial systems can facilitate climate adaptation and mitigation by mobilising capital for renewable energy, climate-resilient infrastructure and low-carbon technologies. The literature therefore presents a two-way relationship in which climate change influences the development and resilience of financial systems, while financial institutions and markets shape economies' capacity to respond to environmental risks. However, the direction and magnitude of these effects differ according to institutional strength, financial depth, regulatory capacity and regional economic conditions.

Theoretical Literature

The theoretical relationship between climate change risk and financial sector development cannot be explained adequately by a single theory. The present study therefore draws on several complementary theories and analytical frameworks, including Systemic Risk Theory, the Efficient Market Hypothesis, the Financial Instability Hypothesis, the Systems Theory of Financial Inclusion, the Dynamic Integrated Climate–Economy model, the Ecological Stock-Flow Consistent model and the Dystopian Schumpeter Meeting Keynes model. Collectively, these perspectives explain how climate-related shocks are transmitted through asset prices, lending activities, financial networks, market expectations, institutional behaviour and the broader macroeconomy. Nevertheless, the reviewed literature confirms that no comprehensive theory currently integrates all dimensions of climate change risk and financial sector development namely access, depth, efficiency and stability across both financial institutions and financial markets.

Systemic Risk Theory provides an important foundation for explaining how climate-related shocks can spread throughout an interconnected financial system (Marimo and Takawira, 2026). The theory suggests that distress affecting one institution, market or economic sector may be transmitted to other

components of the financial system through direct financial exposures, correlated assets, liquidity pressures and changes in investor behaviour. Climate-related disasters can reduce property and collateral values, weaken firms' cash flows and increase credit defaults. These effects may initially appear localised but can spread through banks, insurance companies, securities markets and investment portfolios. Similarly, transition policies may cause the repricing of carbon-intensive assets and create stranded-asset risks for institutions with substantial exposure to fossil-fuel-dependent sectors. Climate change may therefore become a systemic risk when losses are transmitted across highly interconnected financial institutions and markets.

The Efficient Market Hypothesis provides a financial-market perspective by proposing that asset prices incorporate available information. Under this framework, information about climate vulnerability, carbon regulation, environmental liabilities and transition strategies should be reflected in securities prices. Investors may reduce the value of companies exposed to severe physical climate risks or carbon-intensive activities while assigning higher valuations to firms that demonstrate stronger climate resilience and sustainable business practices. However, the theory assumes that relevant information is available, accurately measured and efficiently processed by market participants. In practice, incomplete climate disclosures, uncertainty regarding future regulation and the long-term nature of environmental risks may prevent climate information from being fully incorporated into market prices. Consequently, apparent financial-market stability may conceal climate vulnerabilities that have not yet been adequately priced.

The Financial Instability Hypothesis further explains how periods of financial expansion can generate increasing vulnerability as institutions become more willing to accept risk. During prolonged periods of economic and financial stability, lenders and investors may underestimate climate-related threats and continue financing carbon-intensive or climate-sensitive activities. This can create concentrated exposures and asset-price distortions that become apparent only when a climate shock or policy transition occurs. The hypothesis is particularly relevant where short-term profitability considerations discourage institutions from accounting for long-term environmental risks. Climate change may therefore amplify existing financial fragilities by exposing weaknesses accumulated during periods of optimistic lending, investment and risk assessment.

The Systems Theory of Financial Inclusion extends the analysis to financial access by viewing financial inclusion as the outcome of interactions among institutions, markets, regulations, technology and social conditions. Climate shocks can interrupt access to banking facilities, reduce household income, damage business operations and weaken the ability of vulnerable groups to qualify for formal financial services. Conversely, accessible savings, insurance, credit and digital payment systems may improve the capacity of households and businesses to absorb climate shocks and finance recovery. This perspective suggests that the effects of climate change on financial development are not confined to financial stability, but extend to the ability of individuals and enterprises to obtain and use financial services.

Integrated assessment models also contribute to the theoretical foundation of the study. The Dynamic Integrated Climate–Economy model connects economic activity, greenhouse-gas emissions, climate damage and mitigation costs, thereby illustrating how climate change can alter output, investment and welfare over time. The Ecological Stock-Flow Consistent model incorporates environmental constraints into the interdependent financial and real sectors of the economy, allowing climate-related changes in production, credit, income and wealth to be examined simultaneously. The Dystopian Schumpeter Meeting Keynes framework further introduces technological innovation, financial dynamics and climate damage into an agent-based setting. These models collectively demonstrate that the relationship between climate risk and financial development is dynamic, nonlinear and dependent on feedback mechanisms among environmental, economic and financial systems. Accordingly, climate change may simultaneously constrain conventional financial activity and stimulate new financial opportunities through green innovation, sustainable investment and climate finance.

Empirical Literature

The empirical literature generally recognises that climate change affects financial systems through physical and transition-risk channels, although the findings remain mixed across measures, countries and methodologies. Physical climate risks can reduce asset values, disrupt production, weaken borrower

repayment capacity and increase insurance losses, while transition risks can alter the profitability of carbon-intensive firms and expose financial institutions to policy, technological and reputational shocks. Grippa et al. (2019) argue that climate risks manifest through increased loan-default probabilities and the revaluation of financial assets. Battiston et al. (2021) similarly identify climate change as a source of systemic financial risk and emphasise the need for financial institutions to evaluate their exposure to climate-sensitive sectors. Wu et al. (2023) show that climate risks can reduce financial returns, increase market volatility and transmit instability through banking, insurance and securities markets.

Evidence relating to financial-market development is not uniform. Some studies suggest that climate risk weakens market stability by increasing uncertainty, volatility and the probability of abrupt asset-price corrections. Climate-related disasters may reduce corporate earnings, disrupt supply chains and increase risk premiums, thereby lowering stock-market returns and discouraging investment (Amo-Bediako, Takawira and Choga, 2025). Transition policies may similarly reduce the valuation of firms whose business models depend heavily on fossil fuels. In contrast, other studies indicate that growing climate risk can stimulate financial-market depth by increasing the issuance of green bonds, sustainability-linked instruments and climate-related investment products. Developed financial markets may respond to climate risk by creating new opportunities for capital mobilisation, risk diversification and technological innovation. This helps explain why climate change may have a positive association with financial-market development in economies possessing sophisticated markets and established climate-finance frameworks.

Empirical evidence concerning financial institutions also reveals contrasting effects. Climate shocks can weaken banking stability through higher non-performing loans, declining collateral values and reduced borrower income. Insurance institutions face increased claims following floods, storms, droughts and other extreme events, while banks may encounter liquidity and capital pressures when climate-related losses become widespread. Beck and Poelhekke (2023) emphasise the need for financial institutions to incorporate environmental risks into lending and investment decisions. Fu et al. (2023) further note that physical and transition risks can affect the valuation of financial assets and institutional portfolios. These adverse effects are expected to be more pronounced in countries where supervision, financial infrastructure and adaptation capacity remain weak.

Despite these risks, developed financial institutions can also support climate resilience. Banks may finance renewable energy, climate-smart agriculture, clean technologies and resilient infrastructure, while insurers can provide products that transfer climate-related losses (Gangata and Takawira, 2025). Green credit and sustainable investment can therefore deepen financial intermediation and create new financing channels. Apeaning and Labaran (2025) argue that developed financial systems are important for mobilising resources for climate-mitigation innovation. Paramati et al. (2021) and Tolliver et al. (2020) similarly associate financial development with support for green technology and sustainable investment. The impact of climate change on institutional development may therefore depend on whether financial institutions possess the regulatory capacity, financial resources and expertise required to transform climate pressures into sustainable financing opportunities.

The regional evidence reinforces the importance of economic and institutional heterogeneity. European economies generally have deeper capital markets, stronger financial regulation and more developed climate-finance instruments. Consequently, climate risk may encourage the expansion of green bonds, sustainable funds and environmental disclosure systems, thereby supporting certain dimensions of market development. By comparison, many African economies experience high exposure to physical climate risks alongside shallow financial markets, limited insurance coverage and constrained adaptation finance. The Middle East faces a distinctive combination of physical risks and transition exposure arising from the importance of hydrocarbons to national income and financial-sector activity. A transition away from fossil fuels may create stranded assets and weaken the value of carbon-dependent investments, although it may also accelerate diversification and sustainable-finance development.

Overall, the empirical literature suggests that the effects of climate change on financial sector development are multidimensional and region-specific. Climate risk may reduce financial access, stability and efficiency in vulnerable economies, while stimulating financial depth and sustainable investment in countries with more advanced financial systems. The extended abstract reports that climate change risk is positively associated with financial-market development in the long run, particularly in Europe, but

negatively affects financial-institution development in regions with weaker regulatory depth and institutional resilience. It also indicates adverse effects on financial access and depth in Africa, contrasting with positive effects on depth and mixed access outcomes in Europe and the Middle East. These differences support the use of models that explicitly recognise regional heterogeneity and distinguish between financial markets and financial institutions.

Methodology

Data and Variables

This study adopts a quantitative research design to examine the impact of climate change risk on financial sector development in selected Europe, Middle East and Africa (EMEA) countries. Annual panel data covering the study period were compiled from internationally recognised databases to ensure consistency, comparability and reliability. Financial sector development indicators were obtained from the International Monetary Fund (IMF) Financial Development Database, while climate change risk indicators were sourced from the Notre Dame Global Adaptation Initiative (ND-GAIN) database. Macroeconomic control variables, including real gross domestic product (RGDP) and inflation (INF), were collected from the World Development Indicators (WDI) published by the World Bank. These databases are widely used in cross-country financial and climate-related studies because they provide harmonised and internationally comparable indicators.

Financial sector development was measured using the World Bank's 4×2 Financial Development Framework, which captures two major components of the financial system, namely financial markets and financial institutions. Each component comprises four dimensions: access, depth, efficiency and stability. Following the IMF Financial Development Database, two composite indices were employed in this study: the Financial Markets Sub-Index (FMSI) and the Financial Institutions Sub-Index (FISI). The FMSI reflects the development of equity and bond markets through indicators measuring market access, depth and efficiency, whereas the FISI measures banking sector and financial institution performance through indicators of institutional access, depth, efficiency and stability (Sahay et al., 2015).

Climate change risk was proxied by the Climate Change Risk Index (CCRI) obtained from the ND-GAIN database. The index measures a country's vulnerability to climate-related shocks while incorporating its adaptive capacity and readiness to respond to climate change. Higher CCRI values indicate greater exposure to climate-related risks that may adversely affect economic performance and financial systems. To minimise omitted-variable bias, the study controls for real gross domestic product (RGDP) and inflation (INF), both of which have been widely recognised as important determinants of financial sector development. Table 1 presents the variables employed in the empirical analysis.

Table 1. Description of Variables

Variable	Measurement	Expected Sign	Source
Financial Markets Sub-Index (FMSI)	IMF Financial Development Index	Dependent	IMF Financial Development Database
Financial Institutions Sub-Index (FISI)	IMF Financial Development Index	Dependent	IMF Financial Development Database
Climate Change Risk Index (CCRI)	ND-GAIN Climate Risk Index	±	ND-GAIN Database
Real Gross Domestic Product (RGDP)	Constant US$ (logged)	+	World Development Indicators
Inflation (INF)	Consumer Price Index (Annual %)	–	World Development Indicators

Model Specification

The empirical analysis is based on the financial development framework, which postulates that financial sector development is influenced by climate-related risks and macroeconomic conditions. Accordingly, the functional relationship is expressed as

$$FSD = f(CCRI, RGDP, INF)$$

where:

- FSD denotes financial sector development measured separately by the Financial Markets Sub-Index (FMSI) and Financial Institutions Sub-Index (FISI);
- CCRI represents climate change risk;
- RGDP denotes real gross domestic product; and
- INF represents inflation.

Two empirical models are estimated.

Model 1: Financial Markets

$$FMSI_{it} = \beta_0 + \beta_1 CCRI_{it} + \beta_2 RGDP_{it} + \beta_3 INF_{it} + \varepsilon_{it}$$

Model 2: Financial Institutions

$$FISI_{it} = \beta_0 + \beta_1 CCRI_{it} + \beta_2 RGDP_{it} + \beta_3 INF_{it} + \varepsilon_{it}$$

where

- $i = 1, \dots, N$ denotes countries;
- $t = 1, \dots, T$ denotes time;
- β_0 is the intercept;
- $\beta_1 - \beta_3$ are the slope coefficients; and
- ε_{it} is the error term.

To improve normality and minimise heteroscedasticity, the continuous variables were transformed into natural logarithms before estimation.

Estimation Technique: PMG-ARDL

The study employs the Pooled Mean Group Autoregressive Distributed Lag (PMG-ARDL) estimator developed by Pesaran, Shin and Smith (1999). The PMG estimator is particularly appropriate for macro-panel datasets characterised by heterogeneous countries because it allows the long-run coefficients to remain homogeneous across countries while permitting short-run dynamics, intercepts and error variances to differ. This feature is particularly relevant for the EMEA region, where countries exhibit substantial differences in financial development, institutional quality, economic structures and climate vulnerability.

Compared with conventional panel estimators such as Fixed Effects, Random Effects and Generalised Method of Moments (GMM), the PMG estimator offers several advantages. First, it simultaneously estimates long-run equilibrium relationships and short-run adjustment processes. Second, it accommodates regressors integrated of order I(0) and I(1) without requiring all variables to have the same order of integration, provided none is integrated beyond I(1). Third, it produces efficient and consistent estimates under heterogeneous panel settings where countries adjust differently towards long-run equilibrium.

The PMG-ARDL error correction specification is expressed as

$$\Delta Y_{it} = \phi_i (Y_{it-1} - \theta_i X_{it-1}) + \sum_{j=1}^{p-1} \lambda_{ij} \Delta Y_{it-j} + \sum_{j=0}^{q-1} \delta_{ij} \Delta X_{it-j} + \mu_i + \varepsilon_{it}$$

where

- Y_{it} denotes financial sector development;
- X_{it} represents the vector of explanatory variables;
- ϕ_i is the error correction coefficient;
- θ_i represents the long-run coefficients;
- λ_{ij} and δ_{ij} denote the short-run dynamics;
- μ_i captures country-specific effects; and

- ε_{it} is the disturbance term.

A negative and statistically significant error correction coefficient confirms the existence of a stable long-run relationship among the variables.

Empirical Results

This section presents and discusses the empirical findings on the impact of climate change risk on financial market stability and financial institution stability in selected EMEA countries. The analysis begins with descriptive statistics and correlation analysis, followed by cross-sectional dependence, panel unit root and cointegration tests. The section then reports the short-run and long-run PMG-ARDL estimates for the two study models and concludes with an assessment of regional heterogeneity across Africa, Europe and the Middle East. The analysis is based on 1,870 country-year observations covering 55 EMEA countries over the period 1990–2023.

Descriptive Statistics

Table 1 presents the descriptive statistics for the variables included in Models 1 and 2.

Table 1. Descriptive Statistics

Variable	Observations	Mean	Median	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
FMSI	1,87	0.000	−0.172	1.038	−1.241	31.320	15.418	444.074
FISI	1,87	0.000	0.028	1.025	−5.475	4.047	−0.281	1.308
CCRI	1,87	0.000	−0.111	1.132	−1.630	7.698	2.994	14.083
RGDPz	1,87	0.355	0.356	0.041	0.000	1.000	2.043	45.105
INFz	1,87	0.054	0.048	0.039	0.000	1.000	14.611	273.741

Source: Authors' computations from the EMEA dataset.

The standardised indices have mean values close to zero, reflecting the transformations applied before estimation. The Financial Market Stability Index (FMSI) displays considerable variability, ranging from −1.241 to 31.320. Its high positive skewness and kurtosis indicate a strongly right-skewed and heavy-tailed distribution, suggesting that most countries recorded relatively moderate market stability, while a few observations exhibited exceptionally high values. By comparison, the Financial Institution Stability Index (FISI) is more evenly distributed, with mild negative skewness and substantially lower kurtosis.

The Climate Change Risk Index (CCRI) is positively skewed and leptokurtic, demonstrating substantial differences in climate vulnerability across the EMEA countries. Most observations are concentrated below the mean, while a smaller number of countries experience considerably higher climate risk. The standardised inflation variable also exhibits pronounced skewness and kurtosis, reflecting extreme inflationary episodes in a limited number of economies. These distributional characteristics confirm substantial macroeconomic, financial and climatic heterogeneity across the sample and support the use of an estimator that permits heterogeneous short-run responses and does not rely heavily on the assumption of normally distributed regressors.

Correlation Analysis

Table 2 reports the Pearson correlation coefficients among the variables included in the two models.

Table 2. Pearson Correlation Matrix

Variable	FMSI	FISI	CCRI	RGDPz	INFz
FMSI	1.000				
FISI	0.027	1.000			
CCRI	0.117	−0.122	1.000		
RGDPz	−0.068	0.036	−0.133	1.000	
INFz	0.077	0.071	0.072	−0.185	1.000

Source: Authors' computations from the EMEA dataset.

Climate change risk has a weak positive correlation with financial market stability ($r = 0.117$) and a weak negative correlation with financial institution stability ($r = -0.122$). These coefficients suggest that the direct contemporaneous linear association between climate risk and the two financial stability measures is limited. However, weak correlation does not exclude dynamic or long-run relationships, which are subsequently examined through the PMG-ARDL estimator.

RGDPz is weakly negatively correlated with FMSI but weakly positively correlated with FISI. Inflation has weak positive relationships with both financial market and institution stability. The highest absolute correlation among the explanatory variables is only 0.185, between RGDPz and INFz. Since all coefficients are substantially below the conventional threshold of 0.80, severe multicollinearity is unlikely. This conclusion is consistent with the reported VIF values of approximately 1.02–1.05 and a mean VIF of 1.03. The thesis similarly reports that CCRI is only weakly associated with most financial-sector indicators, indicating that its effects may be indirect, delayed or nonlinear rather than immediately visible through simple correlations.

Cross-Sectional Dependence

The Pesaran CD test was conducted to establish whether shocks affecting one EMEA economy are correlated with developments in other countries. The results for the variables relevant to Models 1 and 2 are presented in Table 3.

Table 3. Pesaran Cross-Sectional Dependence Test

Variable	CD statistic	p-value	Mean correlation	Mean absolute correlation	Decision
RGDP	62.74	0.000	0.28	0.32	Cross-sectional dependence
INF	60.15	0.000	0.27	0.32	Cross-sectional dependence
CCRI	22.83	0.000	0.10	0.35	Cross-sectional dependence
FMSI	53.52	0.000	0.23	0.31	Cross-sectional dependence
FISI	26.16	0.000	0.12	0.36	Cross-sectional dependence

Source: Authors' computations from Stata 18.

All p-values are below 0.05, leading to the rejection of the null hypothesis of cross-sectional independence. The results indicate that climate, macroeconomic and financial developments are interrelated across the sampled economies. This is reasonable because EMEA countries are connected through trade, capital flows, banking networks, energy markets and common global shocks. A climatic, economic or financial disturbance occurring in one country may therefore influence other countries within the region.

The presence of cross-sectional dependence means that conventional first-generation panel procedures based on independent cross-sectional units may produce biased inference. It consequently justifies the application of second-generation panel unit root tests and dynamic panel estimators capable of accommodating common shocks and heterogeneous responses.

Panel Unit Root Tests

Given the presence of cross-sectional dependence, the Cross-Sectionally Augmented Dickey–Fuller (CADF) second-generation panel unit root test was applied. Table 4 reports the results for the variables used in Models 1 and 2.

Table 4. CADF Panel Unit Root Test Results

Variable	Level: Constant	Level: Constant + trend	First difference: Constant	First difference: Constant + trend	Integration order
RGDP	−2.90**	−2.79**			I(0)
INF	−2.62**	−2.66**			I(0)
CCRI	−1.73	−2.18**	−3.90**	−3.98**	I(0)/I(1)
FMSI	−1.78	−2.26	−3.68**	−3.73**	I(1)
FISI	−1.76	−2.32	−3.69**	−2.83**	I(1)

*Note: ** denotes significance at the 5% level.*
Source: Authors' computations from Stata 18.

RGDP and inflation are stationary at levels under both the constant and constant-plus-trend specifications and are therefore classified as I(0). FMSI and FISI are non-stationary at levels but become stationary after first differencing and are classified as I(1). CCRI is stationary at level under the constant-plus-trend specification and is clearly stationary after first differencing.

The test therefore reveals a mixture of I(0) and I(1) variables, with none integrated of order two, I(2). This mixed integration structure supports the use of the PMG-ARDL estimator, which can accommodate regressors that are stationary at levels and after first differencing, provided that no variable is I(2).

Cointegration Tests

The Kao panel cointegration test was used to determine whether climate change risk, economic growth, inflation and the financial stability indicators share stable long-run relationships.

Table 5. Kao Panel Cointegration Test

Test	Model 1: FMSI	Model 2: FISI
t-statistic	−7.40	−1.85
p-value	0.000**	0.032**
Decision	Cointegrated	Cointegrated

*Note: ** denotes significance at the 5% level.*
Source: Authors' computations from Stata 18.

The Kao test statistics are negative and statistically significant for both models. The null hypothesis of no cointegration is therefore rejected, confirming the existence of long-run equilibrium relationships between financial stability, climate change risk, RGDP and inflation. This finding indicates that although the variables may deviate from one another temporarily, they tend to move towards a common equilibrium over time. The confirmation of cointegration provides further justification for estimating the long-run coefficients and short-run error-correction dynamics using the PMG-ARDL framework.

PMG-ARDL Estimation Results

Model 1: Financial Market Stability

The first model estimates the effects of climate change risk, economic growth and inflation on financial market stability:

$$FMSI_{it} = \beta_0 + \beta_1 CCRI_{it} + \beta_2 RGDP_{it} + \beta_3 INF_{it} + \varepsilon_{it}.$$

Table 6. PMG-ARDL Results for Financial Market Stability

Variable	Long-run coefficient	Standard error	Short-run coefficient	Standard error
CCRI	−0.289	0.169	0.602	0.544

RGDPz	−10.195**	1.323	3.503**	0.531
INFz	−1.297	1.022	17.643**	6.343
ECT	–	–	−0.297**	0.026
Constant	–	–	1.124**	0.109

*Note: ** denotes significance at the 5% level.*
Source: Authors' computations from Stata 18.

The long-run coefficient of CCRI is negative but statistically insignificant. Similarly, its short-run coefficient is positive but insignificant. These results indicate that climate change risk does not exert a statistically identifiable direct effect on financial market stability in either the short or long run across the full EMEA sample. The finding may indicate that market-based systems possess regulatory buffers, portfolio-diversification mechanisms and pricing processes that partly absorb immediate climate shocks. It may also reflect the gradual and indirect manner in which physical and transition risks enter asset values and financial-market indicators.

RGDP has contrasting short-run and long-run effects. Its short-run coefficient is positive and significant, indicating that an improvement in real economic growth initially strengthens financial-market stability. Increased output can support corporate earnings, investor confidence and trading activity. However, the long-run coefficient is negative and significant, suggesting that persistent growth may be associated with increased financial-market exposure, leverage or risk-taking. This result may also reflect the diverse structural characteristics of the sampled countries, where economic expansion does not always translate into more stable markets.

Inflation is statistically insignificant in the long run but positive and significant in the short run. The short-run positive coefficient may reflect the ability of nominal asset prices, earnings and market turnover to adjust during moderate inflationary episodes. Nevertheless, the insignificant long-run result suggests that inflation does not consistently explain financial-market stability after longer-term adjustment.

The error-correction coefficient is negative and statistically significant. Its value of −0.297 indicates that approximately 29.7% of a deviation from long-run equilibrium is corrected within one year. This confirms the stability of the estimated dynamic relationship and implies that financial-market stability returns gradually to its equilibrium path following climate or macroeconomic disturbances.

Model 2: Financial Institution Stability

The second model examines the effects of climate change risk and the macroeconomic controls on financial institution stability:

$$FISI_{it} = \beta_0 + \beta_1 CCRI_{it} + \beta_2 RGDP_{it} + \beta_3 INF_{it} + \varepsilon_{it}$$

Table 7. PMG-ARDL Results for Financial Institution Stability

Variable	Long-run coefficient	Standard error	Short-run coefficient	Standard error
CCRI	1.270**	0.262	−0.135	0.187
RGDPz	−1.370	1.430	0.754**	0.331
INFz	−4.904**	1.704	12.902**	5.327
ECT			−0.157**	0.016
Constant			0.162**	0.043

*Note: ** denotes significance at the 5% level.*
Source: Authors' computations from Stata 18.

Climate change risk has an insignificant negative short-run coefficient but a positive and statistically significant long-run coefficient. A one-unit increase in CCRI is associated with an approximately 1.27-unit increase in financial institution stability over the long term. Although this result is contrary to the initial expectation of a negative relationship, it may indicate that persistent exposure to climate risk encourages

financial institutions to strengthen capital buffers, adopt climate-risk management systems, adjust loan portfolios, improve disclosures and introduce climate-resilient lending and insurance products.

The insignificant short-run coefficient suggests that these institutional adjustments do not occur immediately. Climate-related risks may initially be absorbed through existing capital, liquidity and risk-management structures before generating meaningful changes in institutional stability.

RGDP has a positive and significant short-run coefficient but an insignificant long-run coefficient. Economic growth therefore appears to strengthen financial institutions in the short term through improved borrower income, higher deposits and stronger loan performance. Its long-run effect is less consistent across the heterogeneous EMEA economies.

Inflation has a positive short-run effect but a negative long-run effect. In the short run, inflation may increase nominal banking revenues and asset values. Over time, however, persistent inflation can weaken borrower repayment capacity, increase funding costs, reduce the real value of financial assets and create balance-sheet uncertainty. The long-run coefficient of −4.904 consequently indicates that sustained inflation constitutes a significant threat to institutional stability.

The error-correction coefficient is −0.157 and statistically significant, indicating that approximately 15.7% of disequilibrium is corrected annually. Financial institutions therefore return to long-run equilibrium more slowly than financial markets, which record an adjustment rate of 29.7%. This slower response is plausible because institutional balance sheets, loan portfolios and regulatory capital structures generally adjust gradually.

Regional Heterogeneity Analysis

The regional analysis distinguishes the effects of climate change risk across Africa, Europe and the Middle East. The results reveal substantial heterogeneity and demonstrate that pooled EMEA estimates can conceal important regional differences.

Table 8. Regional Effects of CCRI on Financial Market Stability

Region	Long-run coefficient	Standard error	Short-run coefficient	Standard error	ECT
Africa	−0.288	0.169	0.602	0.544	−0.297**
Europe	−0.195	0.186	−0.237	0.189	−0.317**
Middle East	−0.585	0.328	−0.579	0.461	−0.315**

*Note: ** denotes significance at the 5% level.*
Source: Authors' computations from Stata 18.

Climate change risk has negative but statistically insignificant effects on financial market stability in all three regions, in both the short and long run. The negative coefficients are largest in the Middle East, followed by Africa and Europe. Although statistically insignificant, this pattern may indicate that Middle Eastern financial markets are more exposed to climate-transition risks because of the region's dependence on hydrocarbon-related revenues and assets.

The statistically significant negative ECT coefficients confirm convergence towards equilibrium in all regions. Europe records the fastest adjustment, with approximately 31.7% of disequilibrium corrected annually, followed by the Middle East at 31.5% and Africa at 29.7%. Overall, the findings suggest a degree of financial-market resilience across the regions, although climate vulnerability may still be transmitted through dimensions other than stability, particularly efficiency, depth and access.

Table 9. Regional Effects of CCRI on Financial Institution Stability

Region	Long-run coefficient	Standard error	Short-run coefficient	Standard error	ECT
Africa	1.271**	0.262	−0.135	0.186	−0.157**

Europe	−0.180	0.093	−0.124	0.243	−0.157**
Middle East	−0.218**	0.104	0.780	0.577	−0.198**

*Note: ** denotes significance at the 5% level.*
Source: Authors' computations from Stata 18.

The regional results for financial institution stability differ substantially. In Africa, climate change risk has a significant positive long-run effect, implying that greater climate exposure is associated with strengthened institutional stability over time. This may reflect regulatory and institutional adaptation, including improved capital requirements, risk assessment and the growing integration of climate considerations into financial-sector policy. However, this result should not be interpreted as evidence that climate change itself is beneficial. Rather, it may capture the stabilising institutional responses triggered by increasing climate vulnerability.

In Europe, CCRI has a negative but statistically insignificant long-run effect. European financial institutions may be better positioned to absorb climate shocks because of stronger supervision, developed insurance markets, climate disclosure systems and established sustainable-finance frameworks. The insignificant coefficient may consequently reflect both underlying climate exposure and effective mitigation mechanisms.

In the Middle East, the long-run coefficient is negative and significant. A one-unit increase in CCRI reduces financial institution stability by approximately 0.218 units. This suggests that climate and transition risks may weaken financial institutions through hydrocarbon exposure, stranded-asset risk, water scarcity, extreme temperatures and economic concentration. The region nevertheless records the fastest institutional adjustment rate, with approximately 19.8% of disequilibrium corrected annually.

The broader regional results also show that climate risk reduces financial institution efficiency across all three regions. It significantly reduces institutional depth and access in Africa, while increasing depth in Europe and the Middle East. Access improves in Europe but deteriorates in Africa and the Middle East. Financial markets show a comparatively more favourable response: climate risk improves market efficiency in Africa and Europe, increases market depth in Europe and the Middle East, and enhances market access across all three regions. These patterns suggest that developed markets and robust climate-finance mechanisms enable some economies to transform climate risk into new financial products and investment channels, whereas institutionally weaker systems experience reduced lending capacity, higher costs and restricted financial access.

Overall, the results establish that the relationship between climate change risk and financial sector development is dynamic, multidimensional and region-specific. Climate risk does not significantly affect financial market stability in the pooled EMEA model, but it has a significant long-run effect on financial institution stability. The regional findings further demonstrate that the direction and magnitude of the relationship depend on institutional resilience, regulatory capacity, economic structure, digitalisation and the sophistication of climate-finance instruments. These results reinforce the importance of regionally differentiated climate-finance policies rather than uniform interventions across the EMEA region.

Policy Implications

The findings of this study have important implications for policymakers, financial regulators, central banks and financial institutions throughout the EMEA region.

First, governments should integrate climate risk considerations into national financial sector development strategies. Climate change should no longer be treated solely as an environmental issue but as a macro-financial risk capable of influencing financial stability, investment decisions and long-term economic development. National climate adaptation policies should therefore be closely aligned with financial sector policies to strengthen economic resilience.

Second, central banks and financial supervisory authorities should continue incorporating climate-related risks into prudential regulation and macroprudential supervision. Climate stress testing, environmental risk disclosure, scenario analysis and climate-related capital adequacy requirements should become integral components of financial sector oversight. These measures would improve the

ability of financial institutions to identify, measure and manage climate-related risks before they evolve into systemic financial crises.

Third, policymakers should promote sustainable finance and expand green financial markets. The development of green bonds, sustainability-linked loans, climate funds and environmental investment products would facilitate the mobilisation of private capital towards climate adaptation and mitigation projects. Such initiatives would simultaneously strengthen financial market development while supporting the transition towards low-carbon economies.

Fourth, African economies require targeted interventions aimed at strengthening financial institutions and improving climate resilience. Governments should invest in financial infrastructure, improve regulatory quality, enhance institutional capacity and expand access to climate finance. International development partners should increase financial and technical support to vulnerable economies to improve their adaptive capacity and reduce climate-related financial risks.

Fifth, Middle Eastern countries should accelerate economic diversification strategies that reduce dependence on carbon-intensive industries. Transition risks associated with global decarbonisation policies pose significant challenges for financial institutions heavily exposed to fossil fuel sectors. Expanding renewable energy investments, sustainable infrastructure financing and diversified financial products would reduce long-term financial vulnerabilities.

Finally, international cooperation remains essential. Climate change represents a global challenge that transcends national boundaries. Regional financial institutions, multilateral development banks and international organisations should strengthen cooperation in developing common climate risk standards, improving climate data availability and supporting sustainable finance initiatives across the EMEA region.

Conclusion

This study examined the impact of climate change risk on financial sector development in selected EMEA countries using the Pooled Mean Group Autoregressive Distributed Lag (PMG-ARDL) estimator. Financial sector development was examined separately through financial market stability and financial institution stability, while climate change risk was measured using the Climate Change Risk Index alongside real gross domestic product and inflation as control variables.

The empirical findings reveal that climate change risk has heterogeneous effects on financial sector development across the EMEA region. Climate change does not exert a statistically significant direct effect on financial market stability in the pooled sample, suggesting that financial markets possess considerable resilience in responding to climate-related information and shocks. In contrast, climate change risk positively influences financial institution stability in the long run, indicating that financial institutions may strengthen their resilience through improved climate risk management, regulatory reforms and sustainable finance initiatives. The results further demonstrate that economic growth enhances financial sector performance in the short run, whereas persistent inflation weakens financial institutions over longer horizons.

The regional analysis confirms that the effects of climate change differ substantially across Africa, Europe and the Middle East. European economies generally exhibit stronger financial resilience due to advanced financial markets, higher institutional quality and well-developed climate finance mechanisms. African countries remain relatively vulnerable because of weaker financial systems and limited climate adaptation capacity, while Middle Eastern economies face additional transition risks associated with dependence on carbon-intensive industries. These findings highlight the importance of recognising regional heterogeneity when designing climate-related financial policies.

The study makes several important contributions to the literature. First, it extends existing research by examining financial markets and financial institutions separately using the multidimensional IMF Financial Development Framework. Second, it provides one of the few comprehensive comparative analyses of climate change risk and financial sector development across the EMEA region. Third, the application of the PMG-ARDL estimator enables simultaneous estimation of long-run equilibrium relationships and heterogeneous short-run dynamics, thereby providing richer insights than conventional panel regression techniques.

Despite these contributions, several limitations should be acknowledged. The study focuses primarily on aggregate financial development indicators and does not explicitly consider individual banking sectors, insurance markets or capital market subsectors. Furthermore, climate change risk is measured using a composite climate risk index, which may not fully capture the diverse dimensions of physical and transition risks across countries. Future research may therefore examine specific financial sectors, incorporate alternative climate indicators and employ nonlinear or machine learning techniques to further explore the complex interactions between climate change and financial development.

Overall, the study demonstrates that climate change has become an important determinant of financial sector development. Building resilient financial systems capable of supporting sustainable economic growth under increasing climate uncertainty will require coordinated efforts involving governments, central banks, financial institutions and international development partners. Strengthening climate-responsive financial regulation, expanding sustainable finance and improving institutional resilience will be essential for ensuring long-term financial stability and sustainable development throughout the EMEA region.

References

Amo-Bediako, E., Takawira, O. and Choga, I., (2025). Analysing climate change and banking system stability in selected sub-Saharan economies. International Journal of Economics and Finance Studies, 17(3), pp.1-28.

Apeaning, R. W., & Labaran, M. (2025). Does financial development moderate the impact of climate mitigation innovation on CO_2 emissions? Evidence from emerging economies. Innovation and Green Development, 4(2), 1–9. https://doi.org/10.1016/j.ig d.2025.100211

Battiston, S., Mandel, A., Monasterolo, I., Schütze, F., & Visentin, G. (2021). Climate risk and financial stability in the age of COVID-19. Climate Risk Management, 32, 100282. https://doi.org/10.1016/j.crm.2021.100282

Beck, T., & Poelhekke, S. (2023). Follow the money: Does the financial sector intermediate natural resource windfalls? Journal of International Money and Finance, 130, 102769.

European Commission. (2024). European climate risk assessment. Publications Office of the European Union.

Fu, C., Lu, L. and Pirabi, M., 2023. Advancing green finance: a review of sustainable development. Digital Economy and Sustainable Development, 1(1), p.20.

Gangata, I. and Takawira, O., (2025). The relationship between climate change, macroeconomic indicators and bank performance. The Business & Management Review, 16(2), pp.90-105.

Grippa, P., Schmittmann, J., Suntheim, F., Chua, J., Sun, Y., & Lizarazo Ruiz, R. (2019). Climate change and financial risk. International Monetary Fund.

International Monetary Fund. (2019). Global financial stability report: Lower for longer. International Monetary Fund.

International Monetary Fund. (2024). Financial development index database. International Monetary Fund. https://www.imf.org

Kao, C. (1999). Spurious regression and residual-based tests for cointegration in panel data. Journal of Econometrics, 90(1), 1–44. https://doi.org/10.1016/S0304-4076(98)00023-2

Marimo, S. and Takawira, O., (2026). The Relationship between Climate Change Risk and the Efficiency of Financial Markets and Institutions. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=6102393

Notre Dame Global Adaptation Initiative. (2024). ND-GAIN Country Index. University of Notre Dame. https://gain.nd.edu

Paramati, S. R., Mo, D., & Huang, R. (2021). The role of financial deepening and green technology on carbon emissions: Evidence from major OECD economies. Finance Research Letters, 41, 101794–101805.

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. Journal of Applied Econometrics, 22(2), 265–312. https://doi.org/10.1002/jae.951

Pesaran, M. H., & Yamagata, T. (2008). Testing slope homogeneity in large panels. Journal of Econometrics, 142(1), 50–93. https://doi.org/10.1016/j.jeconom.2007.05.010

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. Journal of the American Statistical Association, 94(446), 621–634. https://doi.org/10.1080/01621459.1999.10474156

Sahay, R., Cihák, M., N'Diaye, P., Barajas, A., Mitra, S., Kyobe, A., Mooi, Y. N., & Yousefi, S. R. (2015). Rethinking financial deepening: Stability and growth in emerging markets (IMF Staff Discussion Note SDN/15/08). International Monetary Fund.

Takawira, O., Amo-Bediako, E., Sekwati, D. and Marimo, S., (2026). The Impact of Climate Change on Banking System Stability in Southern Africa Development Communities (SADC). Risks, 14(3), p.69.

Tolliver, C., Keeley, A. R., & Managi, S. (2020). Policy targets behind green bonds for renewable energy: Do climate commitments matter? Technological Forecasting and Social Change, 157, 120051–120061.

World Bank. (2024). World development indicators. World Bank. https://databank.worldbank.org/source/world-development-indicators

Wu, L., Liu, D., & Lin, T. (2023). The impact of climate change on financial stability. Sustainability, 15(15), 1–17.

Emotional intelligence as a predictor of effective leadership: An empirical examination of leader–follower dynamics and performance outcomes

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Keywords
Emotional Intelligence; Leadership Effectiveness; Leader–Member Exchange; Transformational Leadership; Team Performance.

Abstract

Purpose: *This paper explores emotional intelligence as a predictor of an effective leader and its role in developing relationships between a leader and team members, employee attitudes, and team performance, based on Ability-Based Emotional Intelligence Theory, Transformational Leadership Theory, and Leader–Member Exchange (LMX) Theory.*

Design/methodology: *A quantitative survey design was used, with data gathered from 300 employees in education, healthcare, retail and public service. Descriptive statistics, reliability analysis, correlation, and regression analyses were conducted.*

Findings : *The findings indicate that emotional intelligence plays a significant role in enhancing leadership effectiveness by strengthening leader–member relationships, increasing employee job satisfaction, and improving overall team performance. Results showed moderate emotional intelligence (M = 2.60–3.38), with highest scores in understanding own emotions (M = 3.38) and lowest in emotional awareness (M = 2.60). Reliability was strong (Cronbach's a = .82–.89). Emotional intelligence was positively correlated with leadership behaviour (r = .46), LMX (r = .42), job satisfaction (r = .39), and team performance (r = .33). Leadership behaviour was strongly related to LMX (r = .51) and team performance (r = .48), while LMX was linked to job satisfaction (r = .55). Regression analysis confirmed emotional intelligence as a predictor of transformational leadership (β = .46, R^2 = .21) and LMX (β = .42, R^2 = .18), with LMX predicting job satisfaction (β = .55, R^2 = .30) and leadership behaviour predicting team performance (β = .48, R^2 = .23).*

Practical implications and Conclusions: *The results confirm a relational leadership model where emotional intelligence improves leadership effectiveness, employee satisfaction, and team performance. The study emphasises the strategic importance of developing emotional intelligence in leadership training and organisational performance management. Organisations should prioritise emotional intelligence in leadership development by integrating it into training, recruitment, and performance management. Enhancing leaders' emotional competencies can strengthen leader–follower relationships, improve employee satisfaction and engagement, and ultimately boost team performance and organisational effectiveness.*

Introduction

The efficacy of leadership will continue to be one of the most studied subjects in the field of organisational and management research due to its direct relationship with the performance of an organisation, the welfare of its employees, and its sustainability as a whole. With high levels of organisational complexity in the form of technological change, cultural diversity, international competition as well as changing expectations in workplaces, the long-standing focus on technical skills and cognitive intelligence is no longer deemed enough to enhance effective leadership. Modern leadership theories are becoming more aware that a leader's job also demands emotional and interpersonal skills that help leaders to comprehend and deal with organisational relationships (Northouse, 2025; Yukl, 2013). As organisations grow to become more collaborative and knowledge intensive, leaders are faced with the challenge of managing interpersonal relationships, encouraging diverse teams and being adaptable to uncertainty. These facts have put emotional intelligence at the centre stage of leadership studies.

Mayer and Geher (1996) were the first ones to provide a systematised definition of emotional intelligence (EI), which they described as the skill to perceive, handle and use emotions successfully in both oneself and others (Mayer et al., 2004; Salovey & Mayer, 1990). The concept became popular later owing to the contributions of Goleman (1995) who first believed that the success of a leader is in most cases determined more by the emotional competencies rather than their cognitive intelligence (Goleman, 1995, 1998). Emotional intelligence is a complex of several interconnected competencies such as emotional awareness, emotional regulation, empathy, and social skills. The abilities allow a person to read the emotional signals correctly and behave in response to social situations.

In the organisational context, leaders who possess high levels of emotional intelligence are usually in a better position to deal with interpersonal relationships, workplace disputes and promote collaborative cultures. Emotional intelligence helps leaders to better comprehend the issues of employees, effectively communicate and foster trust in the teams (Cote, 2014). This category of relational competencies is becoming critical in contemporary organisations where teamwork and communication are critical and psychological safety is required to ensure productivity and innovation. Empathic and emotionally aware leaders are able to establish positive working conditions that foster employee engagement and commitment (Boyatzis, 1982).

There is a large amount of literature indicating that emotional intelligence is closely connected with transformational leadership behaviour. Transformational leadership is a term that characterises the leaders who motivate their followers to surpass their own self-interest and instead, pursue the collective interest (Bass & Riggio, 2006). It was originally theorised by Burns (1978) and was later advanced by Bass (1985) who defined it in the following way: Transformational leadership refers to the style of leadership in which the leaders themselves provide followers with the inspiration to go beyond their self-interest towards the intended objective (Bass & Riggio, 2006). Transformational leaders have a strong vision, offer intellectual stimulation, and show personalised consideration to the followers. Emotional intelligence helps to facilitate these behaviours because leaders need to be sensitive to emotional signals, have empathetic reactions, and have positive relationships with followers. Empirical research has shown that leaders with high emotional intelligence tend to be more likely to portray the transformational leadership traits of inspirational motivation and individualised support (Harms & Crede, 2010).

In addition to the leadership style, emotional intelligence can be applied in determining various follower outcomes. The workers of emotionally intelligent leaders are likely to report their job satisfaction, commitment to organisations, and levels of psychological wellbeing were higher (Miao, Humphrey & Qian, 2021). The quality of interactions between leaders and followers is one of the explanations of this relationship. The Leader-Member Exchange (LMX) theory implies that the quality of relationships established among leaders and their subordinates defines the effectiveness of leaders to a large extent (Graen & Uhl-Bien, 1995). Leaders with effective emotional competencies can be more apt in establishing high-quality interactions that are characterised by trust, respect and mutual obligation. These relationship forces have the potential of affecting the attitudes, motivation and performance of employees at large.

Moreover, another possible contribution of emotional intelligence to organisational performance is that it can improve decision-making and the conflict management processes. Leaders often work in emotionally charged conditions where they make decisions that impact various stakeholders. Emotional intelligence enables the leaders to stay calm during times of pressure, read emotional cues in the right manner, and act in a manner that keeps the group together (Ashkanasy & Daus, 2005). These abilities can facilitate teams as well as enhance organisational efficiency.

Although the popularity of emotional intelligence in the leadership research is increasing, the empirical evidence is rather inconsistent. Although many research studies indicate that emotional intelligence can be positively related to leadership results, other researchers claim that the connexion between the two might depend on situational characteristics, including organisational culture, job complexity, and methods of measuring emotional intelligence (Antonakis, Ashkanasy & Dasborough, 2009). Also, there are researchers who indicate that emotional intelligence can have an indirect impact on leadership by using mediating factors like trust, quality of communication, and relational exchange. These discussions emphasise the fact that new empirical research is necessary to explain the effect of emotional intelligence on leadership procedures in practical organisational set-ups.

The proposed study aims to make contributions to this current academic debate by empirically testing the hypothesis of emotional intelligence as the predictor of leadership success. In particular, the paper examines the role of emotional intelligence of leaders in affecting the leader-follower relationships and the organisational performance in terms of employee motivation and team performance. This study will seek to offer more in-depth insight into how the emotional competencies as theory of effective leadership are engineered by relational leadership perspectives in modern day organisations.

Literature Review and Theoretical Framework

Emotional Intelligence

Emotional intelligence (EI) is the latest notion that gained prominence in the study of organisations and leadership practises. Though the research into emotions in organisational life is traceable back to the earlier psychological research, the systematic study of emotional intelligence as a scientific concept has been developed by Salovey and Mayer (1990). These thinkers theorised emotional intelligence as a combination of cognitive skills which help individuals to recognise, comprehend, control and apply emotions in the self and others (Mayer, 2003). In this context emotions are not just a reaction, but a source of information that may inform thinking, behaviour, and decision-making. Emotional intelligence is thus a combination of emotional and mental activities that promote the ability of individuals to work within social settings.

According to the proposed ability model, Mayer and Salovey (1990) distinguish four key dimensions of emotional intelligence that are perceiving emotions, facilitating emotion-based thought, understanding emotions, and managing emotions. Perceiving emotion means identifying the emotional cues in facial expressions, tonal voice, and behaviour whereas facilitating thought means the ability to utilise emotions to aid in reasoning and problem solving. Emotional awareness involves having an understanding of emotional meanings and shifts, and emotional control can be regarded as controlling own emotions and having a positive impact on the feelings of other people (Mayer, Salovey & Caruso, 2008). The competencies are especially topical in organisational contexts when the leaders should be able to interpret multifaceted interpersonal signals and react to them correctly to ensure the functionality of relationships.

The notion started to be more widely known and regarded by the population and management due to the influential work by Goleman (1995) who believed that emotional intelligence is the key to being successful in the workplace and leading with effectiveness (Goleman, 1995). Goleman had developed the notion further with the competencies of self-awareness, self-regulation, motivation, empathy, and social skills. Based on this approach, emotionally intelligent people are more likely to cope with stress, overcome interpersonal difficulties and motivate other people. These competencies empower the leaders to earn trust, convey vision to followers, and be sensitive to the needs of the followers in the context of leadership (Goleman, Boyatzis & McKee, 2013).

The emotional intelligence has been associated with numerous desirable workplace achievements within the organisational behaviour research. Emotional intelligence and emotional intelligence allow leaders to demonstrate better interpersonal skills, empathy, and conflict management skills (Cote, 2014). These are the features that are necessary to promote working in teams, especially when it comes to the contemporary organisations where teamwork and communication are the key elements of performance. Emotionally intelligent leaders can address emotional state of the employees by proper identification so that they can react in a manner that builds the morale and improves the relationship within the teams.

In addition, emotional intelligence leads to establishment of trust between leaders and followers. It is well known that trust forms the basics of strong leadership given that it influences the capacity of employees to cooperate, give information and dedicate themselves to organisational objectives (Dirks & Ferrin, 2002). Emotional awareness and empathy help leaders to become more supportive and fairer, which leads to a higher confidence of followers in their leadership. This type of relational trust promotes organisational cohesion, as well as motivating employees to become more active in their work.

Studies also reveal that emotional intelligence is of importance in conflict management and problem solving of organisations. Miscommunication, stress, or conflicting interests among employees of the same group are the common causes of workplace conflicts. The leaders with a high level of emotional regulation experience fewer such tensions and positively cope with them and avoid further development

of conflicts and allow finding some mutually advantageous solutions (Sabo, 2020). The role of emotional intelligence is thus a valuable tool to be able to create harmony and productivity in a team by the leader.

Besides the interpersonal advantages, emotional intelligence may also affect organisational performance because of its impact on employee motivation and engagement. The more the leaders are sensitive to the concerns and emotions of employees, the more they are likely to feel valued and understood. The proposed leadership style can contribute to building psychological safety, promoting open dialogue, and increasing employee motivation to organisational goals (Miao, Humphrey & Qian, 2021). Consequently, the emotionally intelligent leadership may not only help to improve the working relationships but also assist in the enhanced organisational performance.

Even though it is acknowledged to be an important concept, the notion of emotional intelligence is still subject to scholarly controversy in terms of conceptual scope and measurement methods. Other researchers plan that emotional intelligence is a variation of the already existing personality constructs or social skills, whereas others contend that emotional intelligence is a separate type of intelligence that has cognitive aspects that can be measured (Antonakis, Ashkanasy & Dasborough, 2009). However, an accumulated empirical literature is behind the applicability of emotional intelligence to leadership performance and organisational behaviour. Due to the growing dependence of organisations on collaboration, flexibility and innovation, emotional competencies will probably continue to play a core role in successful leadership practise.

Transformational Leadership

The focus on inspiring followers, encouraging innovation and bringing change to an organisation has made transformational leadership one of the most powerful frameworks in the modern day leadership studies. The idea has been first presented by Burns (1978) who differentiated between transactional and transformational leadership. Khanin (2007) argues that transactional leadership is founded on the interactions between the leaders and the followers; in such a situation compliance is rewarded or punished. Transformational leadership on the other hand arises when the leaders and the followers take each other to greater heights in terms of motivation, morality and commitment. It is a kind of leadership that goes beyond a one-dimensional exchange and brings people to strive towards a common purpose and shared ideals.

Bass (1985) subsequently extended the theory and operationalised transformational leadership in the context of organisations as well as created measurement instruments to test the impact of this leadership style (Bass, 1985). Bass theorised followers with the aid of four major dimensions of behavioural influence mostly known as the four Is; idealised influence, inspirational motivation, intellectual stimulation and individualised consideration (Bass & Riggio, 2006). The idealised influence is the fact that the leader acts as a role model showing acting in an ethical manner, integrity and adhering to organisational values. Inspirational motivation has to do with selling a vision that motivates the followers to work towards achieving a common goal. Intellectual stimulation promotes resourcefulness and thoughtfulness by pushing the current assumptions aside and promoting innovation. Individualised consideration translates into how the leader pays concern to personal growth, needs and aspirations of the followers.

Transformational leadership in the organisational context has been linked to numerous positive results. A study has shown that transformational leaders have the capacity to augment employee motivation, organisational commitment, job satisfaction, and general performance (Judge & Piccolo, 2004; Northouse, 2025). Such leaders develop a sense of purpose and collective identity to motivate employees to go beyond the bare job requirements and play a much bigger role in the success of organisations. Transformational leadership is especially applicable in the conditions of quick change and unpredictability when the leader has to recruit the employees to adapt to the new challenges and innovate at all times (Yukl, 2013).

The relational and emotional nature of transformational leadership is one factor of great importance. Transformational leaders do not merely command them, they affect the emotions and the psychological conditions of the followers. These leaders establish a workplace where employees feel appreciated and encouraged through proper use of communication, empathy and supportive behaviour. This relational orientation brings out the importance of emotional competencies in leadership processes. It is becoming

common among scholars that emotional intelligence is a pivotal factor that leads leaders to be able to implement transformational behaviours successfully (Harms & Crede, 2010).

Emotional intelligence adds to the transformational leadership by boosting the ability of leaders to identify and control emotions in others and themselves. Emotionally aware leaders are in a better position to analyse the responses of followers, to consider their concerns and empathise with them during work situations. These are the skills that are required to establish trust, open communication and promote psychological safety in teams (Goleman, 1998). When employees believe their leaders are emotional and responsive to them, they would find it easier to feel motivated and committed towards organisational objectives.

More so, emotionally intelligent leaders can better cope with emotional needs involved in leadership. Leadership in organisations is always about conflict management, handling uncertainty and keeping morale in tough times. Emotional intelligence helps leaders to manage their personal emotions and define the emotional atmosphere in their organisations (Cote, 2014). This is especially needed in the case of transformational leadership where the leader must be able to instil confidence and optimism in followers.

Transformational leadership behaviour is associated with emotional intelligence, and empirical evidence supports this. Meta-analytic literature has indicated the higher the emotional intelligence of the leader the greater the likelihood that he or she will exhibit the transformational leadership traits which include inspirational motivation and individualised consideration (Harms & Crede, 2010). These observations indicate the emotional intelligence is an inherent capacity that promotes emergence of transformational leadership practises. Emotionally intelligent leaders are able to convey vision better, handle interpersonal relationships, and build conducive working conditions that boost the involvement of followers.

Transformational leadership has also been exposed to scholarly criticism, as much as it has had a good empirical support. There are those scholars who hold the view that the theory is redundant with other constructs of leadership and that it occasionally tends to be overly charismatic (Antonakis, 2012). Some of them state that transformational leadership could have been more or less effective depending on the contextual conditions of organisation culture, expectations of the followers and institutional structures. However, the framework is still very powerful since it includes the dynamic and relational nature of leadership that are crucial in modern organisations.

In contemporary work settings which are typified by teamwork, diversity and high change, a combination of emotional intelligence and transformational leadership offers a beneficial perspective to leadership effectiveness. Employees can be more motivated by leaders who understand their emotions and have a visionary approach to leadership because they can build stronger relationships with their employees and lead the organisations on the road to sustainable success.

Leader–Member Exchange Theory

Leader Member Exchange (LMX) theory is a theory of relation to leadership who places emphasis on the quality of interactions that exist between the leaders and their followers instead of placing emphasis on the traits or behaviours of the leaders. According to LMX theory, the effectiveness of leaders is mainly determined by the relationships that the leaders establish with individual subordinates in a work group (Graen & Uhl-Bien, 1995). LMX theory acknowledges that leaders tend to establish various kinds of relationships with different employees unlike the traditional models of leadership which assume that leaders should treat all their followers equally.

The key point at LMX theory is the contrast between high-quality and low-quality exchange relationships. The nature of the leader member exchanges is high quality and this is linked to mutual trust, respect, open communication and mutual sense of obligation between the leader and the follower. In these relationships, followers have high chances of getting support, autonomy and professional development by their leaders. On the other hand, poor quality exchanges are more task-based and restricted to official job duties with little emotional involvement or discretional assistance (Graen & Uhl-Bien, 1995). Such variations in quality of relationships have the capability of impacting on employee attitudes and behaviours in organisations.

Studies have always portrayed that superior quality of LMX relationships correlate with various organisational beneficial results. Achieving high satisfaction of job, commitment to organisation, role-clarity, and better performance are reported in employees who have good relations with leaders (Gerstner & Day, 1997). Quality exchanges also help in building more trust in the leadership, better communication, and engagement of employees. The followers will tend to feel appreciated and esteemed by their leaders and therefore respond by working harder and cooperating more and this is an incidence of the social exchange theory that forms the basis of LMX framework (Cropanzano & Mitchell, 2005).

Most of the time, the process of role negotiation and social interaction leads to the development of leader-member exchange relationships. In the early phases of the leader follower relationship, the leaders and followers evaluate the reliability, competence and desire of each other to work together. As the relationship grows, tendencies of trust, support, and expectation are created. In exchange Leaders can offer more responsibilities and opportunities to competent and committed followers, which enhances the relationship between them. These relational patterns in the long run influence how the employees view the leadership as fair and the organisational support (Liden, Sparrowe & Wayne, 1997).

The emotional intelligence has a vital contribution to the development of a high-quality leader-member exchange. The leaders with high levels of emotional intelligence and empathy can better grasp the needs, concerns and the inspirations of their followers. This knowledge will help them to better communicate, resolve conflicts in a constructive manner, and be sensitive to the moods of the employees (Cote, 2014). The behaviours also lead to trust and mutual respect that are the key components of effective LMX relationships.

Moreover, emotionally intelligent leaders are more likely to be able to handle interpersonal processes in teams. The organisational environment is a social setting whereby different people come with different personalities, expectations, and emotional reaction to their employment. Leaders that possess the ability to effectively decipher the emotional signals and carefully manage their own emotional responses will have a higher chance of sustaining positive relationships with the followers (Goleman, 1998). These emotional competencies facilitate the creation of good and supportive working environments whereby employees are free to exchange ideas and issues.

Empirical studies show that there is evidence of the relationship between emotional intelligence and leader-member exchange quality. Research indicates that leaders who possess more emotional intelligence create better relations with subordinates and enhance the degree of trust, collaboration, and job satisfaction (Miao, Humphrey & Qian, 2021). The ability of emotional intelligence helps leaders gain an awareness of the unspoken emotional cues, handle conflicts tactfully, and foster an atmosphere of inclusion which encourages respect toward one another. In turn, emotional intelligence may be considered as a core competence which will contribute to the effectiveness of the leaders in developing effective relational interactions in an organisation.

LMX theory has not gone without criticism in spite of its high level of empirical support. Other academics say that the difference in the relationship between leaders and followers can easily generate impressions of either favouritism or inequality in teams (Yukl, 2013). Otherwise, differences in the quality of exchange may create rifts between the representatives of the in-group and the out-group. However, advocates of the LMX theory argue that it is possible to create high quality relationships with all employees by using fair leadership practises, open communication and through inclusive organisational cultures.

The relational knowledge of LMX theory is very applicable in the modern organisational contexts that are characterised by collaboration, sharing of knowledge, and empowering employees. The concept of leadership effectiveness is becoming more of how well a leader acts rather than how well the leader relates with his/her followers. Emotional intelligence augments this relational ability by providing leaders with interpersonal understanding and compassion to accomplish the development of trust-based interactions that lead to employee wellbeing and organisational achievement.

Theoretical Framework

The theoretical background of this research is based on the Ability-Based Emotional Intelligence Theory and Transformational Leadership Theory to describe how the emotional competencies of leaders

influence the process of leadership and organisational performance. By using these frameworks together, we have a holistic picture of how emotional capabilities shape the interaction of leaders with their followers, the motivational methods to employ employees and how to improve the performance of a team. The modern leadership literature is becoming more aware of the fact that cognitive performance and formal power alone do not indicate leadership effectiveness; rather, it is the ability of a leader to learn and cope with the emotional processes in the organisational context (Northouse, 2025; Yukl, 2013). Emotional intelligence thus presents a convenient explanatory process to the differences in leadership behaviour and results.

A theory of ability-based Emotional Intelligence was developed Mayer, Salovey, and Caruso (2008), and it views emotional intelligence as a collection of mental skills among emotional information processing (Mayer, Salovey & Caruso, 2008). This school of thought presents that emotional intelligence entails four fundamental skills, which include the ability to perceive emotions, the ability to employ emotions to aid thought, the ability to be able to interpret emotional meanings, and the ability to be able to manage emotions (Mayer, Salovey & Caruso, 2008). These skills allow an individual to handle complicated social experiences and react in a proper way to an emotional stimulus. In the organisational environment, leaders are often confronted with circumstances that involve sensitivity to the feelings of employees, interpersonal dynamics and transforming motivational orientations. Leaders with high emotional intelligence will thus be able to deal with such dynamics more effectively in a manner that fosters collaboration and productivity.

The ability-based model underlines the fact that emotional intelligence is just like any other intelligence in that it is an information processing and adaptive problem-solving process. Emotions give a good indication regarding relationship, environmental needs, and wellbeing of individuals. Leaders that are able to comprehend these cues are in a better position to make informed decisions and lead their teams through the uncertainty (Cote, 2014). Self-regulation also comes in through emotional intelligence as leaders are able to remain in cheque when faced with stressful circumstances and not to react as they do in response. This emotional control is especially valuable in leadership where the emotional tone of leaders may affect the morale and behaviour of employees.

Transformational Leadership Theory is another theory that supplements the emotional intelligence view by identifying how leaders can transfer their personal competencies to behaviours that motivate and encourage their followers. Transformational leadership is concerned with the capability of the leader to enhance the motivation of the followers, set personal objectives to organisational vision and create a sense of commitment to the organisational goals. Bass and Riggio (2006) developed four main elements of transformational leadership, namely idealised influence, inspirational motivation, intellectual stimulation, and individualised consideration. Such behaviours by transformational leaders convince followers to go beyond self-interest and work towards the greater organisational objectives.

The combination of emotional intelligence and transformational leadership theory has a theoretical importance since emotional competencies are essential in most transformational leadership behaviours (Bass, 1985; Khanin, 2007). An example is inspirational motivation which relies on the capability of the leader to explain the vision in a manner that the followers can connect with. Individualised consideration means that one must be empathetic and sensitive to the needs of employees whereas intellectual stimulation may entail dealing with uncertainty and promoting open communication (Goleman, Boyatzis & McKee, 2013). High emotional intelligence leaders are hence better placed to implement transformational leadership behaviours.

There exist empirical studies that affirm the theoretical relationship between emotional intelligence and transformational leadership. Research has demonstrated that emotionally intelligent leaders tend to gain more trust, good relationship in the workplace, and develop favourable working environments that can boost employee involvement (Harms & Crede, 2010). Emotional intelligence helps leaders to know the emotional condition of followers, reactions to challenges in a positive manner and positive organisational climate. These competencies help in increasing employee satisfaction, employee commitment, and performance.

Moreover, the combination of these theories accentuates the process of relationships in which a leader becomes effective. Leadership is not a solitary process but a process that takes place between the leaders

and the followers (Khanin, 2007). Emotional intelligence will add value to these interactions by ensuring that they are better in communication, conflict management and understanding each other. Transformational leadership, in its turn, offers the behavioural channel whereby these emotional competencies get converted into motivational and organisational results (Bass, 1985). Employees have a higher chance to feel valued, motivated and committed to organisational goals when the leaders adequately manage emotions and clearly formulate an appealing vision (Judge & Piccolo, 2004).

In this research, emotional intelligence is thus theorised as a lead up to being a good leader. Highly emotionally intelligent leaders are supposed to interact better with the followers, build stronger leader-member relationships, and promote employee engagement cases. These interrelations are likely to affect team working and organisational performance. Combining the Ability-Based Emotional Intelligence Theory with the Transformational Leadership Theory, the given study can offer the structure of analysing the role of emotional competencies in influencing the leadership procedures and consequences in the modern organisational setting.

Methodology

The research design used in the study was a quantitative survey design that was used to test the relationship between emotional intelligence and leadership effectiveness under different settings of organisations. The total number of respondents, who took part in the collection of the data, was 300 people who work in education, healthcare, retail, and public service. The participants were a sample of various positions that included junior workers, supervisory employees and top-level management to have a holistic view of the leadership dynamics and experiences in the workplace.

The emotional intelligence was also measured with self-reported items that included the awareness of emotions, regulation of emotions, the awareness of other people emotions, and the decision making based on emotion. Outcomes of leadership and followers were measured by survey items that concentrated on motivation of employees, perceived organisational value, strong team performance and stress at work environment. All the answers were noted with a five-point Likert scale that used a scale of 1 (strongly disagree) to 5 (strongly agree) where the participants were allowed to indicate the degree of agreement with the statements given.

The analysis of the collected data was carried out through descriptive statistics analysis, correlation analysis, as well as composite variable analysis. These analytical methods have promoted an in-depth study of the correlation between emotional intelligence and leadership outcomes and gave us an understanding of how the emotional competencies of the leaders transform into the team performance, job satisfaction, and workplace relationship. On the whole, this research method allowed this study to provide empirical results regarding the significance of emotional intelligence in effective leadership in various organisational environments.

Data Analysis

Sample Size

Valid Responses	Missing	Total
300	0	300

All returned questionnaires were usable for analysis.

Descriptive Statistics

Variable	Mean	Std. Deviation	N
Emotional awareness	2.60	1.53	300
Understanding own emotions	3.38	1.43	300
Recognising emotions in others	3.03	1.36	300
Managing emotions under pressure	3.26	1.42	300
Emotional decision making	3.12	1.36	300

The descriptive statistics summarise the emotional intelligence competence of respondents in five major dimensions, which include emotional awareness, knowledge of individual emotions, understanding another person's emotions, emotional managing under pressure as well as making

emotional decisions. A review of 300 answers was done to provide a significant framework in which to consider the trends present in the data.

The findings denote that the respondents have reported an average level of emotional intelligence in general with a mean score of 2.60 to 3.38. One of the variables was the best understanding of own emotions with the highest mean score (M = 3.38, SD = 1.43). It implies that respondents tend to view themselves as reasonably competent in the process of recognising and explaining their internal emotional conditions. According to the scholars, emotional intelligence is based on self-awareness since a person needs to be self-aware of how they feel before they can successfully manage their behaviour or relate with others (Mayer, Salovey & Caruso, 2008; Goleman, 1998). The mean is relatively large hence, suggesting that there is a significant number of respondents who have a reasonable degree of intrapersonal emotional insight.

The second mean score was the highest in dealing with pressures (M = 3.26, SD = 1.42). This observation means that the respondents feel that they are reasonably able to control their emotional responses in challenging or stressful events. The emotional control is especially significant when it comes to leadership, whereby being able to stay calm in the face of uncertainty is part of making superior decisions and organisational stability (Gross, 2015). Managers who manage their emotions better also have higher chances of having a pleasant working environment and minimising interpersonal conflict.

Likewise, the emotional decision-making was moderate (M = 3.12, SD = 1.36) in terms of the mean score, which indicates that the respondents occasionally take into account the emotional information in their decision-making. In the most recent research on leadership, the importance of rational decision making is not absolute but most of the time it entails the incorporation of emotional and social cues (George, 2000). Leaders that recognise signs of emotion are in a better position to predict team response and organisational implications.

The skill to identify the emotions of other people also had a moderate mean score (M = 3.03, SD = 1.36). This skill is an indication of social awareness and empathy, which are the main elements of emotional intelligence. Previous studies indicate that leaders who are capable of correctly interpreting the feeling of team members have better chances of establishing trust and enhancing communication (Ashkanasy and Daus, 2005). The findings consequently show that the interpersonal emotional sensitivity in the respondents is moderate.

Nonetheless, emotional awareness had the lowest mean score (M = 2.60, SD = 1.53) which implies that some respondents might not find it easy to remain conscious of emotional cues in real-time. The standard deviation is also relatively large and this is a further indication that there is a lot of variation between the participants. This means that although there are people who show high levels of emotional awareness, others show much lower levels. This variability that occurs in organisational samples is apparent due to the fact that, emotional competencies are determined by personality traits, leadership experience, and organisational culture (Joseph and Newman, 2010).

Reliability Analysis (Cronbach's Alpha)

Construct	Items	Cronbach Alpha
Emotional Intelligence	5	0.87
Leadership Behaviour	6	0.89
Leader–Member Exchange	5	0.86
Job Satisfaction	4	0.88
Team Performance	4	0.85
Workplace Stress	4	0.82

All constructs exceed the recommended 0.70 threshold.

To establish the internal consistency of the constructs, Cronbach alpha was used to determine the reliability of the measurement instruments used in this study. The findings suggest that the all constructs have a high level of reliability, with Cronbachs alpha values very much higher than the generally recognised standard of 0.70. In particular, the Emotional Intelligence scale, which was rated using five items, had a high reliability coefficient of 0.87, meaning that the items are always able to reflect the construct of emotional intelligence. The Leadership Behaviour with a 6-item assessment had an even

greater reliability of 0.89 with an implication of excellent internal consistency. On the same note, the Leader Member Exchange construct, which was measured using five items, gave a Cronbachs alpha of 0.86, which proved the reliability of the scale in measuring the quality of leader-member relationships. Job Satisfaction had 4 items and a Cronbachs alpha of 0.88 which indicates high level of consistency among the items. Team Performance construct, which has four items as well, had a reliability coefficient of 0.85, which is good internal consistency. Lastly, the Workplace Stress which was measured using four items reported a Cronbachs alpha of 82 and it was concluded that the scale measures the perceived stress levels at the workplace. On the whole, these findings indicate that the survey tools used in this research are sound and can be used in further statistical calculations.

Correlation Matrix

Variables	EI	Leadership	LMX	Satisfaction	Performance
Emotional Intelligence	1				
Leadership Behaviour	.46**	1			
LMX	.42**	.51**	1		
Job Satisfaction	.39**	.44**	.55**	1	
Team Performance	.33**	.48**	.41**	.46**	1

p < 0.05

Correlation analysis was done to test the association of Emotional Intelligence (EI), Leader Behaviour, Leader Member Exchange (LMX), Job Satisfaction and Team Performance. The findings, as shown in Table 4.4, indicate that there are significant positive associations of all the variables at $p < 0.05$.

In particular, Leadership Behaviour was related to Emotional Intelligence in a moderate positive manner ($r = 0.46$), and it implies that the more emotionally intelligent the leader, the more effective was the leadership behaviour. EI had also a good relationship with LMX ($r = 0.42$), indicating that EI leaders tend to build good relationships with their subordinates. Moreover, EI showed positive relationships with Job Satisfaction ($r = 0.39$) and Team Performance ($r = 0.33$), which presupposes that the higher the emotional intelligence, the higher the satisfaction of the employees and the better the team results.

There was strong correlation between Leadership Behaviour and LMX ($r=0.51$) indicating that good leadership behaviours are closely related to better relationships between leaders and their members. It was also positively associated with Job Satisfaction ($r = 0.44$) and Team Performance ($r = 0.48$) which means that effective leaders not only make their employees satisfied but also make their organisation effective as well.

The positive correlation between LMX and Job Satisfaction ($r = 0.55$) and moderate correlation with Team Performance ($r = 0.41$) indicated that positive leader–member relations are significant in employee morale and performance outcomes. Lastly, Team Performance was positively associated with Job Satisfaction ($r = 0.46$), implying that job satisfaction correlates with team performance and so the more employees are satisfied the higher the chances of them performing well in a team.

All in all, the findings suggest that emotional intelligence, leadership behaviour, and good relations between the leader and members are all positively related with employee satisfaction and team performance, which justify the interrelation of these organisational constructs.

Regression Analysis

Model 1

Dependent Variable: Transformational Leadership

Predictor	Beta	t	Sig
Emotional Intelligence	0.46	8.12	0.000

$R^2 = 0.21$

An analysis was performed with a simple linear regression in order to analyse the predictive value of Emotional Intelligence (EI) on Transformational Leadership. These findings suggest that EI is a strong positive foreteller of transformational leadership (= 0.46, = 8.12, p = 0.000). This observation implies that the more the emotional intelligence of leaders, the more they are involved in transformational leadership behaviours, i.e., to inspire, motivate, and intellectually stimulate their followers. Transformational leadership was explained by the model ($R^2 = 0.21$) as 21 percent of the variance, which means that

although emotional intelligence is an important factor to explain transformational leadership, there were other factors other than EI that have some influence in explaining leadership behaviour. On the whole, these findings demonstrate the significant importance of emotional intelligence in the increase of transformational leadership effectiveness in the organisational context.

Model 2

Dependent Variable: Leader–Member Exchange

Predictor	Beta	t	Sig
Emotional Intelligence	0.42	7.41	0.000

$R^2 = 0.18$

Simple linear regression was performed to determine the impact of Emotional Intelligence (EI) on Leader Member Exchange (LMX). It was analysed that EI is a major positive predictor of LMX (0.42, t = 7.41, p = 0.001). This implies that leaders who have a greater emotional intelligence tend to establish better quality relationships with their subordinates and such a relationship is one that is built on trust, respect, and communication. The model explained 18% of the variance in LMX (R 2 = 0.18) and this indicates that even though the role of emotional intelligence is significant in defining the nature of leader-member relationship, there are other factors that determine the nature of such relationships. These results indicate that emotional intelligence is a significant tool in establishing good, effective, and training interactions between leaders and team members.

Model 3

Dependent Variable: Job Satisfaction

Predictor	Beta	t	Sig
LMX	0.55	9.67	0.000

$R^2 = 0.30$

Simple linear regression was done to investigate the predicting value of Leader Member Exchange (LMX) on Job Satisfaction. The findings show that LMX is a noteworthy positive foreboding of job satisfaction (0.55, t = 9.67, p < 0.001). This result implies that employees who have had positive interactions with their leaders, where the interaction is characterised by trust, support, and effective communication are likely to record an increased rate of job satisfaction. The model contributed 30 percent of the variance in job satisfaction (R) = 0.30), which implies that LMX plays a significant role in the job satisfaction of the employees but there are other factors, which contribute to the overall job satisfaction beyond LMX. These findings underscore the need to focus on positive leader-member relationships in boosting employee morale and workplace job satisfaction.

Model 4

Dependent Variable: Team Performance

Predictor	Beta	t	Sig
Leadership Behaviour	0.48	8.90	0.000

$R^2 = 0.23$

Simple linear regression was done to investigate how Leadership Behaviour influences Team Performance. These findings indicate that leadership behaviour is an important positive predictor of team performance (8.90, 0.001). This shows that the performance of teams that are headed by leaders with exhibited good leadership behaviours like offering guidance, support and motivation were more likely to perform better and also reach greater heights of productivity and goal achievement. The model explained 23 percent of the variation in the team performance (R 2 = 0.23), which implies that leadership behaviour is a significant factor that can influence the team performance but there are other factors, which affect the team performance. The findings provide relevance to the need to ensure that leadership practises are effective in ensuring team success and organisational effectiveness.

Hypothesis Testing Summary

Hypothesis	Statement	Result
H1	EI positively predicts leadership behaviour	Supported
H2	EI positively predicts LMX	Supported
H3	LMX positively predicts job satisfaction	Supported
H4	Leadership behaviour predicts team performance	Supported

Discussion of Findings

The main objective of the study was to test the interrelationships between emotional intelligence, leadership behaviour, leader-member exchange (LMX), job satisfaction, and team performance and to determine the predictive power of key constructs on key organisational outcome. The results of the study can be useful in understanding the contribution of both personal competencies and relationship dynamics to workplace attitudes and behaviour.

On the one hand, the reliability analysis showed that all measurement scales were characterised by high internal consistency, whereas the value of Cronbach alpha ranged between 0.82 and 0.89. These scores are more than the generally set standard of 0.70 (Nunnally and Bernstein, 1994), which means that emotional intelligence constructs, constructs of leadership behaviour, LMX, job satisfaction, team performance, and workplace stresses were highly measured. This gives a good empirical background to the interpretation of further correlation and regression.

The correlation table demonstrated that all the variables of the study had significant positive correlations. There were moderate and positive correlations between emotional intelligence and leadership behaviour (r = .46), LMX (r = .42), job satisfaction (r = .39), and team performance (r =.33). Such results are consistent with the previous studies that proposed that emotionally intelligent people have a greater capacity to identify and regulate their emotions and those of other people in a manner that improves interpersonal relationships and work performance (Mayer, Salovey, and Caruso, 2008; Goleman, 1998). Particularly, leaders who have stronger emotional intelligence are more inclined towards making behaviours that lead to the development of trust and cooperation that is subsequently helpful in promoting increased levels of job satisfaction and performance among group members.

There were also strong correlations between leadership behaviour and LMX (r =.51), job satisfaction (r =.44), and team performance (r =.48), which reflect the argument that good leadership practises are highly linked with positive relational exchanges and employee outcomes. This agrees with transformational and relational leadership theories, which highlight that leaders who are supportive, thought provoking and consideration involve tend to develop greater levels of employee satisfaction and team productivity (Bass and Riggio, 2006; Graen and Uhl-Bien, 1995). The positive relationship between LMX and job satisfaction (r =.55) also supports the idea that leaders-member relations of high quality based on mutual trust and respect are at the heart of positive attitude of employees in the workplace (Dulebohn et al., 2012).

The regression analysis helped more in understanding the dynamics of predictability of the variables. Model 1 revealed that transformational leadership was highly determined by emotional intelligence (0.46, p <.001), which explained 21% of the change in leadership behaviour. This is congruent with the available literature which points to the fact that emotionally intelligent leaders are better placed to inspire and motivate subordinates (Cote et al., 2010). Emotional intelligence helps leaders to cope with their feelings successfully, to interpret social signs correctly, and to work out in a complicated interpersonal context, all these things are very crucial in transformational leadership (Barbuto & Burbach, 2006).

In the same way, Model 2 revealed the emotional intelligence to be an important predictor of LMX (= 0.42, p <.001), with the ability to explain 18 percent of the variance. This implies that leaders with greater emotional intelligence levels have greater ability to develop trustful and supportive relationships with their followers. These leaders are more competent to address the needs and concerns of the followers in a sensitive manner which is one of the main principles of the LMX theory (Graen & Uhl-Bien, 1995). This observation highlights the role of emotional intelligence as one of the core competencies in the development of high-quality leader-member interactions.

LMX became a predictive variable in Model 3 with a strong positive correlation with job satisfaction (= 0.55, p =.001) and it explained 30 percent of the variation. This is in line with the studies which have

pointed out the role of relational quality in work attitude of employees (Harris, Wheeler & Kacmar, 2009). The employees are more likely to feel valued and satisfied with their jobs when they have a respectful, supportive and high trust relationship with its leaders. This would be applicable on retention, engagement, and the general climate in organisations (Erdogan & Bauer, 2010).

Lastly, the Model 4 revealed that team performance was strongly predicted by leadership behaviour (0.48, p <.001) with 23 percent of the variance explained. Leadership behaviour that entails communication transparency, goal-setting, and feedback on performance is required when leading a team and being able to coordinate team activities and support group achievement (Yukl, 2013). This observation supports the evidence showing that leadership behaviour is one of the most important factors that dictate team performance especially when working in a complex and dynamic setting (Kozlowski & Ilgen, 2006).

Combining these results would indicate a coherent theoretically based model where emotional intelligence is a precursor of successful leadership behaviour and good quality of leader-member relationships, which in turn are correlated with increased job satisfaction and better team performance. The positive correlations and forecasting relations that have been found in this research point at the pivotal role that is played by individual competencies as well as relational processes in attaining admirable organisational results. The practical implications of these findings include the idea that organisations must invest in development programmes that facilitate the development of leaders on the basis of emotional intelligence and relationship skill to create positive work environments that facilitate employee satisfaction and high performance.

Conclusion and Recommendations

The first purpose of this paper was to discuss the interrelationships between emotional intelligence, leadership behaviour, leader-member exchange (LMX), job satisfaction, and team performance and determine the predictive power of key constructs on critical organisational results. The results provide useful information about the functions of personal competencies and relations in workplace attitudes and behaviours.

On the one hand, the reliability analysis indicated that the measurement scales of all scales showed high internal consistency, where Cronbach alpha ranged between 0.82 and 0.89. Such scores surpass the widely agreed mark of 0.70 (Nunnally & Bernstein, 1994) which implies that the variables of emotional intelligence, leadership behaviour, LMX, job satisfaction, team performance, and stress at the workplace were measured with high reliability. This offers a good empirical basis to explain a later correlation and regression analysis.

The correlation table presented a significant positive correlation between all variables in the study. Leadership behaviour had moderate and positive relationships with emotional intelligence (r =.46), LMX (r =.42), job satisfaction (r =.39) and team performance (r =.33). These results are consistent with some of the other studies that propose that more emotionally intelligent individuals can learn to better identify and regulate their emotions and feelings and those of other people, thus leading to improved interpersonal relationship and work performance (Mayer, Salovey & Caruso, 2008; Goleman, 1998). In particular, employees of higher emotional intelligence tend to use behaviour that facilitates the creation of trust and teamwork that consequently promote elevated job satisfaction and performance rates among team members.

There were also high correlations of leadership behaviour with LMX (r = .51), job satisfaction (r =.44), and team performance (r =.48), which pointed out that good relational exchanges and employee performance were closely related to leadership practises. This goes in line with transformational and relational leadership theories which underscore the role that leaders who are supportive, intellectually stimulating and individual considerate play in fostering greater levels of employee satisfaction and team performance (Bass & Riggio 2006; Graen & Uhl-Bien 1995). The close positive relationship between LMX and job satisfaction (r =.55) is another evidence that high-quality leader-member relationships, mutual trust, and respect are the main focus of the positive attitude of employees in the workplace (Dulebohn et al., 2012).

The regression analyses better explained about the predictive dynamics between the variables. Model 1 revealed that emotional intelligence was a significant predictor of transformational leadership (= 0.46, p =.001) to the extent that it explained 21 percent of the leadership behaviour variance. This conforms to the established literature that emotional intelligent leaders are able to inspire and motivate subordinates more (Coute et al., 2011). The emotional intelligence helps a leader to control his/her emotions appropriately, interpret social messages correctly, and negotiate intricate human relationships- all that are paramount in transformational leadership (Barbuto and Burbach, 2006).

In the same vein, Model 2 indicated that emotional intelligence was a predictor of LMX with a significant coefficient (18) (0.42, p =.001). This implies that leaders with a greater degree of emotional intelligence will have an enhanced ability to form trustful and supportive relationships with the followers. These kinds of leaders are in a better position to be sensitive to the needs and concerns of the followers and that is one of the key principles of the LMX theory (Graen & Uhl-Bien, 1995). The results of this finding highlight the relevance of emotional intelligence as a core competency on the promotion of high-quality leader and member interactions.

In the Model 3, LMX showed a significant predictor of job satisfaction (= 0.55, p =.001), explaining 30 percent of the variance. This is in line with the study that has indicated the role played by relational quality in the work attitudes of the employees (Harris, Wheeler, and Kacmar, 2009). The more respectful, supportive and high trustful relations employees have with their leaders, the more likely they will feel valued and satisfied with their work. This has some repercussions on retention, engagement, and climate of the organisation (Erdogan and Bauer, 2010).

Lastly, the Model 4 suggested that the leadership behaviour was a strong predictor of team performance (= 0.48, p <.001) and the variance was found to be 23%. Strong leadership behaviour that involves effectiveness in communication, goal setting, and performance feedback is the key to organising the team activity and enabling people to achieve success collectively (Yukl, 2013). This result supports studies illustrating that leadership behaviour is a major factor towards team performance especially in active and challenging working environments (Kozlowski and Ilgen, 2006).

Collectively, these results imply that there exists a consistent set of theoretically based assumptions where emotional intelligence is a pre-cursor to effective leadership behaviour and high-quality leader-member relationships, which are then linked to higher job satisfaction and better team performance. The correlational and anticipatory relationships in the current study bring out the focus of individual and relationship competences in the attainment of desirable organisational results. The implications of these findings in practise imply that organisations ought to invest in development programmes that will help them develop leaders with high emotional intelligence and with strong relationships to create a positive work environment that will stimulate employee satisfaction and high performance.

References

Antonakis, J. (2012). Transformational and charismatic leadership. The nature of leadership, 256-288.

Antonakis, J., Ashkanasy, N. M., & Dasborough, M. T. (2009). Does leadership need emotional intelligence?. The leadership quarterly, 20(2), 247-261.

Ashkanasy, N. M., & Daus, C. S. (2005). Rumors of the death of emotional intelligence in organizational behavior are vastly exaggerated. Journal of Organizational Behaviour, 26(4), 441-452.

Barbuto, J. E., & Burbach, M. E. (2006). The emotional intelligence of transformational leaders: A field study of elected officials. The Journal of social psychology, 146(1), 51-64.

Bass, B. M. (1990). From transactional to transformational leadership: Learning to share the vision. Organizational dynamics, 18(3), 19-31.

Bass, B. M., & Bass Bernard, M. (1985). Leadership and performance beyond expectations (Vol. 25, No. 3, pp. 481-484). New York: Free press.

Bass, B. M., & Riggio, R. E. (2006). Transformational leadership. Psychology press.

Boyatzis, R.E. (1982). The competent manager: a model for effective performance. New York; Chichester: J. Wiley.

Cote, S. (2014). Emotional intelligence in organizations. Annual Review Organisation Psychology Organisation Behaviour, 1(1), 459-488.

Cote, S., Lopes, P. N., Salovey, P., & Miners, C. T. (2010). Emotional intelligence and leadership emergence in small groups. The Leadership Quarterly, 21(3), 496-508.

Cropanzano, R., & Mitchell, M. S. (2005). Social exchange theory: An interdisciplinary review. Journal of management, 31(6), 874-900.

Dirks, K. T., & Ferrin, D. L. (2002). Trust in leadership: meta-analytic findings and implications for research and practice. Journal of applied psychology, 87(4), 611.

Dulebohn, J. H., Bommer, W. H., Liden, R. C., Brouer, R. L., & Ferris, G. R. (2012). A meta-analysis of antecedents and consequences of leader-member exchange: Integrating the past with an eye toward the future. Journal of management, 38(6), 1715-1759.

Erdogan, B., & Bauer, T. N. (2010). Differentiated leader–member exchanges: The buffering role of justice climate. Journal of applied psychology, 95(6), 1104.

George, J. M. (2000). Emotions and leadership: The role of emotional intelligence. Human relations, 53(8), 1027-1055.

Gerstner, C. R., & Day, D. V. (1997). Meta-Analytic review of leader–member exchange theory: Correlates and construct issues. Journal of applied psychology, 82(6), 827.

Goleman, D. (1995). Emotional Intelligence. Bantam Books: New York.

Goleman, D. (1998). Working with emotional intelligence. Bantam Books. New York.

Goleman, D., Boyatzis, R. E., & McKee, A. (2013). Primal leadership: Unleashing the power of emotional intelligence. Harvard Business Press.

Graen, G. B., & Uhl-Bien, M. (1995). Relationship-based approach to leadership: Development of leader-member exchange (LMX) theory of leadership over 25 years: Applying a multi-level multi-domain perspective. The leadership quarterly, 6(2), 219-247.

Gross, J. J. (2015). Emotion regulation: Current status and future prospects. Psychological inquiry, 26(1), 1-26.

Harms, P. D., & Crede, M. (2010). Emotional intelligence and transformational leadership: A meta-analysis. Journal of Leadership & Organizational Studies, 17(1), 5–17.

Harris, K. J., Wheeler, A. R., & Kacmar, K. M. (2009). Leader–member exchange and empowerment: Direct and interactive effects on job satisfaction, turnover intentions, and performance. The leadership quarterly, 20(3), 371-382.

Joseph, D. L., & Newman, D. A. (2010). Emotional intelligence: an integrative meta-analysis and cascading model. Journal of applied psychology, 95(1), 54.

Judge, T. A., & Piccolo, R. F. (2004). Transformational and transactional leadership: a meta-analytic test of their relative validity. Journal of applied psychology, 89(5), 755.

Khanin, D. (2007). Contrasting Burns and Bass: Does the transactional-transformational paradigm live up to Burns' philosophy of transforming leadership? Journal of leadership studies, 1(3), 7-25.

Kozlowski, S. W., & Ilgen, D. R. (2006). Enhancing the effectiveness of work groups and teams. Psychological science in the public interest, 7(3), 77-124.

Liden, R. C., Sparrowe, R. T., & Wayne, S. J. (1997). Leader-member exchange theory: The past and potential for the future.

Mayer, J.D. and Geher, G. (1996). Emotional intelligence and the identification of emotion. Intelligence, [online] 22(2), pp.89–113. doi:https://doi.org/10.1016/s0160-2896(96)90011-2, (Accessed March 24.2026).

Mayer, J. D., Salovey, P., & Caruso, D. R. (2004). "TARGET ARTICLES:" emotional intelligence: Theory, findings, and Implications". Psychological inquiry, 15(3), 197-215.

Mayer, J. D., Salovey, P., & Caruso, D. R. (2008). Emotional intelligence: New ability or eclectic traits? American psychologist, 63(6), 503.

Miao, C., Humphrey, R. H., & Qian, S. (2021). Emotional intelligence and servant leadership: A meta-analytic review. Business ethics, the environment & responsibility, 30(2), 231-243.

Northouse, P. G. (2025). Leadership: Theory and practice. Sage publications.

Nunnally, J. C., & Bernstein, I. H. (1994). Psychometric Theory. McGraw-Hill (3rd ed.).

Sabo, N. (2020). Emotional intelligence and conflict resolution styles: a quantitative study with practical implications.

Salovey, P. and Mayer, J.D. (1990). Emotional Intelligence. Imagination, Cognition and Personality, [online] 9(3), pp.185–211. doi:https://doi.org/10.2190/DUGG-P24E-52WK-6CDG.

Yukl, G., & Gardner, W. L. (2013). Leadership in Organizations, Harlow Essex.

Enabling sustainable economic transition through open innovation and emerging technologies

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Keyword
Circular economy, PLS-SEM, Open innovation, Technology, Sustainability.

Abstract

The transition from a linear to a circular economy is essential for reducing resource depletion, improving resource efficiency, and minimizing waste generation. This study examines the role of open innovation and technological advancement in supporting this transition. Open innovation is driven by resource availability, governance infrastructure, willingness to adopt change, and knowledge-sharing practices. At the same time, technologies such as big data analytics, the Internet of Things, and additive manufacturing contribute significantly to the development of circular economy practices. Using the frameworks of open innovation and circular economy theories, data were collected from 1,001 participants across different professions and age groups. Partial Least Squares Structural Equation Modelling (PLS-SEM) was applied to analyse the relationships among variables. The findings show that both open innovation and technological capabilities have a significant positive effect on the adoption of circular economy practices. The study offers practical insights for businesses, organizations, and policymakers seeking to accelerate sustainable development through circular economy strategies.

Introduction

The circular economy has emerged as an important framework for achieving sustainable development through efficient resource utilization, waste minimization, and environmental protection. Unlike the traditional linear economic model based on the "take–make–dispose" approach, the circular economy emphasizes reducing waste, extending product life cycles, and reusing materials through recycling, repairing, and regeneration processes (Geissdoerfer et al., 2017). This model promotes a closed-loop production and consumption system in which resources are continuously reused to reduce environmental degradation and improve long-term sustainability (Elisha, 2020). Core principles of the circular economy include reducing resource consumption, improving product durability, encouraging repair and remanufacturing, and integrating recyclable materials into production systems (Kirchherr et al., 2017). Such practices help preserve natural resources, lower pollution levels, and decrease ecological pressure caused by excessive industrial activities (Morseletto, 2020).

In addition to environmental benefits, the circular economy also creates economic opportunities by encouraging innovation, supporting new business models, and promoting industries based on recycling and sustainable production practices (Murray et al., 2017). The shift toward circular systems encourages businesses and consumers to adopt responsible production and consumption behaviours while improving resource efficiency and reducing operational costs (Hernandez et al., 2020). Technological advancement further strengthens circular economy initiatives by enabling efficient waste management, product tracking, resource recovery, and sustainable manufacturing processes. Open innovation has also become a significant driver of the circular economy transition. Unlike conventional innovation systems that rely mainly on internal knowledge, open innovation promotes collaboration among firms, researchers, customers, and other stakeholders to generate sustainable solutions and share expertise (Chesbrough, 2003). Through collaborative networks, organizations can exchange ideas, accelerate innovation, and develop environmentally responsible products and processes that support circular economy goals (Geng et al., 2019). Different forms of open innovation, including collaborative partnerships, crowdsourcing, and knowledge-sharing practices, help organizations improve resource management, reduce production costs, and strengthen sustainable development effort (Rajput & Singh, 2019).

Problem Statement

The circular economy has emerged as an important approach for improving resource efficiency, reducing waste, and promoting sustainable production and consumption. Open innovation and technological advancement are considered key drivers in supporting the transition from a traditional linear economy to a circular economy model. Open innovation encourages collaboration, knowledge sharing, and partnerships among organizations, while technology enables efficient product design, recycling, and resource management. However, limited empirical research explains how open innovation and technology collectively facilitate the implementation of circular economy practices. Therefore, this study examines the relationship between circular economy, open innovation, and technology to provide insights for policymakers, industries, and researchers in promoting sustainable development.

Research Questions

1. What key factors influence the relationship between open innovation, technology, and the adoption of circular economy practices?
2. How does open innovation contribute to the implementation of circular economy principles across industries?
3. How does technology enhance resource efficiency and support circular economy initiatives?

Research Objectives

- To identify the main enablers linking open innovation, technology, and circular economy adoption.
- To examine the contribution of open innovation to the implementation of circular economy practices.
- To assess the role of technology in improving resource efficiency within the circular economy

In conclusion, circular economy is recognized as a revolutionary approach to production and consumption practices. It sustained the resource allocation, resource efficiency and waste reduction. While integrating with the open innovation & technology adoption, businesses can enhance the transition toward the circular economy. It not only promotes environmental sustainability but also drives the economic growth, employment generation and technological advancement. As the stakeholders continue to evolve, adopting the circular economy practices and engaging with open innovation, the global challenges can be addressed and sustainability can be achieved.

Review of Literature

Linear to Circular economy

Economic sustainability focal the economic needs of the economic man without affecting his future potential to satisfy the needs (Rennings & Wiggering, 1997). The traditional "take-make-dispose" approach of linear economy has resulted in significant environmental problem, influencing resources availability and the quality. This leads to sustainability threats. The resource depletion and environmental degradation as an outcome of the traditional economic linear approach, highlight the demand for a worthy liveable model and transition to it is the need of the time. This provides with the foundation that why we should try to adopt a more sustainable solution to overcome the challenges of the linear economy. The circular economic model focus on the efficient and optimal use of resources with little generation of waste by employing 3R strategy (reuse, recycle and reduce). This approach helps in creating the closed system where the materials are reprocessed and remodelled reducing utilization of new resources, recycling the product and conserving the ecosystem by reducing the environmental impact. The sustainability crafted by this approach assists in separating the economic wellbeing from the consumption of resources. The new circular business models are adopted in the corporate environment that support the circular economy (Awan & Sroufe, 2022; Urbinati et al., 2017). Companies are leasing products rather than selling, service-based economy is growing, products that ensure durability are designed to ensure the reduction of the resource utilization and the resources on repair. If such practices penetrate into the society the environmental damages of the firms can be reduced. Moreover, the social sustainability as one of the understated outcomes of the circular economy. As the stakeholder engagement approach, community integration approach and inclusive approaches help in creating stronger relations and ensure

the practices that beneficial to all participant. Academia and researchers can play a significant role in stimulating the open innovation and advocating the circular economy. They help in providing with the tools and the knowledge that industries could implement to promote the circular economy. Thus, a collaboration between the education and the industry leads to sustainability (Jesus & Jugend, 2023). Lastly the government as a main player in most economies- can provide with the regulations, incentives and the funding that create the institutions the hub of the innovation and accelerate the transformation toward the circular economy (Li & Maskin, 2021).

Technological Advancements Facilitating the Shift to Circular Economy

Technology enables transformation in the economy by shifting toward the efficient resource allocation and adoption of innovative ideas. Technologies comprising of internet of things, block chain and artificial intelligence are central to the adoption of the circular economy. IoT assists in product lifecycle monitoring, by improving its design, using efficiency and traceability. AI assists in optimal allocation of the resources, forecasting the future needs of maintenance and reducing waste. Block chain technology help in improving supply chains by ensuring transparency and trust and collaboration among stakeholders (Chishty, 2023). Kirchherr et al., (2023) identified 3D Printing and additive manufacturing is also form of the technological advancement that leads to the promotion of circular economy. It ensures that the waste or by-product is reduced during production process. Further the 3D printing can build objects by using recycled material contributing to resource efficient utilization and optimization (Kirchherr et al., 2023). Online marketplaces dedicated to selling second-hand goods extend the life of products and reduce the need for new manufacturing. Circular business models are easier to adopt due to digital technologies (Corvellec et al., 2022). Examples include "product as a service," in which customers pay to use a product rather than purchase it, and "take-back" programs, in which businesses collect and refurbish products for resale or recycling (Mendoza et al., 2022). Thus, the technological advancement facilitates the circular economy by advancing the manufacturing processes, creating new business models, reducing the waste in manufacturing, recycling and reusing, all of which help in creating a sustainable future. Continuous promotion and adoption of these technologies help in development of resilient economy.

Barriers to Adopting Circular Economy Open Innovation

Open innovation is significant in promoting the open economy beyond organizational boundaries, sometime is identified as a measure to overcome the barriers to adoption of circular practices. AlJaber et al. (2023) highlights the regulations unavailability, fragmented supply chains and high upfront investment cost as the prime obstacles to implementation of the circular economy practices. Their findings indicate that the financial incentives, proper legislation and regulatory framework and innovation can act as driver of circular economy. Jaeger and Upadhyay (2020) emphasize the insufficient technological tools and infrastructure as the prime barrier to the circular economy. The lack of the technologies, innovations and development of advance methods is barrier to it. According to them the gap limits the efficient allocation, optimal utilization and reuse & recycling of resources making it challenging in various sectors to be implemented. Mhatre et al., (2023) highlighted the importance of environmental barriers that are prevalent in the various sectors of economy, like the construction sector of India. The lack of environmentally safe material for construction, environmentally unfriendly supply chains and high operating costs are significant barriers. The integration of the open innovation with the CE provides with course to subdue the limitations to its implementation. Continued innovation, cooperation, shared learning and participation leads to various economic as well as environmental benefits.

Theoretical Framework & Hypothesis Building

This study is based on Open Innovation Theory (Chesbrough, 2003) and Circular Economy Theory (MacArthur, 2013) to examine how innovation and knowledge sharing support circular economy practices. Open innovation emphasizes the use of both internal and external ideas to improve innovation and sustainability. It encourages collaboration, knowledge exchange, and stakeholder engagement, which can help organizations shift from a linear to a circular economy model. Previous studies also suggest that open innovation plays an important role in developing sustainable systems and infrastructure that

support circular economy practices.

Conceptual Framework

The conceptual framework explains the key factors influencing the adoption of circular economy practices. The independent variables include governance, willingness to adopt new market strategies, knowledge sharing culture, availability of resources, Internet of Things (IoT), big data analytics, and additive manufacturing. These factors directly support the development of circular economy practices. Open innovation and technology act as mediating variables by strengthening the relationship between these factors and the circular economy. The dependent variable, circular economy, focuses on reducing waste, improving resource efficiency, and promoting sustainable production through recycling and reuse. Understanding these relationships helps explain how organizations can successfully adopt circular economy models.

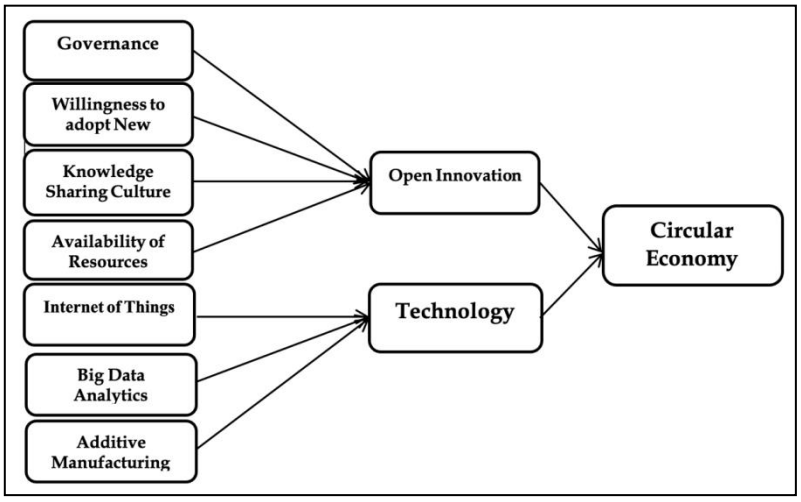


Figure 1: Research Model

Thus, it is hypothesized that;

H1: Open innovation is significantly related to the circular economy.

Additionally, Lee et al. (2010) highlight that how effective governance can facilitates the open innovation by promoting engagement among stakeholders, collaboration and exchange of ideas. Thus, governance can create a conductive environment to sustainability. Chesbrough (2003) discuss that how governance framework influences the adoption of the open innovation principles. The relation can be hypothesized as;

H2: Governance is significantly associated with the open innovation.

The role of the SME's in adoption of the open innovation practices. It is identified that the willingness of the firms to adapt new market trends, making it critical component of the innovation. (Lichtenthaler & Ernst, 2009) analyze the willingness to explore the new ideas as a crucial component to open innovation. Thus, it can be hypothesized that;

H3: Willingness to adopt new is significantly associated with the open innovation.

Creating a knowledge sharing culture also facilitates the open innovation practices. A study by Huang & Rice (2009) highlights the importance of the knowledge sharing culture in facilitating the open innovation by emphasizing on the internal and external knowledge flow to succeed the innovation (Huang & Rice, 2009). Cumming &Teng (2003) also focus on enhancing the open innovation by improving collaboration, exchange of ideas and flow of information (Cummings & Teng, 2003). Thus, it can be hypothesized as;

H4: Knowledge sharing culture is significantly associated with the open innovation.

A study by Dahlander and Gann (2010) investigate the importance of financial, human and technological resources in influencing open innovation practices. It highlights that the resources enable organization to develop new ideas, experiment new methods and practice new knowledge (Dahlander & Gann, 2010). Research by West & Gallagher (2006) explore the role of resources in supporting innovation by increase the probability of engagement with the new stakeholders and resources (West & Gallagher, 2006). Thus, relation can be hypothesized as;

H5: Availability of resources is significantly associated with the Open innovation.

Circular economy theory focuses on minimizing the waste and maximizing the resource use efficiently by reuse, regenerate and recycle principles. This contributes to the overall sustainability and reduce the environmental degradation (Ghisellini et al., 2016). Technology play and important role in create such mechanism that ensure the product recovery and recycling, extending its lifecycle (Lieder & Rashid, 2016). The role of additive manufacturing in supporting the circular economy by enabling the use of waste in recycling, repairing of product and localizing the production processes (Ford & Despeisse, 2016). Study by (Jia et al., 2020) examine the role of technological advancement supporting the development of closed loop system, creating the supply chains, internet of things and the blockchain as a critical component of circular economy. Thus, relationships can be hypothesized as;

H6: Technological advancement is significantly related to the circular economy.

Similarly, McAfee &Brynjolfsson (2012), discusses how the big data analysis transforms the organizations and industries toward the informed data-based (Berman, 2012) decisions and harness the sustainability (McAfee et al., 2012). Berman (2012) highlights the importance of 3D printing in creating technological revolution and developing customized products, thus, additive manufacturing has affected the product development, supply chains and innovation. There are strong implications of the additive manufacturing on technological advancement including development of new business models to limiting orthodox manufacturing practices (Petrick & Simpson, 2013).

H7: Big data analysis is positively associated with the technology.
H8: Additive manufacturing is positively associated with the technology.
H9: Internet of things are positively associated with the technology

Materials and Method

Data collection

This study utilized purposive sampling to select participants with in-depth knowledge and experience in the field. The study selects a set of organizations known for their effective circular economy practices and significant utilization of technology. To achieve the objectives, this study administered structured surveys. This study design and distribute structured questionnaires to diverse organizations representing broad-spectrum industries and sectors in Guangdong Province in P.R. China. The study employs stratified random sampling for the second objective to ensure proportional representation from each sector. The survey measures the extent of open innovation practices and their correlation with circular economy adoption. The response of 1001 respondent's is recorded for the estimation of the research model based on the variables and their items are mentioned with the statements.

Data analysis

The Structure Equation Modelling (SEM) approach has been used to analyse the hypothesis. The process of conducting SEM involves several key stages to ensure the accuracy and reliability of the analysis. The collected data is carefully prepared in line with the assumptions of the selected SEM model. The reliability of data examined through Cronbach's alpha (Hair Jr, Hult, Ringle, Sarstedt, Danks, Ray, et al., 2021). The model is then estimated using SEM analysis, which evaluates how well the model fits the data by establishing the relationships between latent variables and observed indicators (Singh et al., 2021). The findings of the SEM analysis, including parameter estimates, and significance levels presented in this study.

Results and Discussions

Measurement model

The evaluation of measurement model includes assessing the reliability of the variables and their items including the internal consistency by using Cronbach Alpha and composite reliability rho_A, convergent validity by using Average variance extracted (Chin, 1998). Composite reliability represents the internal consistency of the items in the variables. Its value should be greater than 0.7. Table 1 show that the value of composite reliability (rho_a) is between 0.8 to 0.9 highlighting good reliability. The internal consistency reliability of model also presented by Cronbach's Alpha given in the table1, indicating the consistent reliability, as their values are above threshold of 0.7. Average Variance Extracted show the strength of linkage between the variable and its items. Average Variance Extracted is higher than the threshold of 0.5. All the value for VIF is less than 5 indicating that the model is free from multi-collinearity. When item loadings are higher or equal to 0.7, there is more shared variance between the construct and its error variance. The loadings ranging from 0.7 to 0.8. The outer loadings for the variables are higher than 0.7 (Gefen & Straub, 2005).

VARIABLES	ITEMS	LOADINGS	VIF	C.A	C.R	AVE
Additive Manufacturing	ADM1	0.810	1.524	0.793	0.802	0.707
	ADM2	0.825	1.743			
	ADM3	0.886	1.965			
Availability of Resources	AOR1	0.828	1.767	0.827	0.833	0.743
	AOR2	0.897	2.218			
	AOR3	0.860	1.859			
Big Data Analytics	BDA1	0.726	1.439	0.807	0.814	0.634
	BDA2	0.824	1.748			
	BDA3	0.813	1.752			
	BDA4	0.818	1.721			
Circular Economy	CE1	0.919	1.809	0.802	0.803	0.834
	CE2	0.908	1.809			
Governance	GOV1	0.863	2.659	0.871	0.878	0.611
	GOV2	0.858	2.534			
	GOV3	0.772	1.871			
	GOV4	0.718	1.657			
	GOV5	0.713	1.579			
	GOV6	0.752	1.681			
Internet of Things	IoT1	0.782	1.680	0.812	0.822	0.64
	IoT2	0.867	2.054			
	IoT3	0.772	1.527			
	IoT4	0.776	1.609			
Knowledge Sharing Culture	KSC1	0.738	1.497	0.831	0.842	0.666
	KSC2	0.857	2.122			
	KSC3	0.781	1.664			
	KSC4	0.879	2.331			
Open Innovation	OI1	0.811	1.738	0.823	0.825	0.653
	OI2	0.783	1.649			
	OI3	0.819	1.791			
	OI4	0.819	1.739			
Technology	TECH1	0.785	1.651	0.829	0.834	0.661

	TECH2	0.874	2.227			
	TECH3	0.791	1.695			
	TECH4	0.800	1.722			
Willingness to Adapt New	WANM1	0.824	1.907	0.854	0.858	0.696
	WANM2	0.882	2.392			
	WANM3	0.824	1.894			
	WANM4	0.804	1.808			

Table 1: Specification of outer model

The discriminate validity is tested by using the Heterotrait- Monotrait (HTMT) ratio presented in table 2. The maximum value obtained by applying the test is 0.622 which is less than the threshold value of 0.90. The values highlight the validity of the variables (Hair Jr et. al., 2021). The analysis of measurement model exhibit that variables are internally consistent, convergent validate, discriminant validate and the items are reliable.

	ADM	AOR	BDA	CE	GOV	IoT	KSC	OI	TECH	WANM
ADM										
AOR	0.239									
BDA	0.419	0.356								
CE	0.479	0.442	0.541							
GOV	0.396	0.425	0.332	0.571						
IoT	0.267	0.191	0.419	0.432	0.385					
KSC	0.213	0.518	0.354	0.428	0.423	0.138				
OI	0.230	0.654	0.385	0.447	0.444	0.186	0.571			
TECH	0.248	0.204	0.446	0.504	0.411	0.622	0.212	0.236		
WANM	0.387	0.340	0.592	0.480	0.282	0.377	0.357	0.356	0.408	

Table 2: HTMT ratio

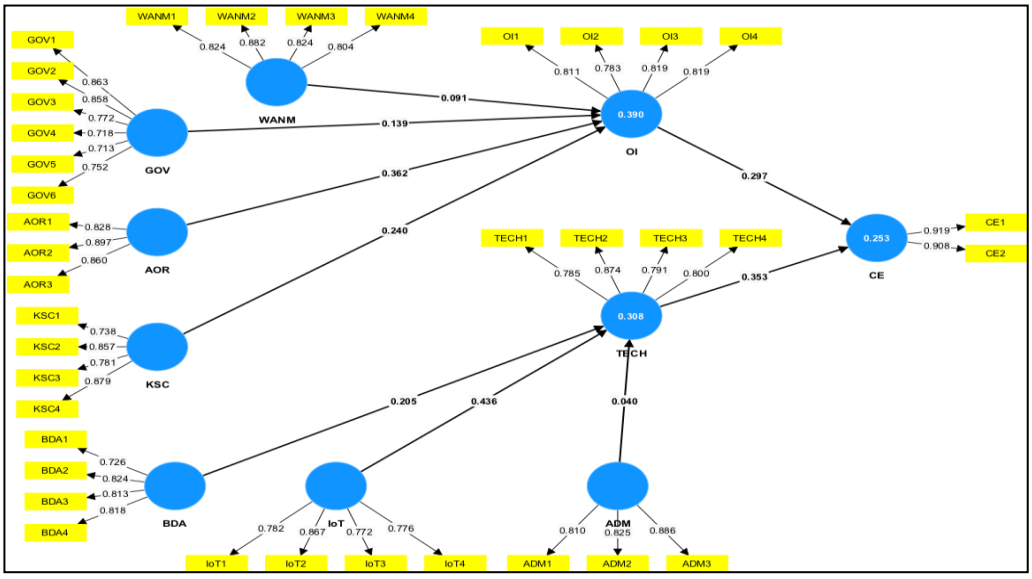
Structural model

The hypothesizes are tested using the PLS-SEM method and relationship between the variables are identified based on the model (figure 2). The structural model is evaluated by using the significance and relevance of the model and assess the R square of the model (Hair & Alamer, 2022). The first hypothesis predict that the open innovation is related positively to the circular economy. Governance, Availability of resources, Knowledge sharing culture, willingness to adopt new are significantly related to open innovation, highlighting the hypothesis 2 to 5. The sixth hypothesis states that the technology is associated (positively) to the circular economy. Additive manufacturing, Big data analytics, Internet of things are significantly related to the technology, accepting the hypothesis 7-9.

Direct effect	(O)	(STDEV)	T statistics	P values	Results
ADM -> TECH	0.040	0.028	1.426	0.154	Accepted
AOR -> OI	0.362	0.028	12.897	0.000	Accepted
BDA -> TECH	0.205	0.030	6.821	0.000	Accepted
GOV -> OI	0.139	0.029	4.746	0.000	Accepted
IoT -> TECH	0.436	0.027	16.168	0.000	Accepted
KSC -> OI	0.240	0.029	8.171	0.000	Accepted
OI -> CE	0.297	0.027	10.859	0.000	Accepted
TECH -> CE	0.353	0.027	12.848	0.000	Accepted
WANM -> OI	0.091	0.027	3.304	0.001	Accepted

Table 3: PLS bootstrapping result

Figure 2: Structural Model



The findings confirm that open innovation significantly promotes the circular economy, supporting the transition from a linear to a sustainable economic model. This result is consistent with prior studies emphasizing the importance of collaboration, knowledge exchange, and innovative practices in achieving circular economy objectives (Jesus & Jugend, 2023; Kohler et al., 2022; Sergianni et al., 2024). The results of H2–H5 further indicate that governance, networking and monitoring capability, knowledge-sharing capability, and adoption readiness positively influence open innovation. These factors strengthen organizational collaboration, improve information exchange, and enhance firms' ability to adopt sustainable innovation practices (Lam et al., 2021; Sivam et al., 2019). Additionally, H6 demonstrates that technology positively affects the circular economy by improving resource efficiency, waste reduction, and sustainable production processes. Emerging digital technologies support recycling, reuse, and circular business practices (Bressanelli et al., 2017). Finally, H7–H9 reveal that additive manufacturing, big data analytics, and the Internet of Things significantly contribute to technological advancement. These technologies enhance decision-making, operational efficiency, and sustainable resource management, thereby facilitating the implementation of circular economy practices (Awan et al., 2021).

Conclusion

The findings of this study highlight the significance of the research questions and confirm that Internet of Things big data analytics, and additive manufacturing play a crucial role as enablers in shaping the relationship between technology and the transition toward a circular economy. The results indicate that organizations that actively pursue circular business models are more likely to achieve successful adoption of sustainable practices, improved resource efficiency, and stronger environmental performance. In this regard, open innovation emerges as a key mechanism that enhances the effectiveness of circular economy implementation by facilitating collaboration, knowledge exchange, and better access to internal and external resources.

The empirical results further demonstrate that technological advancement is a strong driver of circular economy practices. Big data analytics supports informed decision-making by enabling organizations to analyze large volumes of data for optimizing resource use and reducing waste. Additive manufacturing contributes to sustainability by minimizing material consumption, reducing production waste, and enabling localized and efficient production systems. Similarly, IoT enhances connectivity across systems, allowing real-time monitoring, improved coordination, and efficient resource management. Together, these technologies strengthen operational efficiency and significantly contribute

to the transition from linear to circular economic systems. The study also confirms that open innovation is strongly influenced by key organizational and institutional factors such as governance, resource availability, knowledge-sharing capability, and willingness to adopt change. These factors collectively enhance organizational readiness for innovation and improve the capacity to implement sustainable practices. Knowledge-sharing practices further strengthen collaboration, and willingness to adopt change reflects organizational adaptability in response to evolving sustainability demands. These findings reinforce the importance of an enabling environment for fostering open innovation and sustainable development.

Theoretical Implications

The theoretical contribution of this study lies in extending the understanding of how open innovation and technological advancement jointly influence the transition toward a circular economy. It provides empirical evidence supporting the idea that innovation networks and digital technologies are critical drivers of sustainability-oriented transformation. By integrating open innovation theory with circular economy principles, the study contributes to a more comprehensive understanding of how organizational and technological factors interact to promote sustainable economic systems. The findings also provide a foundation for future research exploring these relationships in different industries, regions, and technological contexts.

Practical Implications

From a policy perspective, the study suggests that governments and relevant stakeholders should prioritize strengthening governance frameworks that actively encourage circular economy practices. Regulatory systems should be designed to facilitate innovation rather than hinder it. Organizations are encouraged to invest in research and development activities, strengthen digital capabilities, and promote a culture of collaboration and knowledge sharing. Moreover, strategic investment in digital and technological infrastructure—particularly IoT systems, big data analytics platforms, and additive manufacturing technologies—should be promoted through funding initiatives, incentives, and awareness programs. In addition, fostering societal awareness and willingness to adopt sustainable consumption and production practices is necessary to ensure long-term success of circular economy initiatives.

Limitations and direction for future research

Despite these contributions, the study has certain limitations. The use of cross-sectional data limits the ability to capture long-term causal relationships between variables. Future studies could adopt longitudinal research designs to better understand how these relationships evolve over time. Additionally, the study focuses on a limited scope of industries and contexts, which may restrict generalizability. Expanding the research to different sectors and geographical regions would provide more robust insights. Furthermore, as technological innovation continues to evolve rapidly, future research should incorporate emerging technologies and examine their role in enhancing circular economy transitions.

Reference

Adams, R., Bessant, J., & Phelps, R. (2006). Innovation management measurement: A review. International journal of management reviews, 8(1), 21-47.

AlJaber, A., Martinez-Vazquez, P., & Baniotopoulos, C. (2023). Barriers and enablers to the adoption of circular economy concept in the building sector: a systematic literature review. Buildings, 13(11), 2778.

Almaiah, M. A., Al-Rahmi, A. M., Alturise, F., Alrawad, M., Alkhalaf, S., Lutfi, A., Al-Rahmi, W. M., & Awad, A. B. (2022). Factors influencing the adoption of internet banking: An integration of ISSM and UTAUT with price value and perceived risk. Frontiers in Psychology, 13(1), 1-23.

Antikainen, M., Uusitalo, T., & Kivikyto-Reponen, P. (2018). Digitalisation as an enabler of circular economy. Procedia CIRP, 73, 45-49.

Awan, U., Shamim, S., Khan, Z., Zia, N. U., Shariq, S. M., & Khan, M. N. (2021). Big data analytics capability and decision-making: The role of data-driven insight on circular economy performance. Technological Forecasting and Social Change, 168, 120766.

Awan, U., & Sroufe, R. (2022). Sustainability in the circular economy: insights and dynamics of designing circular business models. Applied Sciences, 12(3), 1521.

Berman, B. (2012). 3-D printing: The new industrial revolution. Business horizons, 55(2), 155-162.

Bressanelli, G., Perona, M., & Saccani, N. (2017). Reshaping the washing machine industry through circular economy and product-service system business models. Procedia CIRP, 64, 43-48.

Chesbrough, H. W. (2003). Open innovation: The new imperative for creating and profiting from technology. Harvard Business Press.

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. Modern methods for business research, 295(2), 295-336.

Chishty, S. K. (2023). Economic and environmental efficiencies of organizations: role of technological advancements and circular economy practices. Sustainability, 15(22), 15935.

Corvellec, H., Stowell, A. F., & Johansson, N. (2022). Critiques of the circular economy. Journal of industrial ecology, 26(2), 421-432.

Cummings, J. L., & Teng, B.-S. (2003). Transferring R&D knowledge: the key factors affecting knowledge transfer success. Journal of Engineering and technology management, 20(1-2), 39-68.

Dahlander, L., & Gann, D. M. (2010). How open is innovation? Research policy, 39(6), 699-709.

Elisha, O. D. (2020). Moving beyond take-make-dispose to take-make-use for sustainable economy. Int. J. Sci. Res. Educ, 13(3), 497-516.

Ford, S., & Despeisse, M. (2016). Additive manufacturing and sustainability: an exploratory study of the advantages and challenges. Journal of Cleaner production, 137, 1573-1587.

Gefen, D., & Straub, D. (2005). A practical guide to factorial validity using PLS-Graph: Tutorial and annotated example. Communications of the Association for Information systems, 16(1), 5.

Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hultink, E. J. (2017). The Circular Economy–A new sustainability paradigm? Journal of Cleaner production, 143, 757-768.

Geng, Y., Sarkis, J., & Bleischwitz, R. (2019). How to globalize the circular economy. Nature, 565(7738), 153-155.

Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. Journal of Cleaner production, 114, 11-32.

Hair, J., & Alamer, A. (2022). Partial Least Squares Structural Equation Modeling (PLS-SEM) in second language and education research: Guidelines using an applied example. Research Methods in Applied Linguistics, 1(3), 100027.

Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). Partial least squares structural equation modeling (PLS-SEM) using R: A workbook. Springer Nature.

Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., Ray, S., Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2021). An introduction to structural equation modeling. Partial least squares structural equation modeling (PLS-SEM) using R: a workbook, 1-29.

Hassandoust, F., & Techatassanasoontorn, A. A. (2020). Understanding users' information security awareness and intentions: A full nomology of protection motivation theory. In Cyber influence and cognitive threats (pp. 129-143). Elsevier.

Hernandez, R. J., Miranda, C., & Goñi, J. (2020). Empowering sustainable consumption by giving back to consumers the 'right to repair'. Sustainability, 12(3), 850.

Huang, F., & Rice, J. (2009). The role of absorptive capacity in facilitating" Open innovation" outcomes: A study of Australian SMEs in the manufacturing sector. International journal of innovation management, 13(02), 201-220.

Jaeger, B., & Upadhyay, A. (2020). Understanding barriers to circular economy: cases from the manufacturing industry. Journal of Enterprise Information Management, 33(4), 729-745.

Jesus, G. M. K., & Jugend, D. (2023). How can open innovation contribute to circular economy adoption? Insights from a literature review. European Journal of Innovation Management, 26(1), 65-98.

Jia, F., Yin, S., Chen, L., & Chen, X. (2020). The circular economy in the textile and apparel industry: A systematic literature review. Journal of Cleaner production, 259, 120728.

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. Resources, conservation and recycling, 127, 221-232.

Kirchherr, J., Yang, N.-H. N., Schulze-Spüntrup, F., Heerink, M. J., & Hartley, K. (2023). Conceptualizing the circular economy (revisited): an analysis of 221 definitions. Resources, conservation and recycling, 194, 107001.

Kohler, J., Sonnichsen, S. D., & Beske-Jansen, P. (2022). Towards a collaboration framework for circular economy: The role of dynamic capabilities and open innovation. Business Strategy and the Environment, 31(6), 2700-2713.

Lam, L., Nguyen, P., Le, N., & Tran, K. (2021). The relation among organizational culture, knowledge management, and innovation capability: Its implication for open innovation. Journal of Open Innovation: Technology, Market, and Complexity, 7(1), 66.

Lee, S., Park, G., Yoon, B., & Park, J. (2010). Open innovation in SMEs—An intermediated network model. Research policy, 39(2), 290-300.

Li, D. D., & Maskin, E. S. (2021). Government and economics: An emerging field of study. Journal of Government and Economics, 1, 100005.

Lichtenthaler, U., & Ernst, H. (2009). Opening up the innovation process: the role of technology aggressiveness. R&d Management, 39(1), 38-54.

Lieder, M., & Rashid, A. (2016). Towards circular economy implementation: a comprehensive review in context of manufacturing industry. Journal of Cleaner production, 115, 36-51.

MacArthur, E. (2013). Towards the circular economy. Journal of industrial ecology, 2(1), 23-44.

McAfee, A., Brynjolfsson, E., Davenport, T. H., Patil, D., & Barton, D. (2012). Big data: the management revolution. Harvard business review, 90(10), 60-68.

Mendoza, J. M. F., Gallego-Schmid, A., Velenturf, A. P., Jensen, P. D., & Ibarra, D. (2022). Circular economy business models and technology management strategies in the wind industry: Sustainability potential, industrial challenges and opportunities. Renewable and Sustainable Energy Reviews, 163, 112523.

Mhatre, P., Gedam, V. V., Unnikrishnan, S., & Raut, R. D. (2023). Circular economy adoption barriers in built environment-a case of emerging economy. Journal of Cleaner production, 392, 136201.

Morseletto, P. (2020). Targets for a circular economy. Resources, conservation and recycling, 153, 104553.

Murray, A., Skene, K., & Haynes, K. (2017). The circular economy: an interdisciplinary exploration of the concept and application in a global context. Journal of business ethics, 140, 369-380.

Petrick, I. J., & Simpson, T. W. (2013). 3D printing disrupts manufacturing: how economies of one create new rules of competition. Research-Technology Management, 56(6), 12-16.

Rajput, S., & Singh, S. P. (2019). Connecting circular economy and industry 4.0. International Journal of Information Management, 49, 98-113.

Rennings, K., & Wiggering, H. (1997). Steps towards indicators of sustainable development: linking economic and ecological concepts. Ecological economics, 20(1), 25-36.

Sergianni, L., De Chiara, A., & Mauro, S. (2024). Open Innovation as Fuel for the Circular Economy: an Analysis of the Italian Context. Journal of Innovation Management, 12(1), 188-204.

Singh, S., Babbitt, C., Gaustad, G., Eckelman, M. J., Gregory, J., Ryen, E., Mathur, N., Stevens, M. C., Parvatker, A., & Buch, R. (2021). Thematic exploration of sectoral and cross-cutting challenges to circular economy implementation. Clean technologies and environmental policy, 23, 915-936.

Sivam, A., Dieguez, T., Ferreira, L. P., & Silva, F. J. (2019). Key settings for successful open innovation arena. Journal of Computational Design and Engineering, 6(4), 507-515.

Urbinati, A., Chiaroni, D., & Chiesa, V. (2017). Towards a new taxonomy of circular economy business models. Journal of Cleaner production, 168, 487-498.

Van de Vrande, V., De Jong, J. P., Vanhaverbeke, W., & De Rochemont, M. (2009). Open innovation in SMEs: Trends, motives and management challenges. Technovation, 29(6-7), 423-437.

West, J., & Gallagher, S. (2006). Challenges of open innovation: the paradox of firm investment in open-source software. R&d Management, 36(3), 319-331.

West, J., Salter, A., Vanhaverbeke, W., & Chesbrough, H. (2014). Open innovation. Open Innovation Community.

Assessing the Impact of Corporate Governance and TQM on Service Quality in the Telecom Sector

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Keywords
Total Quality Management, Corporate Governance, Telecommunication, Company, Service Quality.

Abstract

The objective of this study is to assess the impact of corporate governance and TQM on service quality in the telecom sector. The study relied on questionnaires as survey instruments to gather data on corporate governance and TQM on service quality. A self-completion questionnaire was administered to customers, employees, and management of MTN Ghana, Telecel Ghana, and AT Ghana. There were 800 respondents from both companies' customers, employees, and management, although 850 questionnaires were administered using the structural equation model (SEM). The collected data were analyzed, and conclusions were derived from the study results. The key finding states that corporate governance and Total Quality Management significantly impact service quality. It is also concluded that the key practices of corporate governance and TQM positively influence employee engagement and equipment & materials, respectively, which positively influence service quality. Moreover, employee engagement and equipment & materials have been identified as significant mediating variables of corporate governance and TQM in achieving service quality in the telecommunication companies in Ghana.

Introduction

In order to link individuals and facilitate global communication, the telecommunications sector is essential. Telecommunications firms face the challenge of providing their consumers with exceptional service experiences due to the rapid improvements in technology, the growing demand for high-quality services, and fierce competition (Sacco, 2020). The methods, procedures, and frameworks that control how a company's board of directors and management behave and make decisions are referred to as corporate governance. It includes the values and procedures that guarantee openness, responsibility, and moral behavior inside the company.

Likewise, the management strategy known as overall quality management places a strong emphasis on staff engagement, customer happiness, and ongoing improvement (Ababneh, 2021). By emphasizing process optimization, quality control, and customer input, TQM seeks to improve the caliber of goods and services. In the telecom sector, TQM procedures help to improve customer happiness, lower mistakes, and provide better services (Ghodke, 2021). Research and attention have been focused on the connection between service quality, TQM, and corporate governance in the telecom sector. Research has examined how corporate governance practices—such as CEO salary, board composition, and ethical standards—affect the results of service quality (Rezaee & Safarzadeh, 2023). According to the results of the literature currently under publication, telecom businesses' service quality is positively impacted by good corporate governance procedures.

The objectives of this study are:

(1) To assess the impact of corporate governance and total quality management (TQM) on service quality in the telecommunication sector.
(2) To examine the mediating effects of employee engagement and equipment & materials on corporate governance, TQM, and service quality in the telecommunication sector.

(3) To provide practical recommendations for telecommunication companies on optimizing corporate governance practices and enhancing TQM implementation to improve service quality.

The following are the researcher's questions at the end of the study.

(1) What impact do corporate governance and TQM have on service quality in the telecommunication sector?
(2) What role do employee engagement and equipment & material play in the relationship between corporate governance, TQM, and service quality in the telecommunication sector?
(3) What are the practical recommendations for telecommunication companies on optimizing corporate governance practices and enhancing TQM implementation to improve service quality?

Literature Review And Theoretical Concepts

Researchers, academics, managers, supervisors, governments, business organizations, etc. frequently mention corporate governance, a worldwide phenomenon (Mallin, 2019). Nevertheless, they usually fail to define corporate governance. Consequently, corporate governance may imply many different things. Different people have different and vague definitions of corporate governance (Shu & Chiang, 2020). There is still no widely accepted definition or demonstrated unified concept of corporate governance, despite much research. This is due to the fact that the varied or multicultural social systems of various countries have a significant impact on corporate or institutional governance. The set of guidelines, procedures, and policies that regulate how a company is run is known as corporate governance (Solomon, 2020).

Theories of Corporate Governance

The function of the board of directors in providing the firm with the resources it requires is the main emphasis of resource dependency theory (Oliveira, Kakabadse, & Khan, 2022). Furthermore, they claim that resource dependency theory focuses on the role directors play in obtaining or providing essential resources to a company through their external relationships. It is true that representatives of independent organizations ought to be nominated in order to have access to the resources required for the growth of a corporation. This concern is emphasized by resource dependency theorists. According to (Larcker & Tayan, 2020), directors provide the business credibility and resources, including knowledge, experience, and connections to key stakeholders like suppliers, buyers, legislators, and social groups.

Since its incorporation into the field of management in 1970, stakeholder theory has grown to encompass accountability to a broad range of stakeholders (Dmytriyev, Freeman, & Hörisch, 2021). The organizational and social domains were combined to develop stakeholder theory. In fact, rather than being a formal, unified theory, stakeholder theory incorporates philosophy, ethics, political theory, economics, law, and organizational science. "Any group or individual who can affect or is affected by the achievement of the organization's objectives" is how stakeholders are defined. Stakeholder theory theorists assert that managers in businesses have a network of relationships to watch out for, including those with suppliers, customers, and business partners. In addition to the owner-manager-employee connection, this network is said to be important (Guilaire, Nicaise, ESSONO BELLA, & Achile, 2024).

Businesses have broader societal objectives than just boosting shareholder wealth, according to the Stewardship Theory, which forms the basis of the stewardship thesis (Gordon, 2021). According to this theory, enterprises are social structures that affect the welfare of multiple stakeholders. Stakeholders are organizations or people who interact with a business, influence its objectives, or are affected by them. Success is measured by an organization's ability to deliver value to all of its stakeholders. Some scholars contend that the environment is a significant stakeholder. Stakeholders have legal and ethical rights and can play a significant role in a company's success (Stahl, Brewster, Collings, & Hajro, 2020).

According to the stewardship hypothesis, a company's board of directors and CEO, acting as stewards, should be driven to act in the company's best interests rather than their self-interests; this is because, over time, senior executives tend to view a firm as an extension of themselves (Shaikh, Drira, & Hassine, 2019). The stewardship idea contends that a company's senior management is more concerned with the long-term prosperity of the company.

Agency theory defines the relationship between the principals (like the firm's shareholders) and the agents (like the Directors of the company) (Jensen & Meckling, 2019). According to this theory, the owners of the business hire the agents to complete tasks. The principles provide the responsibility of running the business to the directors or managers, who act as the representatives of the shareholders. The agents' actions and decisions are expected to be in the best interests of the principal by the shareholders. Conversely, the agent is not obligated to act in the best interests of the principal while making judgments. The agent could fail to meet the principal's expectations due to self-interest and opportunistic behavior. The core idea of agency theory is the separation of ownership and control. According to the principle, individuals or workers should be held accountable for their duties and commitments. Agents' priorities can be adjusted through rewards and penalties (Gupta, Chaturvedi, Prasad, & Ananthi, 2022).

The Theories of TQM

Deming identified the Shewart Cycle (Plan-Do-Check-Act) and the system of profound knowledge, which form the foundation of his theory of Total Quality Management (TQM). Deming is well-known for his ratio, which states that quality is equal to the sum of the costs and the results of labor. The issue is that when a business focuses on expenses, quality declines, and costs increase (N. M. Agrawal, 2019). The Plan-Do-Check-Act (PDCA) cycle was developed for ongoing enhancement. Actions and goals are delineated at the planning stage.

Another individual who is recognized for having initiated the TQM movement is Philip Crosby (N. Agrawal, 2020). Like Deming, he emphasized the importance of quality as an investment that is worthwhile. Crosby based his list of fourteen steps to quality improvement on his four absolutes of quality management. According to Crosby, "quality is free." It's free, but it's not a gift.

The "Quality Trilogy" as it has come to be known was created by Joseph Juran. Quality planning, quality improvement, and quality control comprise the quality triad (Chisty & Adusumalli, 2022). All quality improvement activities need to be meticulously thought out and managed if a project is to succeed. Juran, noted several expenses related to product distribution and manufacturing. He proposed a three-pronged strategy based on projects, control, and an annual quality program to reduce costs. Juran, emphasized the importance of the human element, the understanding of which is essential for solving technical problems (N. Agrawal, Rabiee, & Jabbari, 2023).

Nine quality management principles form the basis of the European Foundation for Quality Management (EFQM) Model (Heydari, Lai, & Xiaohu, 2019). There are four results (criteria covering what a firm accomplishes) and five (criteria covering the foundation of what a company does). The result is a paradigm that acknowledges diversity management approaches rather than recommending any particular approach.

The graphic that bears Dr. Kaoru Ishikawa's name is well-known. Nevertheless, he also created a philosophy that outlines how businesses should manage their quality improvement initiatives. Ishakawa examines quality from a human perspective. He notes that there are seven fundamental tools for improving quality. According to Ishikawa, customers should be satisfied with the quality of goods or services at the lowest possible cost (Antony, McDermott, & Sony, 2021). He advocated participation by all to realize the quality goals. He emphasized the need for all employees to know the seven basic tools of quality.

In order to avoid producing defective goods, quality control was implemented to identify and address issues along the production line. In this field, statistical theory was crucial. Dr. W. Shewhart, created statistical techniques for quality management in the 1920s (Montgomery, 2020). He created the first contemporary control chart and proved that changes in the production process result in changes in the final product. As a result, removing process variation results in high-quality final products.

Merging Corporate Governance and TQM

The collapse of well-known business giants like Enron brought the importance of ethical and sound corporate governance home more than ever before (Rebeiz, 2024). But can strong corporate governance alone satisfy investors in a business that has been struggling because of fraudulent threats, bad management, and a lack of accountability in the boardroom? Organizations may only fully benefit from

strong corporate governance if they also strive for business excellence. A best practice model for business excellence that pleases stakeholders, customers, and regulators can be created by combining the complementary ideas of ethical corporate governance and total quality management (Neri, Pinnington, Lahrech, & Al-Malkawi, 2019). Although providing exceptional customer service has always been a top concern for businesses, this is no longer sufficient. They now have to take it a step further and provide them even more than they expect. Quality management systems are primarily responsible for improving customer service. In the interim, corporate governance and stakeholders' interests have garnered international attention after the collapse of Enron and other major companies, including WorldCom, Tyco, and Parmalat, as well as the establishment of numerous new regulatory requirements (Markham, 2022).

Literature Review Summary

Six TQM theories and four important corporate governance theories serve as the primary guiding principles for this study. The resource dependency, stakeholders, agency, and stewardship theories in corporate governance, although leaning more toward the latter. The emphasis of resource dependence theory is on management's role in establishing connections to both internal and external contexts. The stewardship theory incorporates significant elements of philosophy, ethics, politics, economics, legal theory, and organizational science.

The theories of TQM: Deming's theory, Crosby's theory, Joseph's theory, the European Foundation for Quality Management, Ishikawa's theory, and Quality Control and Statistical theory are accepted ones. Deming's theory focuses on a known ratio- Quality is equal to the result of work efforts over the total costs. If a company is to focus on costs, the problem is that costs rise while quality deteriorates. This theory is a good plan to ensure absolute TQM application. Crosby also made the same points as Deming. While Joseph Juran's theory talks of quality planning, quality improvement, and quality control.

Conceptual Framework And Development Of Hypothesis

The conceptual framework suggests that corporate governance practices and TQM practices serve as independent variables that directly influence service quality. Corporate governance practices, such as board structures, board composition, and ethical conduct, are expected to have a direct impact on service quality. Similarly, the implementation of TQM practices, including quality control, process improvement, and employee empowerment, is expected to influence service quality outcomes directly.

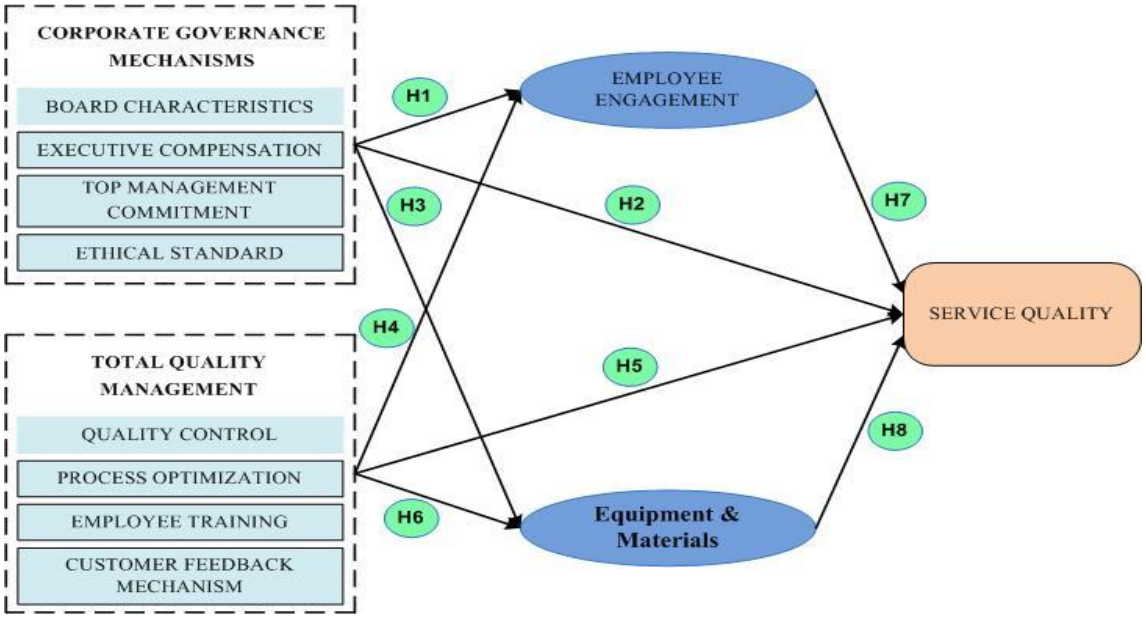


Figure 3. 1: Conceptual operative framework
Source: Author's Design

Hypothesis Development

Three sets of hypotheses are examined in this sector. These are:

(1) Research Hypothesis I (H1, H2, H3): Corporate Governance, Employee Engagement and Equipment & Materials on Service Quality Outcomes

H1: Corporate governance practices have a positive impact on employee engagement in the telecommunication industry.

H2: Corporate governance practices have a positive impact on service quality in the telecommunication industry.

H3: Corporate governance practices have a positive impact on equipment & materials in the telecommunication industry.

(2) Research Hypotheses II (H4, H5, H6): TQM, Employee Engagement and Equipment & Materials on Service Quality

H4: Total quality management (TQM) practices positively influence employee engagement in the telecommunication industry

H5: Total quality management (TQM) practices positively influence service quality in the telecommunication industry.

H6: Total quality management (TQM) practices positively influence equipment & materials in the telecommunication industry.

(3) Research Hypothesis III (H7, H8): Effect of Employee Engagement and Equipment & Materials on Corporate Governance, TQM and Service Quality Outcomes

H7: Employee engagement mediates the relationship between corporate governance and service quality in the telecommunication industry.

H8: Equipment and materials mediate the relationship between total quality management (TQM) and service quality in the telecommunication industry.

Corporate Governance Mechanisms

Corporate governance is the framework of regulations and procedures that determines how the board of directors manages a company (Merendino & Melville, 2019). It includes balancing the interests of the stakeholders in a company, including shareholders, senior executives, customers, suppliers, financial intermediaries, the government, and the community. It helps establish who has power and accountability and who makes decisions. The goal of governance is to facilitate effective, entrepreneurial, and prudent management that helps the company achieve long-term success. Based on the above review, hypotheses H1, H2, and H3 are developed.

Total Quality Management Mechanisms

TQM can be summarized as a management system for a customer-focused organization that involves all employees in continual improvement (Helmold, 2023). It uses strategy, data, and effective communications to integrate quality discipline into the culture and activities of the organization. Many of these concepts are present in modern quality management systems, the successor to TQM. Here are the eight principles of total quality management:

Based on the above review, the hypotheses H4, H5, and H6 are developed.

Employee Engagement

Employee engagement is the strength of the mental and emotional connection employees feel toward the work they do, their teams, and their organization (Clack, 2021). Highly engaged employees hold very favorable opinions of their place of work. When employees feel connected to their teams, love their jobs, and have positive feelings about your organization, they are going to want to stay and put in extra effort to help the organization succeed. These "brand advocates" speak highly of their company to family and friends.

Based on the above review, the hypothesis H7 is developed.

Equipment & Materials

Equipment & Materials means all components (aside from labor) required or appropriate for the pursuit and completion of all aspects of the Contract Work, including materials, manufacturing, manufacturing plants and facilities, storage containers, storage space, warehouses, warehouse space, tools, supplies, schedules, scaffolds, appliances, equipment, utilities, photographs, surveys, permits, licenses, training, transportation, and all other items. In the fields of engineering and production, materials and equipment are two distinct ideas (Black & Kohser, 2020). Materials are the unprocessed substances or mixtures that are used to build things, whereas equipment is the apparatus and tools that are used to process, move, or work with those materials.

Based on the above review, hypothesis H8 is developed.

Service Quality

Modern service marketing theory places a strong emphasis on quality enhancement and adherence to accepted standards of quality (Schiavone, Pietronudo, Sabetta, & Ferretti, 2023). Because it reinforces the idea that the value of the service received exceeds the price paid for it, high-quality service delivery leads to customer satisfaction and retention. High Service quality greatly increases profitability, according to research. Providing what consumers desire, both internal and external, is what service excellence is all about. After using a product or service, a customer's attitude or feeling toward it is known as customer satisfaction, which is a function of the customer's perceptions and expectations. Satisfaction and service quality are frequently treated in tandem. By identifying the consumer's expectations, perceptions of quality, and preferences, customer satisfaction can be calculated .(Rane, Achari, & Choudhary, 2023)

Methodology

SEM model was used in the study as a result. The model was chosen for the analysis of causal linkages in scientific research due to the variations in their configurations. The structural equation model (SEM) is categorized as the second generation. The research hypotheses, which intended to investigate the effects of corporate governance and TQM on the services offered by telecom businesses, were tested using the structural equation model (SEM). The exogenous variables are used to model the variations and covariance of the endogenous variables.

$$\begin{bmatrix} y_1 \\ \dots \\ y_p \end{bmatrix} = \begin{bmatrix} 0 & \dots & \beta_{1p} \\ \dots & \dots & \dots \\ \beta_{p1} & \dots & 0 \end{bmatrix} \begin{bmatrix} y_1 \\ \dots \\ y_p \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \dots & \gamma_{1q} \\ \dots & \dots & \dots \\ \gamma_{p1} & \dots & \gamma_{pq} \end{bmatrix} \begin{bmatrix} x_1 \\ \dots \\ x_q \end{bmatrix} + \begin{bmatrix} \zeta_1 \\ \dots \\ \zeta_p \end{bmatrix}$$

$$y = \beta_y + \Gamma x + \zeta$$

The causal parameters from the above matrix are represented by γ's and β's, including their corresponding subscripts. The γ's denote the parameter estimates of the exogenous variables, while β's represent the parameter measurements of the endogenous variables. The p by q matrix Γconsists of coefficients of the y's on the x's, whereas the error vector,ζ, is p by 1.

Findings And Discussion

As seen in Table 1, the author had four latent/implicit variables: Corporate Governance (F1), TQM (F2), Employee Engagement (F3), Equipment and Materials (F4), and Service Quality (F5). For Corporate Governance (F1), its observable/explicit variables are Board Characteristics (CGOV1), Executive Compensation (CGOV2), Top Management Commitment (CGOV3), and Ethical Standards (CGOV4). Concerning TQM (F2), the factors are Quality Control (TQUA1), Process Optimization (TQUA2), Employee Training (TQUA3), and Customer Feedback Mechanism (TQUA4). The Employee Engagement (F3) has Allowances (EMPG1) and Study Grants (EMPG2) as its observable/explicit variables. In addition, concerning Equipment & Materials (F4), the factors are Quality equipment (EQPM1) and Quality Materials (EQPM2). The factors for Service Quality (F4) are Poor Service Prevention (SQUA1) and Effective Complaint Handling (SQUA2).

Table 1: Selected Latent and Observable Variables

Latent / Implicit variables	Observable / Explicit variables
Corporate Governance (F1)	Board Characteristics (CGOV1)
	Executive Compensation (CGOV2)
	Top Management Commitment (CGOV3)
	Ethical standard (CGOV4)
TQM (F2)	Quality Control (TQUA1)
	Process Optimization (TQUA2)
	Employee Training (TQUA3)
	Customer Feedback Mechanism (TQUA4)
Employee Engagement (F3)	Allowances (EMPG1)
	Study Grants (EMPG2)
EQPM (F4)	Quality Equipment (EQPM1)
	Quality Materials (EQPM2)
Service Quality (F5)	Poor Service Prevention (SQUA1)
	Effective Complaint Handling (SQUA2)

Results and Analysis

Table 2 shows that all of the variables passed the Cronbach's Alpha test with values more than 0.70, and all of the AVEs in this study had values over 0.50. Therefore, the data in this study had satisfactory reliability and convergent validity for the investigation. Composite reliability (CR) demands that outputs should be more than 0.70 (Fornell and Larcker, 1981). However, the discriminant validity test (CR) measured between 0.891 and 0.919 for all the constructs (Table 2), showing excellent reliable figures.

Table 2: Factor loadings, Cronbach's Alpha, AVE, and CR of the variables

Construct	Indicator	Factor Loading	Cronbach's Alpha	AVE	CR	Reliability / Validity Tests
Corporate Governance	CGOV1	0.789	0.913	0.741	0.919	Established
	CGOV2	0.902				
	CGOV3	0.785				
	CGOV4	0.956				
Total Quality Management	TQUA1	0.801	0.876	0.651	0.881	Established
	TQUA2	0.897				
	TQUA3	0.799				
	TQUA4	0.721				
Employee Engagement	EMPG1	0.739	0.782	0.634	0.775	Established
	EMPG2	0.850				
Equipment & Materials	EQPM1	0.911	0.890	0.815	0.898	Established
	EQPM2	0.894				
Service Quality	SQUA1	0.887	0.905	0.803	0.891	Established
	SQUA2	0.905				

Model fit statistics

The estimation of the model fitness, which demonstrates how well the given model replicates the observed covariance matrix among the indicator items, is shown in Table 3. Various indices relied on are Chi-square, $\chi 2$ (CMIN), Degrees of Freedom (DF), the Goodness of Fit Index (GFI), the Normed Fit Index (NFI), the Tucker-Lewis Index (TLI), the Comparative Fit Index (CFI), the Adjusted Goodness of Fit Index (AGFI), and the Root Mean Square Error of Approximation (RMSEA).

Table 3: Measures of the Model Fitness

FIT STATISTICS	RECOMMENDED RANGE	STRUCTURAL MODEL
Chi-square, $\chi 2$ (CMIN)	-	52.428
Degrees of Freedom (DF)	-	31
$\chi 2$ Significance	Significant ($p \leq 0.05$)	0.001
$\chi 2$ / DF	< 5.0	1.350
Goodness of Fit Index (GFI)	> 0.90	0.922
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.957
Normed Fit Index (NFI)	> 0.90	0.932
Relative Fit Index (RFI)	> 0.90	0.929
Incremental Fit Index (IFI)	> 0.90	0.970
Tucker Lewis Index (TLI)	> 0.90	0.959
Comparative Fit Index (CFI)	> 0.90	0.974
Root Mean Square Error of Approximation (RMSEA)	≤ 0.05	0.031

From Table 3, the overall model fitness of this study was found to be suitable. Even though the model seems good, it is also proper to check the value of Chi-square, $\chi 2$ divided by Degrees of Freedom (DF), since $\chi 2$ statistic is generally sensitive to the sample size. However, $\chi 2$ divided by DF is suggested as a better fit. From Table 3, $\chi 2$ / DF was 1.350 (which is less than the threshold, 5.0), signifying an acceptable model fit. The model also exhibited a high significance level (.001). With recommended cut-offs for various indices pegged at 0.90, the study produced 0.922, 0.957, 0.932, 0.929, 0.970, 0.959, and 0.974 for GFI, AGFI, NFI, RFI, IFI, TLI and CFI respectively as found in Table 3. However, all the indices were known to be acceptable within the recommended range, which is indicative of a good fit.

Table 4: Results of R2 and Q2

Small: 0.0 < Q^2 effect size < 0.15; Medium: 0.15 < Q^2 effect size < 0.35; Large: Q^2 effect size > 0.35

	R^2	Q^2	Effect Size
Employee Engagement	0.852	0.403	Large
Equipment & Materials	0.981	0.436	Large
Service Quality	0.582	0.384	Large

Small: 0.0 < Q^2 effect size < 0.15; Medium: 0.15 < Q^2 effect size < 0.35; Large: Q^2 effect size > 0.35

In the study, the R^2 values of the endogenous variables such as Employee Engagement, Equipment and Materials, and Service Quality are 0.852, 0.981, and 0.572, respectively. These R^2 values measure the predictive accuracy of the model, and they are used to assess the structural model. The R^2 values denote the combined effects of the exogenous variables on the endogenous latent variables. It epitomizes the amount of variance in the endogenous constructs explained by the exogenous construct (s) related to them. The R^2 value of Service Quality (dependent variable) for this study is 0.572. The study indicates that the amount of variance, 57.2%, in the endogenous constructs is explained by the entire exogenous construct (s) connected to it. However, the amount of variance in Employee Engagement and Equipment and materials explained by the entire exogenous construct (s) linked to them happened to be 85.2% and 98.1%, respectively. The study shows that the structural model developed in this study has realistic predictive power and significance. According to Table 4, the R^2 values were high (between 80 and 100 percent), demonstrating that the endogenous variables' predictive power was strong.

The Q^2 values of Employee Engagement, Equipment and Materials, and Service Quality are 0.403, 0.436, and 0.384, respectively. As the R^2 values signify the predictive accuracy of the model, Q^2 figures show the predictive relevance of the model. The Q^2 values, also known as 'Stone-Geisser's Q^2 value', demonstrate the path model's predictive relevance for the endogenous latent variables. From Table 4, the Q^2 produced values between 0.403 and 0.436, which are all greater than 0.384. The study indicates that the

path model's predictive relevance for the endogenous latent variables is high. The study results show large effect sizes for Employee Engagement, Equipment and materials, and Service Quality. The study establishes the fact that the structural model for the study has predictive relevance.

Parameter estimation

The model's statistically distributed parameter estimates to standard errors are significant at the 0.05 level of their value. According to Table 5, the model's parameter connections were all extremely significant.

Table 5: Regression Weights

Parameter Relationships			Estimate	Lower	Upper	P	Sig
CGOV1	<---	F1	0.789	0.724	0.854	0.001	***
CGOV2	<---	F1	0.906	0.871	0.941	0.000	***
CGOV3	<---	F1	0.785	0.705	0.864	0.002	***
CGOV4	<---	F1	0.945	0.898	0.991	0.003	***
TQUA1	<---	F2	0.811	0.805	0.816	0.001	***
TQUA2	<---	F2	0.886	0.829	0.942	0.000	***
TQUA3	<---	F2	0.797	0.743	0.851	0.001	***
TQUA4	<---	F2	0.711	0.651	0.771	0.002	***
EMPG1	<---	F3	0.747	0.701	0.793	0.004	***
EMPG2	<---	F3	0.845	0.778	0.912	0.003	***
EQPM1	<---	F4	0.917	0.893	0.940	0.000	***
EQPM2	<---	F4	0.890	0.819	0.961	0.001	***
SQUA1	<---	F5	0.886	0.668	1.104	0.002	***
SQUA2	<---	F5	0.906	0.695	1.117	0.000	***

Depending on the units in which the variables are related, regression weights in the model were assessed. The selection of identification restrictions has no impact on the regression weights and correlations since they are independent of the units in which the research variables are assessed. Table 5 shows that estimates for the model's routes gave strong findings for the links between the parameters. As seen in Table 5, CGOV1 ---> F1 is 0.789, CGOV2 ---> F1 is 0.906, TQUA1 ---> F2 is 0.811, TQUA2 ---> F2 is 0.886, EMPG1 ---> F3 is 0.747, EMPG2 ---> F3 is 0.845, EQPM1 ---> F4 is 0.917, EQPM2 ---> F4 is 0.890 while SQUA1 ---> F5 is 0.886 and SQUA2 ---> F5 is 0.906. The magnitudes of path coefficients were larger, indicating high effects. The paths for all the relationships were highly significant ($p < 0.005$).

Path Analysis of the Structural Equation Model

The pathway diagram (Figure 5.1) shows the impact of corporate governance and TQM on service quality. The features of corporate governance are Board Characteristics (CGOV1), Executive Compensation (CGOV2), Top Management Commitment (CGOV3), and Ethical standard (CGOV4) on Service Quality, which also consists of Poor Service Prevention (SQUA1) and Effective Complaint Handling (SQUA2). This influence is mediated by Employee Engagement, which is made up of Allowances (EMPG1) and Study Grants (EMPG2) to improve service quality. The features of TQM are Quality Control (TQUA1), Process Optimization (TQUA2), Employee Training (TQUA3), and Customer Feedback Mechanism (TQUA4) on service quality (Poor Service Prevention (SQUA1) and Effective Complaint Handling (SQUA2)). This influence is mediated by Equipment and Materials that consist of Quality Equipment (EQPM1) and Quality Materials (EQPM2) to improve service quality.

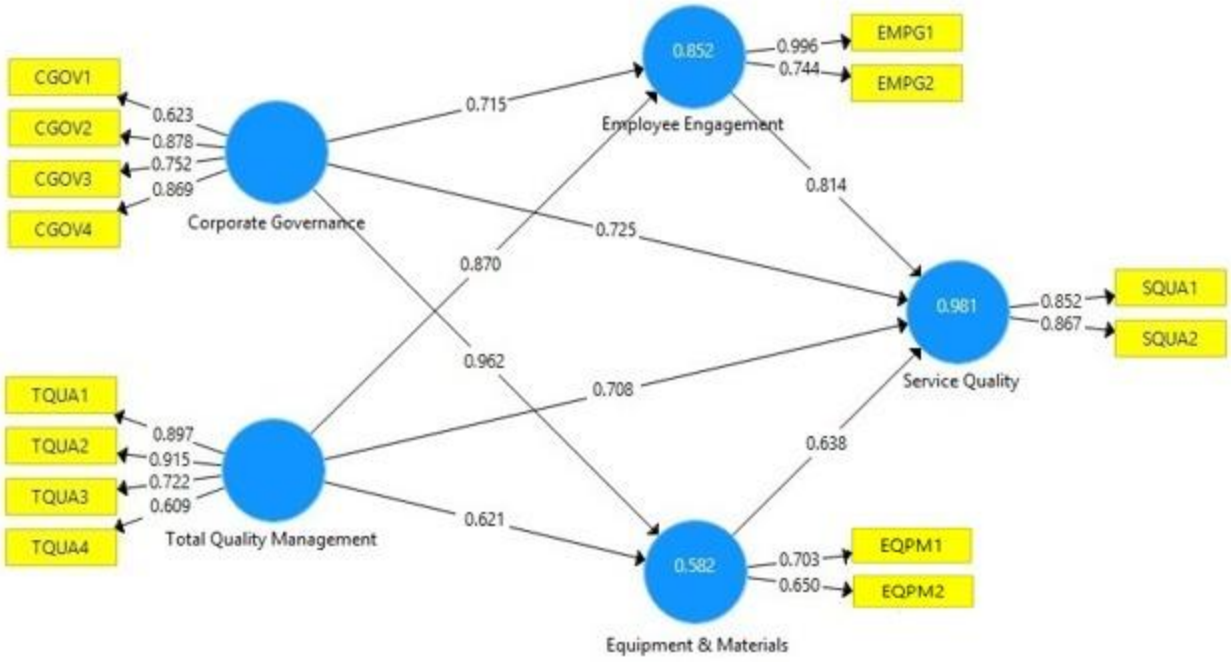


Figure 2: Structural model showing cross-loadings and path coefficients in the constructs.
Source: Author's design

Figure 2 shows the structural model evaluation used to determine how endogenous and exogenous factors relate to one another. Path coefficients are included in the evaluation to calculate the importance of the connections in the structural model and to determine the significant influence of an exogenous variable on an endogenous variable. Figure 2, Corporate Governance is related positively to Employee Engagement, Service quality, and Equipment and Materials, which supports H1, H2, and H3 (Figure 2). The figures produced through the influence of those mentioned above implicit (latent) variables are 0.715, 0.725, and 0.962, respectively. Therefore, the telecom industry must embrace Corporate Governance and ensure that facility rules, guidelines, and policies are adhered to because Corporate Governance has a direct and positive impact on Employee Engagement, Service Quality, and Equipment and Materials, this conforms with (Fatmawatie & Endri, 2022). In addition, following H7, it was established that Employee Engagement has a positive effect on Service Quality (0.814). Equipment and materials have a positive influence on the Service Quality, supporting H8. It signifies that Service Quality can be enhanced when Employee Engagement and Equipment and materials are improved. The results are consistent with the study of (Prentice, Wang, & Loureiro, 2019), which established a positive effect of Employee Engagement and Equipment & Materials on Service Quality. However, the path coefficient value of the Equipment & Materials to Service Quality (0.638) is somewhat lower than other paths, which indicates that telecom companies should also place more emphasis on equipment and materials while considering service quality.

In Figure 2, the cross-loadings between the latent and observable variables exhibited high scores except for Board Characteristics in corporate governance and Customer Feedback Mechanism in TQM, which recorded 0.623 and 0.609, respectively. Cross-loadings allow comparison of correlation among factors. The measurement of cross-loadings has to be more than 0.7 (Yusoff, Peng, Abd Razak, & Mustafa, 2020). The constructs of this study achieved the inference criteria, whereby the outer loading happened to be higher than 0.70. The study reasonably produced cross-loadings between 0.725 and 0.915. For instance (as displayed), the cross-loading between Service Quality and F1 and F2 were 0.708, respectively, which signifies that the constructs have strong relationships with their indicators.

Mediation Analysis

The research model has two mediation effects: the influences of Employee Engagement and Equipment and materials (Figure 2). Employee Engagement is mediated through Corporate Governance to Service Quality. Similarly, TQM and Service Quality are mediated by Equipment and materials. Corporate governance has a direct effect on employee engagement and Equipment and Materials with values of 0.715 and 0.962, respectively; this means that there is a mediation. However, TQM has a direct effect on employee engagement and equipment & materials with 0.870 and 0.621, respectively, and this also shows that there is a full mediation. There is also a direct effect of 0.814, which tells a full mediation from employee engagement to service quality, which also means that there is a direct effect of employee engagement on service quality. In addition, there is a direct effect of 0.638 from equipment & materials to service quality, which also means there is a full mediation and shows that equipment & materials have a direct effect on service quality.

The study used Baron and Kenny's (1986) method for testing mediation analysis. In this method, the independent variable (Corporate Governance and TQM) must predict the dependent variable (Service Quality), and the independent variable must predict the mediators (Employee Engagement and Equipment and Materials). In this study, mediation is tested through three regressions:

- Corporate Governance and TQM are predicting the service quality.
- Corporate Governance and TQM predicting Employee Engagement and Equipment & Materials.
- Corporate governance and TQM, employee engagement, equipment, and materials predict service quality.

Hypotheses Testing

The outcomes of this study's empirical research support hypothesis H1 by showing that there is a beneficial association between corporate governance and employee engagement. Previous research has supported the notion that corporate governance affects employee engagement. A research work by Afriyie, 2019, shows a positive relationship between Corporate Governance and employee engagement that is similar to the results of this study. The results of this study also indicate that corporate governance relates positively to service quality; therefore, H2 is accepted. Effective corporate governance structure helps organizations to improve their quality drive, which then boosts the service quality of the firm. The outcome of this study is similar to the investigation done by Adel & Christine 2019, indicating that there is a positive relationship between corporate governance and service quality.

The experimental results demonstrate that there is a positive relationship between corporate governance and Equipment and materials. Correspondingly, the researcher accepts the postulation H3. This study accepts the hypothesis that corporate governance exerts a positive influence on Equipment and materials. Researchers such as Sofyani, H., Riyadh,2020, agreed that corporate governance relates positively to Equipment & Materials. The study conducted by the researcher shows that TQM positively affects employee engagement. Therefore, the hypothesis, H4, set for the research is accepted. The evidence supports the assertion that employee engagement is enhanced when TQM is improved. The finding is confirmed by a study done by Cavallone et al., in 2022. The empirical investigation provided in this study establishes that there is a positive relationship between TQM and service quality, and thus, H5 is accepted. TQM positively influences service quality (prevention of poor service, proper handling of customer complaints, and growth in sales) of organizations. This study is confirmed by earlier work done by Zaid, et al., 2020, signifying that TQM has a positive relationship with organizational service quality. Does TQM affect Equipment and materials? This study's results reveal that TQM has a positive relationship with equipment & materials. However, the investigator deems it fit to accept H6. If TQM is improved, it has a positive repercussion on equipment & materials, which shows that elements of TQM positively affect equipment & materials.

The finding is analogous to the research executed by Abror & Patrisia,2020. Employee engagement has a positive influence on service quality. Thus, H7 is also accepted. When employees are engaged on the job for quite a long, they give their best based on the experience acquired over a long period. A study by Jenkins, N. A. (2020), confirms this assertion. Equipment and materials, then again, have a positive influence on service quality. When equipment & materials are in good condition, it shows in the quality of

services rendered. The findings realized by Ramya, & Dharanipriya. (2019), clarified equipment & materials through service quality.

Table 5: Summary of hypotheses

	Hypothesis	Conclusion
H1	Corporate governance has a positive influence on employee engagement	Supported
H2	There is a positive relationship between corporate governance and service quality.	Supported
H3	Corporate governance positively affects equipment & materials	Supported
H4	TQM exerts a positive influence on equipment & materials	Supported
H5	TQM has a positive effect on service quality.	Supported
H6	A positive relationship exists between TQM and employee engagement.	Supported
H7	Employee engagement has a positive influence on service quality	Supported
H8	There exists a positive relationship between equipment & materials and service quality.	Supported

Summary

By enabling the application of fundamental concepts that will promote the prosperity of the telecom sector and its clients, corporate governance and TQM are successful in raising the quality of the services offered by telecom enterprises. Good telecom governance provides strategic directions so that the board, CEO, and management may avoid responsibility, accountability, probity, honesty, and integrity while attaining telecom goals. Better service quality is expected when the telecom sector abides by good governance principles, which will demonstrate that, as long as telecom industry stakeholders have good governance systems in place, the goal of eliminating subpar services and effectively addressing complaints may be accomplished. In this study, corporate governance standards are successfully communicated to prevent poor service and appropriately handle complaints.

Additionally, all staff members are required to cautiously assess the corporate governance system's effectiveness to see whether substandard services are avoided and complaints are appropriately handled. The telecom personnel must periodically distribute customer complaint forms to analyze customer feedback on service quality. These directives given to telecom employees are focused on control efforts (preventive, investigative, and remedial) to avoid or lessen poor service quality and to handle complaints effectively.

However, attracting customers to the telecom business depends on its TQM. Users could then easily join their favorite telecom provider whenever they wished to join a network. Since clients could always rely on the quality of the service to TQM practices being monitored, there would be less advertising. Additional customers subscribe to a certain telecom network because of the telecom provider's strong TQM services. Several telecom companies in Ghana have carved out a space for themselves by offering clients innovative, creative, and stand-out services. Telecom companies have also established call centers so that users may contact the network provider in the event of a network outage. In addition, the clients are questioned about the quality of the service they receive from the telecom firm when they contact the call centers. Customers feel somewhat relieved and proud to be valued customers of the telecom provider as a result.

Service quality has been proven to be significantly influenced by employee engagement. It is thought that long-term employees gain valuable experience that improves the quality of the services they offer while employee fatigue is monitored. Long-term personnel are better equipped to handle the challenging problems that the telecom company faces. Equipment and materials are also factors in determining the quality of a service. When equipment and materials are in good condition, service quality can be easily achieved.

Conclusion

Based on the research findings, effective implementation of TQM practices in telecommunication companies is critical for leadership effectiveness and service quality, as well as the survival of telecommunication companies in Ghana. However, efficient management leads to service quality enhancement; therefore, it is important to place more prominence on TQM practices to improve

organizational service quality. According to the investigation, TQM practices such as quality control, process optimization, employee training, and customer feedback mechanisms implemented by telecommunication companies yield significant results for the firm's service quality.

Nonetheless, some criticisms are received from clients, which shows that TQM practices must be boosted to address their clients' grievances. The major reasons for customers' grievances are intermittent network interruptions, unaddressed complaints, and mobile money fraudsters and hackers, which affect the operational activities of these telecom operators and the quality of service rendered. Therefore, top management must be up to their game of ensuring effective practices of TQM at all levels of the organization. However, board characteristics, executive compensation, top management commitment, and ethical standards were seen as corporate governance mechanisms that influence service quality.

In addition, the top management also associated part of their inabilities with the lack of quality equipment. Telecommunication managers in Ghana believe that a large amount of money must be channeled through the procurement of high-value telecom equipment through the board as resource dependency theory is applied in Ghanaian telecommunication companies, and must therefore be protected to have a smooth system to monitor the daily operations of the business, as there is a need to focus more on ensuring client contentment through successful corporate governance and TQM implementation. The reason that corporate governance and total quality management are widely recognized as critical instruments for Telecom Company's long-term success, it is unfortunate that clients expect rapid results, making long-term accomplishments a source of dissatisfaction. Nonetheless, when top management is committed to their work, service quality will be achieved by the Ghanaian telecom companies. However, the needs and prospects of these stakeholders should be balanced to forestall satisfaction.

Corporate governance and TQM mechanisms must be strategically deployed to achieve service quality. Telecommunication companies render services, and the variable nature of service must be observed, so employee training must be regular to have consistency in service delivery. Employees must also understand the perishability nature of service. Therefore, services lost today cannot be recovered since they cannot be stored. The same applies to the inseparable nature of services, knowing that the person rendering the services cannot be separated from the service, so employees must be well-trained to give customers quality service. Therefore, in service operations, employee engagement must not be toiled since experienced employees offer experience services.

Nonetheless, employee engagement must be monitored since fatigue can have adverse effects on performance, thereby affecting service quality. When customers are satisfied, it gives the impression of good service quality; therefore, telecom companies must know the positive influence of customer satisfaction on service quality. Customers always expect consistent service quality, which the governing body of the organization can enforce, so the corporate governance system must be strengthened.

Policy Implications

Quite several policies can be espoused from the conclusion suggestions in the research. Corporate governance mechanisms must be strictly adhered to, so the governing board must be active, as well as the agent and stakeholders, if they want growth and development in the telecom industry. The implication purports that if mechanisms are critically monitored, service quality is assured, as well as improving and achieving quality of service.

Considering the analysis of TQM practices in the telecommunication sector, the quality of telecom service can be improved if guidelines and principles are meticulously followed. The implication is that so long as the TQM practices are addressed, service quality will be enhanced. Based upon the conclusions drawn in the research work, it is recommended that telecommunication companies survive in the competitive environment by emphasizing quality control, process optimization, employee training, and customer feedback mechanisms.

The report also recommends that for businesses to thrive in the current economic climate, they should concentrate on these quality management techniques. Telecommunication companies are generally recommended to build pertinent policies for the improvement of strong total quality management policies, which in turn might produce satisfactory returns for them to grow effectively in the sector. The

goal of the well-implemented total quality management rule is to improve the Telecommunication Company's service quality and prevent major setbacks from happening. However, the study recommends that employee training should be strengthened to mediate the other policies into action. It is believed that when employees are well trained, quality control, process optimization, and customer feedback mechanisms will be properly practiced because employee training catalyzes the other practices to improve service quality.

A defective system can be corrected promptly through quality control to retain optimal internal mechanisms. To ensure high-quality services, all telecom companies must have qualified senior managers who will oversee the entire management and workforce. However, management must develop and adhere to commendable quality management standards that would not limit the telecom company's innovation and technology advancement operations. The researcher also suggests that telecom companies in Ghana adopt technological devices that will drive innovation to achieve maximum quality and maximum satisfaction, as well as machines that can easily detect and trace fraudsters.

In addition, board characteristics, executive compensation, top management commitment, and ethical standards must be well integrated to achieve service quality in a competitive environment. Another policy implication is that when corporate governance and TQM practices are addressed, employee engagement and equipment and materials will be enhanced, which will go a long way to improve service quality. Based upon the conclusions drawn in the research work, it is recommended that by enhancing equipment and materials and employee engagement, telecommunication companies can survive in the competitive environment. The research also suggests that telecom establishments need to focus on corporate governance and total quality management practices to be sustained in the business environment. For organizations to thrive well in the industry, the corporate governance system must work to develop relevant mechanisms for the enhancement of good total quality management policies, which in turn could generate satisfactory returns. Well-executed corporate governance and total quality management policies through service quality are intended to increase customer satisfaction in telecommunication companies and to circumvent massive adversities before they occur. From the findings, it is candidly suggested that corporate governance and the TQM system should improve employee engagement by increasing allowances and giving study grants to boost employees' zeal to work harder. However, the study recommends that corporate governance and TQM must mediate the role of employee engagement and equipment and materials and must constantly check to help put other policies into action. It is believed that when employee engagement and equipment and materials are constantly checked, it will aid in the effective completion of responsibilities assigned to employees, which catalyzes the achievement of service quality.

However, before and during service, which is also a component of service quality, it should be checked by the top management regularly, and reports should be issued without delay to ensure the efficient functioning of the telecom structure. Most of the time, customers experience network disruption that poses a lot of stress on customers when contacting the service providers. Timely corrective action makes a flawed system get back on track to maintain optimum internal mechanisms. Therefore, all telecom companies must have competent top managers who will supervise the entire management team and staff for quality service. However, after-sales service must be adopted and stick to admirable total quality management policies that would regulate the shortfalls of the service rendered to customers of the telecommunication companies.

However, physical facilities and infrastructure must be improved to suit the standard of customers, thereby increasing the service quality level of their customers. Nonetheless, prompt handling of customer complaints needs to be in constant check to offer better service quality to their customers. The research proposes that telecom companies should stress more on corporate governance and TQM variables, which have a positive effect on employee engagement, and equipment and materials that lead to service quality and thus can increase their market share and revenue. The researcher concludes that with good implementation of corporate governance and TQM policies, telecommunication companies would be able to achieve service quality.

Concerning the findings, this study will be appropriate for managers, Chief Executive Officers, directors, and academicians.

Theoretical Implications

Corporate governance is a complex system of organizational frameworks, procedures, guidelines, and norms. The highest level of corporate governance in the telecom business, the Board of Directors, should make sure that results are delivered. Governance theories offer a thorough frame of reference, yet the rules of corporate governance cannot be effectively applied without clear variety.

Agency theory explains how agents and principals interact within an organization. In this scenario, the agent and principal act and decide on behalf of the other. The Chief Executive Officer of the telecom and the board have an agency relationship in which the executive is required to work in the institution's owners' best interests. In this sense, the management faces significant difficulty in achieving both financial and non-financial success while adhering to the organization's ethical standards. Employees who violate the telecom's ideals, however, can seriously harm the facility's finances and reputation. Sometimes, the damage done by these dishonest workers is too great to be repaired, and the company must restructure its business. As a result, the Chief Executive Officer and management must put strategies in place that reflect the opinions of the owners and conduct business in their best interests. Similar to this, directors and owners should have faith in the organization's management and go above and beyond to show their appreciation for their day-to-day business judgments. Directors and owners should receive clear communication from Chief Executive Officer and management whenever a significant business decision is to be made, which will assist them in comprehending and appreciating the changes made. Directors and owners should concentrate on adhering to regulations, supervising employees, and evaluating employee performance concerning the telecom company's goals. The monitoring role of the board, supported by practices like audit and performance reporting, is likely to have the propensity of reducing the issues of managers pursuing their interests or performing poorly as against the institutional mandate, according to agency theory, which places a strong emphasis on conformance. The focus is on avoiding performance issues brought on by ineffective telecom management or inappropriate managerial discretion. The need for the board of directors to oversee management actions is clearly stated by agency theory.

The chief responsibilities of telecom governing bodies include establishing the strategic parameters within which the Chief Executive Officer will run the organization daily, supporting the operation of the telecom facility through effective monitoring and evaluation of business objectives, and ensuring accountability through the sharing of information (disclosures) with and from stakeholders. Industry participants are required to be held accountable and to assert ownership of or develop interests in the organization. According to the notion, businesses exist to generate value for their many stakeholders. Organizational management and corporate ethics, which are responsible for fulfilling business objectives, are influenced by groups including the board, Chief Executive Officer, personnel, local community, government, investors, and others. That is why it is prudent from a realist perspective to involve all stakeholders in providing a comprehensive framework that enhances service quality.

Stewardship theory has some intuitive appeal in the context of the telecom business since it assumes that the board of directors and managers will both focus on reaching the quality goals of the telecom company. The power of the "joint endeavor," when the board and management share a similar attitude of generating improved results, is provided by stewardship theory. A social contract that acts in a community-focused manner may be seen in the alignment between the principals and agents. The telecom board and leadership collaborate to make sure the telecom firm fulfills its purpose and objective by paralleling community and societal needs. The Chief Executive Officer and board of trustees are probably interested in the same things when it comes to running the telecom facility. Under stewardship theory, the Chief Executive Officer or manager moves from being an opportunistic slacker to principally wanting to do a good job and be a good steward of corporate assets.

This study reveals that industry participants use resources wisely by being trustworthy and acting morally toward the firm and its stakeholders. Managers are more likely to serve the organization zealously to meet the set objectives if they demonstrate a higher commitment to the corporate principles. With this charisma, the executive is ready to set strategic policy direction and ensure that service quality goals are met. Financial and non-financial performance may be achieved when trustees and managers collaborate on a single goal.

The study's crucial theoretical implication is that good corporate governance sustains a firm's integrity and effectiveness. Enhancements in both the financial and non-financial aspects of a firm can result from good corporate governance, which affects an establishment's reputation over the long run. It aims to ensure ethical business conduct, including openness, justice, accountability, independence, responsibility, and adherence to all applicable laws and regulations. Balancing the interests of an organization's stakeholders, including shareholders, customers, managers, financiers, suppliers, the government, and the community, is a crucial component of corporate governance. To guarantee that stakeholders are aware of and committed to adhering to activities and conducts that are commonly acknowledged as suitable, proper, and desirable, discipline will be upheld. At the same time, telecom businesses are directed and controlled. According to the research, every institution that carefully considers positive corporate characteristics orients its activities toward effectiveness and general adherence to prudent management that can ensure the establishment's long-term success; this will make it easier to plan effectively and strategically to increase shareholder value and safeguard the interests of other stakeholders while also enhancing service quality.

In the telecom sector, TQM practices must be adhered to in order to attain service quality. The various TQM theories, such as Deming's theory, Crosby's theory, Joseph's theory, the European Foundation for Quality Management, Ishikawa's theory, and Quality Control and Statistical theory, propose that quality assurance must be a priority for telecom companies. The telecom companies must apply the Plan, Do, and Act to influence performance and service quality.

Deming's theory is known for his ratio, where quality is equal to the result of work efforts over the total costs. Deming's theory of management details the steps that must be taken to transform a company's quality culture. It is a theory that means it is insufficient to solve problems that arise. A culture of continuous improvement must be established and maintained with the overall goal of achieving customer satisfaction. If a company has a culture of continuous improvement and maintains it with the overall goals, the telecom company will achieve consistent service quality. Therefore, telecom companies can achieve service quality by applying Deming's theory of TQM.

Crosby's theory also made the point, much like Deming's, that if one spends money on quality, it is money that is well spent. Crosby's principle, Doing It Right the First Time, was his answer to the quality crisis. He defined quality as full and perfect conformance to the customer's requirements. The essence of his philosophy is expressed in what he called "Absolute of Quality Management and the Basic Elements of Improvement." His concept of zero defect and quality council as means of sharing information about quality and services will reduce cost and improve profitability. Therefore, telecom wants to achieve service quality and must do it right for the first time. Telecom companies must fully and perfectly conform to the customer's requirements.

The key steps in Juran's theory on quality encompass three fundamental stages: quality planning, quality control, and quality improvement. Today, these stages are known as the Juran Trilogy or the Quality Trilogy. They are used to both describe the quality management journey and establish quality control best practices. Joseph Juran stated that if a quality improvement project is to be successful, then all quality improvement actions must be carefully planned out, controlled, and improved. Telecom companies must improve all quality actions by planning and controlling all quality actions to achieve quality results.

The European Foundation for Quality Management (EFQM) in Brussels defines excellence as the excellent practice of managing an organization and achieving results based on fundamental principles, such as results orientation, customer focus, leadership and stability of purpose, and management based on processes. EFQM result is a model that refrains from prescribing any one methodology but rather recognizes the diversity management methodologies. Telecom companies must not stick to only one standard way of improving quality. Still, they must employ more methodologies to improve quality, as the world has become a global market with high competition.

Ishikawa's theory also stated that companies should handle their quality improvement projects. An Ishikawa diagram is a diagram that shows the causes of an event and is often used in manufacturing and product development to outline the different steps in a process, demonstrate where quality control issues might arise, and determine which resources are required at specific times. Quality projects are crucial for

telecom companies. They must be able to demonstrate where quality issues might arise and determine which resource is required at a specific time, which will aid in achieving service quality.

Recommendations

Based on the findings, this study makes the following recommendations to improve the system. The study recommends that telecom companies should blend the four theories of corporate governance, which are resource dependency, stakeholders, agency, and stewardship theories, to yield effective results. The study also recommends various TQM theories such as Deming's theory, Crosby's theory, Joseph's theory, the European Foundation for Quality Management, Ishikawa's theory, and Quality Control and Statistical theory should be applied by the telecom companies to influence service quality.

To survive, telecommunication operators in Ghana must drastically alter their business models and service offerings due to increased competition from non-telecom providers, lower network investments, and the rise of digital media and mobile technology. The study also recommends that employees must be properly engaged to ensure good service quality. However, to prevent the country from being overtaken by the negative effects of the telecommunications transformation, the government is also closely monitoring cyber security threats. As a result, the sector is expected to tighten up cyberspace to lessen the negative impact of charlatans. The study also recommends that telecommunication companies put much effort into establishing their quality management systems according to the obligation of ISO 9000 and 9001 for successful TQM implementation and business accomplishment. Such canons would assist the industry in ensuring that telecom companies are meeting the expectations of customers and other stakeholders while staying within the specified regulatory and statutory requirements for the product or service they are offering. Based on the findings, this study will be useful for telecommunication company managers, Chief Executive Officers, directors, and academicians. In addition, other service organizations can also use this study as a policy guide.

This study suggests that corporate governance and TQM policies in the telecommunication sector must be centered on service quality, which consists of prevention of poor service quality and effective handling of customer complaints.

The success of companies depends on how satisfied their consumers are, and one of the elements that directly correlates with customer satisfaction is TQM. If corporate governance and TQM are applied, telecom companies will respond quickly to customer requests and provide them with high-quality services.

The study gives these recommendations:

- Telecom companies must study customer relationships and develop strong communication skills with their customers if they want to achieve service quality. Telecommunication companies must know how customers rate the quality of a company's services.
- According to the results of this survey, the majority of businesses offer a wide range of TQM services, and these services help achieve customer satisfaction, so corporate governance policies must encourage this.

Some customers are only somewhat satisfied with the TQM activities, so the corporate governance system needs to work so the employees will know more about the TQM services.

The study also recommends that Telecommunication companies pay attention:

- To the tangibility nature of services like the equipment & materials.
- The companies should be reliable in their service delivery.
- They should respond to issues and complaints as quickly as possible.
- They should assure customers of good quality of services and readiness to resolve problems as and when they happen.
- In addition, telecom companies must show empathy (the ability to understand and share the feelings of their customers).
- The study finally recommends the merging of corporate governance and TQM to ascertain effective service quality results in the telecom sector.

Therefore, corporate governance and total quality management had a significant impact on service quality.

Limitations Of The Study

The research work significantly contributes to the influence of corporate governance and TQM on telecom companies to enhance service quality. Nevertheless, the study was faced with certain limitations. The first shortfall of the research is the limited data used by the researcher.

The research examination was constrained in the sense that the study could not do a thorough investigation of all the centers of the telecom companies in Ghana. Therefore, the research relied on a sample size of a few centers of the telecom companies in the sector. Data collection concerning telecom operations is difficult, which is probably due to the reluctance of employees to allow easy access to information due to bureaucratic, dogmatic, and other influences in the telecom administration. Hence, the researcher could not administer questionnaires to all possible respondents of the population except those who were reachable. However, the collated data was limited to a cross-section of the total population. In addition, in the model to estimate the impact of corporate governance and TQM on service quality, other satisfaction elements were not available, even though that could not have affected the soundness of the results. Some of the employees also think providing data about the telecom company represents leaking or divulging valuable information into the public domain for competitors to see their strategies, strengths, and weaknesses. However, these limitations enumerated did not affect the predictability, validity, and precision of the research findings.

Recommendation For Future Research

The researcher implores that other areas could also be looked into to extend academic ideas in the field.

Firstly, by hiring qualified employees by way of a good corporate governance system to execute corporate governance mechanisms and TQM policies, telecom companies should hire more qualified employees or provide the present staff with more training on corporate governance mechanisms and TQM practices to improve service quality.

Secondly, improving the understanding of the effect of technical support of TQM on customer satisfaction may be examined (as further research). Telecom operators must improve technical support of Equipment and materials to help telecom businesses cut down on customer complaints and offer customers improved TQM services.

Another worthy area of research for future academics is the influence of TQM on customer satisfaction to explore the amalgamation of TQM and consumer behaviour. Thus, this research direction could be studied from the theoretical relations between TQM and consumer behavior.

Last but not least is improving a good corporate governance system in the telecom sector in Ghana. Improving corporate governance mechanisms in the telecom sector will result in high efficiency in telecom operations, as the poor corporate governance system adopted by Expresso Ghana resulted in the collapse of that telecom company. However, if good corporate governance systems are in place, telecom companies can survive any intensive competition.

References

Adel, Christine, Mostaq M. Hussain, Ehab KA Mohamed, and Mohamed AK Basuony. "Is corporate governance relevant to the quality of corporate social responsibility disclosure in large European companies?." International Journal of Accounting & Information Management 27, no. 2 (2019): 301-332.

Ababneh, O. M. A. (2021). The impact of organizational culture archetypes on quality performance and total quality management: the role of employee engagement and individual values. International Journal of Quality & Reliability Management, 38(6), 1387-1408.

Abror, A., Patrisia, D., Engriani, Y., Evanita, S., Yasri, Y., & Dastgir, S. (2020). Service quality, religiosity, customer satisfaction, customer engagement and Islamic bank's customer loyalty. Journal of Islamic Marketing, 11(6), 1691-1705.

Agrawal, N. (2020). A framework for Crosby's quality principles using ISM and MICMAC approaches. The TQM Journal, 32(2), 305-330.

Agrawal, N., Rabiee, M., & Jabbari, M. (2023). Contextual relationships in Juran's quality principles for business sustainable growth under circular economy perspective: A decision support system approach. Annals of Operations Research, 1-31.

Agrawal, N. M. (2019). Modeling Deming's quality principles to improve performance using interpretive structural modeling and MICMAC analysis. International Journal of Quality & Reliability Management, 36(7), 1159-1180.

Antony, J., McDermott, O., & Sony, M. (2021). Revisiting Ishikawa's original seven basic tools of quality.

Black, J. T., & Kohser, R. A. (2020). DeGarmo's materials and processes in manufacturing: John Wiley & Sons.

Chisty, N. M. A., & Adusumalli, H. P. (2022). Applications of artificial intelligence in quality assurance and assurance of productivity. ABC Journal of Advanced Research, 11(1), 23-32.

Clack, L. (2021). Employee engagement: Keys to organizational success. The Palgrave handbook of workplace well-being, 1001-1028.

Dmytriyev, S. D., Freeman, R. E., & Hörisch, J. (2021). The relationship between stakeholder theory and corporate social responsibility: Differences, similarities, and implications for social issues in management. Journal of Management Studies, 58(6), 1441-1470.

Fatmawatie, N., & Endri, E. (2022). Implementation of the principles of financial governance in service companies. Journal of Governance and Regulation, 11(4), 33-45.

Ghodke, M. V. A. (2021). Role of TQM in improving Customer Satisfaction. National Journal of Research in Marketing, Finance & Hrm, 129.

Gordon, J. N. (2021). Systematic stewardship. J. Corp. L., 47, 627.

Guilaire, D. K. E., Nicaise, O. A. T., ESSONO BELLA, E., & Achile, S. L. A. (2024). Stakeholders and Performance of SMES in Cameroon: Case Study of Dschang (Cameroon). SCIREA Journal of Management, 8(1), 1-17.

Gupta, M. J., Chaturvedi, S., Prasad, R., & Ananthi, N. (2022). Principles and practice of management: AG publishing house (AGPH Books).

Helmold, M. (2023). Total quality management (TQM) Virtual and Innovative Quality Management Across the Value Chain: Industry Insights, Case Studies and Best Practices (pp. 27-41): Springer.

Heydari, M., Lai, K. K., & Xiaohu, Z. (2019). impact of implementation of the european foundation for quality management excellence model and iso on organizationsperformance based on mathematical models. Proceedings of National Aviation University, 80(3).

Jensen, M. C., & Meckling, W. H. (2019). Theory of the firm: Managerial behavior, agency costs and ownership structure Corporate governance (pp. 77-132): Gower.

Jenkins, N. A. (2020). Using positive psychology to increase service quality and reduce employee turnover within the Australian hotel industry: examining the roles of employee empowerment, psychological capital and employee engagement (Doctoral dissertation, Southern Cross University).

Larcker, D., & Tayan, B. (2020). Corporate governance matters: FT Press.

Mallin, C. A. (2019). Corporate governance: Oxford university press.

Markham, J. W. (2022). From Enron to Reform: A Financial History of the United States 2001–2004: Routledge.

Merendino, A., & Melville, R. (2019). The board of directors and firm performance: empirical evidence from listed companies. Corporate Governance: The international journal of business in society, 19(3), 508-551.

Montgomery, D. C. (2020). Introduction to statistical quality control: John wiley & sons.

Neri, S., Pinnington, A. H., Lahrech, A., & Al-Malkawi, H. A. N. (2019). Top executives' perceptions of the inclusion of corporate social responsibility in quality management. Business Ethics: A European Review, 28(4), 441-458.

Oliveira, F., Kakabadse, N., & Khan, N. (2022). Board engagement with digital technologies: A resource dependence framework. Journal of Business Research, 139, 804-818.

Prentice, C., Wang, X., & Loureiro, S. M. C. (2019). The influence of brand experience and service quality on customer engagement. Journal of Retailing and Consumer Services, 50, 50-59.

Ramya, N., Kowsalya, A., & Dharanipriya, K. (2019). Service quality and its dimensions. EPRA International Journal of Research & Development, 4(2), 38-41.

Rane, N. L., Achari, A., & Choudhary, S. P. (2023). Enhancing customer loyalty through quality of service: Effective strategies to improve customer satisfaction, experience, relationship, and engagement. International Research Journal of Modernization in Engineering Technology and Science, 5(5), 427-452.

Rebeiz, K. S. (2024). The evolutionary journey of the American corporation and its governance over two centuries. Corporate Governance: The international journal of business in society, 24(4), 743-763.

Rezaee, Z., & Safarzadeh, M. H. (2023). Corporate governance and earnings quality: the behavioral theory of corporate governance (evidence from Iran). Corporate Governance: The international journal of business in society, 23(1), 189-218.

Sacco, F. M. (2020). The Evolution of the Telecom Infrastructure Business: Unchartered Waters Ahead of Great Opportunities. Disruption in the Infrastructure Sector: Challenges and Opportunities for Developers, Investors and Asset Managers, 87-148.

Schiavone, F., Pietronudo, M. C., Sabetta, A., & Ferretti, M. (2023). Total quality service in digital era. The TQM Journal, 35(5), 1170-1193.

Shaikh, I. A., Drira, M., & Hassine, S. B. (2019). What motivates directors to pursue long-term strategic risks? Economic incentives vs. fiduciary duty. Journal of Business Research, 101, 218-228.

Shu, P.-G., & Chiang, S.-J. (2020). The impact of corporate governance on corporate social performance: Cases from listed firms in Taiwan. Pacific-Basin Finance Journal, 61, 101332.

Solomon, J. (2020). Corporate governance and accountability: John Wiley & Sons.

Stahl, G. K., Brewster, C. J., Collings, D. G., & Hajro, A. (2020). Enhancing the role of human resource management in corporate sustainability and social responsibility: A multi-stakeholder, multidimensional approach to HRM. Human resource management review, 30(3), 100708.

Sofyani, H., Riyadh, H.A. and Fahlevi, H., 2020. Improving service quality, accountability and transparency of local government: The intervening role of information technology governance. Cogent Business & Management, 7(1), p.1735690.

Yusoff, A. S. M., Peng, F. S., Abd Razak, F. Z., & Mustafa, W. A. (2020). Discriminant validity assessment of religious teacher acceptance: The use of HTMT criterion. Paper presented at the Journal of Physics: Conference Series.

Environmental factors and sustainable investment behaviour: Moderating role of financial literacy

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Environment, Sustainable Investment Behaviour, Financial Literacy, Climate Risk

Abstract

Climate change significantly influences investment decisions by creating substantial investment opportunities. The study stems from the fact that emerging economies like Pakistan are heavily reliant on energy intensive sectors (cement, textile, transport, fertilizers, steel, etc.). This study put forwards that the investment behavior and the decisions made under such conditions have now been transformed into a complex relationship. The data was collected from the large retail sector of Pakistan registered with the Pakistan Stock Exchange (PSX). Investors with the last two years were approached for a useable sample of 243 responses. It was found that Perceived climate risk level by investors plays an important role in shaping the overall investment behavior of the investors. This role was mediated by the attitudinal and behavioral constructs like pro-environmental attitude. While researchers have done a lot of work on climate finance, a significant gap exited in evaluating simultaneously, the impact of attitudinal and knowledge factors namely financial literacy in shaping Sustainable investment behavior which found to be a boundary condition of the relationship. Implications for managers have been discussed.

Introduction

Over the past few years, countries throughout the world have experienced severe climatic conditions leading to a climatic emergency. This climate crisis has an influence on many sectors and industries. One of the most important sectors that the changing climatic conditions are impacting is the investment and financing sector. Climate change significantly influences investment decisions by creating substantial investment opportunities. Investors throughout the world are reconsidering their preferences and re-evaluating of specific assets in their portfolios.

Climate risk can be further classified into two main types of material risks i.e. the physical risk and the transition risk. Physical risks are the direct risks associated with the changing climate itself. These can be acute such as hurricanes, floods, rainstorms, wildfires, heat waves, droughts, etc. Or, they can be chronic such as rising sea levels, rising temperatures, ocean acidification etc. Transition risks, on the other hand, are the sorts of risks we take when moving to a low-carbon economy. While governments around the globe put in place policies, technologies and consumer trends to counteract climate change some industries and businesses are made vulnerable financially or operationally. Therefore, in broader terms, it can be said that climate risk is the negative effect of climate change on several aspects of the environment, society and business.

Physical risk, while catastrophic, often translates into uninsured losses or localized damages, which can be diversified or factored into short-term operational expenses. Transition risk on the other hand is driven by international forces such as policy shifts (e.g. carbon pricing) and technological disruptions. It suggests a fundamental and system-wide revaluation of assets. Transition risk for an organization is associated with changes aimed at reducing greenhouse gas emissions and switching to renewable energy sources. The transition is driven by political, legal, technological, and market changes necessary to address the mitigation and adaptation requirements related to the mutations resulting from climate change (Di Febo, 2025).

While the society, particularly the investors recognize climate change as a systemic threat, categorized into two categories (physical and transition), it is the latter the poses the most immediate and quantifiable threat to asset valuation in emerging markets like Pakistan.

Significance of research:

The significance of this study stems from the fact that emerging economies like Pakistan are heavily reliant on energy intensive sectors (cement, textile, transport, fertilizers, steel, etc.). This makes such economies vulnerable to global policy shocks (carbon taxes, de-carbonization, etc.). Not only this, the investors have to reconsider their investment choices and may have to stop investing in activities that further damage the environment leading to excessive climate shocks in the future.

This study put forwards that the investment behavior and the decisions made under such conditions have now been transformed into a complex relationship. The Perceived climate risk level by investors plays an important role in shaping the overall investment behavior of the investors. This role could be mediated by the attitudinal and behavioral constructs like pro-environmental attitude. This attitudinal construct is namely the pro-environmental attitude.

While researchers have done a lot of work on climate finance, a significant gap exits in evaluating simultaneously, the impact of attitudinal and knowledge factors namely financial literacy in shaping Sustainable investment behavior.

Problem Statement

The changing climatic conditions have put the industries throughout the world at a stake. The intensifying climatic crisis creates sever financial risk for companies in emerging markets like Pakistan. Sectors like textile, agriculture, construction and transportation are facing newer problems like carbon taxes and other policy pressures. The problem arises when these companies find the need to finance their business. Investors can either perceive this transition risk as very severe and a complete threat to our environment or stop investing in these sectors at all. Or, if their perceptions are week and pro-environmental attitude is not strong enough, they may continue investing in such sectors as mentioned above.

In current years, as the severity of climate change influences various sectors and regions, a large number of researchers around the globe have started to pay attention towards the effects of these risks on finance, economy and risk assessment (Campiglio, 2016; Sun et al., 2023). Studies on financial and economic impacts of climate change are well established. A rich literature can be found on the severe impacts of climate risk and the approach of companies towards mitigating, reporting and pricing that risk but there is a little focus on investors' behavior and decisions in the light of these risks.

Some studies show how global climatic emergency has changed firms' value and investment efficiency (al, 2022). According to the research by the Intergovernmental Panel on Climate Change (IPCC), global temperatures have risen by 1.1 °C above pre-industrial levels due to fossil fuel combustion and unsustainable energy and land use practices in industrial activities. These events have presented regulatory and policy changes on various industries (Gu et al., 2023; li et al., 2023). In this context, companies reliant on heavy manufacturing and otherwise climate vulnerable companies face greater challenges. Investors funding such companies also face a dual problem; should they continue investing in such companies, or should the shift to other less vulnerable assets/companies that support less carbon emission, less pollution and circular economy as well.

The existing literature, although provides a ground for establishing this "investor dilemma", but it fails to integrate the simultaneous forces driving the choice. Therefore, in order to understand which outcome prevails i.e. the decision of investors to continue investing in climate exposed and environment polluting companies, or considering companies instead that focus on environmental, social and governance perspectives to save the environment, major theories have been discussed in the subsequent sections.

The study falls under the domain of the following theories:

a) Capital Asset Pricing Model (CAPM) and the broader Efficient Market Hypothesis (EMH)
b) Ambiguity Aversion (Knightian Uncertainty)
c) Prospect Theory

Underlying Theories

The following theories play a significant role in building the basis of this study:

Capital Asset Pricing Model (CAPM):

The model was proposed in early 1960s by economists including William Sharpe, John Linter and Jack Treynor. The capital Asset Pricing Model is the foundational model that links risk and expected returns. It describes the relationship between systematic risk and expected returns for assets, specifically stocks. It suggests that investors are only compensated for the non-diversifiable/systematic/market risk which cannot be eliminated through diversification. The market does not reward the investors for holding the risk which can be diversified (company-specific risk) by dropping that asset and investing in some other.

This study aims to utilize the CAPM's logic to establish a rational benchmark. Climate risk is now a new systematic risk. Established in December 2017, the Network for Greening the Financial System (NGFS) which represents a consortium of central banks and financial institutions, claims that climate change is to be considered as a systemic risk because it has the potential to destabilize the entire financial system through its physical and transitional impacts.

Regulators globally are challenging the idea that climate change is merely a firm-specific risk. The consensus among central banks and financial bodies is that climate change must be viewed as a systemic risk with the potential to destabilize the entire financial system and ultimately the environment (NGFS, 2020).

This consensus among authorities is crucial to the model under study. Since climate risk impacts core macro-economic activities and function such as inflation, energy stability, policies, taxation and national supply chains, it becomes a non-diversifiable systematic risk (climate beta) that affects the stocks. Therefore it would not be wrong to propose that investors under such conditions, theories and research may develop strong attitudinal choices, wither favoring the stance of exposed industries and continue investing in them, or completely taking a safe flight to highly ESG contributing companies.

Prospect Theory

It is a behavioral economics model developed by Daniel Kahneman and Amos Tversky in 1979. Prospect theory has emerged as a leading alternative to expected utility as a theory of decision under risk. Prospect theory posits that individuals evaluate outcomes with respect to deviations from a reference point rather than with respect to net asset levels, that their identification of this reference point is a critical variable, that they give more weight to losses than to comparable gains, and that they are generally risk-averse with respect to gains and risk-acceptant with respect to losses (Jack S. Levy, 1992).

The concept of loss aversion is central to understanding investor behavior during a climate crisis. Since the investors feel the pain of potential losses, such as the total devaluation of their assets/portfolios due to an irreversible flood or a policy change, far more intensely than the pleasure of a comparable return, they are compelled to prioritize avoidance. This theoretical framework and concept directly supports the proposed idea of "safety flight" towards ESG high companies' side of the investor dilemma discussed earlier. The logic here is that exposed companies, primarily because of carbon taxes and other restrictions might pay less returns/dividends to investor which is another disadvantage apart from their contribution towards pollution.

Combining this argument with the logic established through CAPM and the one discussed in earlier sections, it would not be wrong to suggest that climate risk is a severe risk as of 2026 and based on the perceptions people develop regarding this risk, they will either perceive climate risk as a severe threat to not only the financial system but also the environment and develop a more Sustainable investment behavior or they will perceive climate risk as something that is not a severe threat to the environment and maintain their original investment behavior, the one including investments in polluting companies.

Ambiguity Aversion

Proposed by Daniel Ellsberg in 1961, the ambiguity aversion bias is a behavioral bias where individuals tend to prefer known outcomes over the unknown outcomes even if the potential gains on the unknown outcomes are greater than (but not guaranteed) the potential returns on known outcomes. It is

the inherent nature of individuals that they prefer certainty over uncertainty. Uncertainty and time increase the complexity of monetary benefit evaluation of environmental investments (Maria Sandsmark, 2007).

In behavioral finance, this bias can lead the investors to drop risky investments and shift towards less risky ones that offer clear potential returns, potentially missing out higher-growth opportunities. When investors find a signal that the climate-exposed assets in their portfolios, though offering higher returns, can face policy issues, additional taxes, destructive impacts of weather, technological risks, and market and reputational risks, they will take a safe flight towards alternatives. This can guarantee the investors a certain amount of return without any fear of loss.

It is also important to take into account the concept that in the case being discussed, climate risk often shifts from quantifiable risk to Knightian Uncertainty when a firm provides low disclosure. For instance, investors know that the consequences of flood can be severe and their investment in related sectors is at stake but they have no basis to estimate the financial probability for a specific company.

Hypotheses Development

Climate Risk Perception (CRP)

Climate risk perception refers to the perceived prominence of climate related risks when making decisions. In broader context, risk perception is the degree to which investors consider a particular risk and rank it as a major threat that requires urgent change of plans or a minor/emerging issue that does not require urgent threat at the exact moment.

Conceptual Definition

The idea of climate risk salience or climate risk perception comes from the salience theory proposed by Pedro Bordalo, Nicola Gennaioli and Andrei Sheifer in 2012. It is the degree to which climate related risks, both physical and transition are perceived as relevant and important by various stakeholders, particularly by investors, corporations and policy makers. When climate risks are salient, investors are more likely to pay attention towards mitigating strategies, either adjusting their portfolios or demanding a higher return for holding onto that risk.

Operational Definition

The construct Climate Risk Perceptions is measured through a set of 4 items.

Evolution of work on Climate Risk Salience:

Extreme weather and climate events such as heat waves and visibility have become more frequent over the past decade. Climate experts find no end to this and only see this as an irreversible damage globally (Hansen et al., 2019, Rao et al.,2022). High humidity levels can increase the likelihood of natural disasters such as rapid melting of glaciers, floods, wildfires and much more. This will ultimately impact investors throughout major industries reliant on temperature patterns such as agriculture, forestry, textile and renewable energy industries (Agovino et al.2019, Rao et al.,2022).

Climate experts have conducted a lot of research based on the recent visibility issues. Poor visibility, smog and cloudy weather for a prolonged period of time can lead to reduced crop yields, lower timber production, increased food prices which will ultimately impact the economy in broader terms. According to Rizwan Ahmed, Xihui Haviour Chen, Yen Hai Hoang and Chi Do-Linh, extreme weather conditions have a greater impact on stock market dynamics, making the returns more volatile.

The direct effect

Extreme weather conditions of various forms impact investor behavior. In today's world, investors find it impossible to neglect such risks. These conditions regularly impact stock index returns and volatility apart from environmental effects discussed in the paragraph above. As a result, investors may decide to adjust their portfolios to reduce possible risks and adopt a more sustainable approach. Similarly, investors may seek opportunities to invest in sectors or businesses that are likely to profit from these circumstances if consistently low temperatures are linked to higher stock returns.

Accordingly, it would not be wrong to hypothesize that:

H1: Following a climate risk salience shock, investors develop strong climate risk perceptions and engage in sustainable investment behavior.

Sustainable Investment Behavior (SIB)

Sustainable investment behavior refers to the practice by investors to incorporate environmental, social and governance dimensions in their investing activities.

Conceptual Definition

From the environmental dimension, companies engaged in sustainable finance promote practices that require low resource input thus promoting less resource exhaustion.

From the social dimension, sustainable investment focuses on inclusivity and accessibility, directly targeting low income groups, distant people and SMEs, especially the small enterprises that lacked access previously.

Finally, from the governance dimension, sustainable finance promotes transparency, disclosure and traceability to reduce information asymmetry between investors/shareholders and the management of the company.

Operational Definition

The construct Sustainable investment behavior is measured through a set of 4 items.

Evolution of work on Sustainable investment behavior:

The concept of sustainable investment finds its roots in ethical, moral and religious values and the studies based on these values that date back to 1500s and 1600s, when people considered investing in tobacco and alcohol companies as morally and religiously wrong and these were categorized as sin stocks.

Evolving from purely religious and moral grounds, the concept revolutionized till 1990s, where negative screening for ethical reasons was done. This evolved from purely religious to social justice issues.

Work on mainstream ESG and Sustainability, including sustainable investment behavior started in late 1990s and is continued till now. Sustainability is no longer regarded as merely an optional thing; it is regarded as tool for identifying material risk and generating alpha values for investors.

The United Nations Global Compact devised the ESG framework in 2004. Based on this framework, Impact investment picked pace after 2010. Current era focuses on Socially responsible investments.

Sustainable Investment behavior is more of a recently discovered variable. This particular concept emerged in response of climate risks and climate shocks and other governance related problems that intensified with time in severity. As a result, big investors or more appropriately, institutional investors had to reconsider their investing activities and preferences. This reconsideration translated in retail investors over time.

Sustainable investment behavior in 2026 is characterized by incorporation of environmental, social and governance dimensions into investment as discussed above. The importance of sustainability in finance is evident from the fact shared by a study published in International Review of Economics and Finance journal which stated that the size of ESG funds as of mid-2025 was reported to be 3.5 trillion dollars. This size was expected to increase by many folds in the near future.

Overall, the evolution of work on Sustainable investment behavior reflects a move from a static, idealized agent to a more complex, dynamic model that incorporates changing economic conditions, psychological factors, and market interactions.

Under the Task force on Climate-related Financial Disclosures (TCFD), companies are increasingly pressured to disclose climate-related risks and opportunities, and consultancies like KPMG Pakistan and organizations like the Ministry of Climate Change and Environmental Coordination are guiding businesses on how to adapt and comply with these growing international and local expectations for climate action and financial reporting. TCFD has 4 core pillars which will form the basis of the index:

1) Governance
2) Strategy
3) Risk management
4) Metrics and Targets

BASIS	CRITERIA
Governance	1) Does the report describe the board's oversight of climate-related risk? 2) Does the report describe management's efforts in assessing climate related risk?
Strategy	1) Are transition risks (carbon taxes, policies etc.) identified? 2) Are physical risks (floods, rainfalls, draughts) identified? 3) Is there a description of impact of these risks? 4) Does the firm describe its strategy for overcoming these risks?
Risk Management	1) Does the firm describe its processes for identifying climate risks?
Metrics and Targets	1) Are climate-related targets (net-zero etc.) disclosed. 2) Are the metrics used to assess climate risks against targets disclosed?

Exploring Interconnections: Relationship between climate risk salience and Sustainable investment behavior:

Investors in the market are quick to adjust their portfolios based on either rationality or behavior. Based on the salience theory, it can be seen that businesses whose operational and financial performance is vulnerable to extreme climate and weather events need to shift towards a distinct climate change corporate investment strategy. The same mechanism goes for investors as well. As the climate risk becomes more salient, investors become more averse to assets exposed to those risks.

Mediation

Pro-Environmental Attitude:

Pro-environmental attitude refers to adopting a responsible behavior that positively impacts the environment. It is a positive, conscious and purposeful disposition towards nature guided by the motive to protect the environment from long-term damage.

Conceptual Definition

In context of this research, Pro-environmental attitude refers to the shift in behavior of investors towards considering environmentally responsible investments. These include investments that have high green innovation index, high sustainability scores and good general perception regarding their compliance in the investing community.

Operational Definition

The construct Pro-environmental attitude is measured through a set of 4 items.

Evolution of Work on Pro-environmental attitude

The concept of pro-environmental attitude dates back to early 1970s when people focused on ecological issues and considerations. Slowly, people gained more knowledge and realized that such environmental attitudes may originate from developing a consideration for eological systems, but it is actually deeper than that. It requires the understanding of complex models that involve interactions of concepts from psychology, social norms and situational factors.

Exploring interconnections

The mediator (Pro-environmental attitude) explains the process through which the independent variable (Climate risk perception) affects the dependent variable (Sustainable investment behavior). In essence, it answers the question how exactly does the climate shock lead to people changing their investment activities and reconsidering the sustainability of their portfolios as well.

When a climate shock hits the market, and the perceived climate related risk is high, it translates its effects in financial and environmental losses is high and the investors flee towards safety. Conversely,

when a climate shock hits the market followed by a perception that the risk is not severe, people continue with their usual investment behavior and do not consider sustainability issues.

Under these assumptions, the following hypothesis can be stated

H2: Following a climate risk salience shock, investors develop strong climate risk perceptions and engage in sustainable investment behavior that is amplified further through pro-environmental attitude.

Moderation

Financial Literacy

Financial literacy refers to the ability of individuals to understand financial methods, tools and terminologies and apply this knowledge to make informed decisions.

Conceptual Definition

In the context of this particular study, financial literacy specifically refers to the ability of the investors to understand financial risks of investing in exposed companies or the companies that have low green innovation indices.

Operational Definition

The construct financial literacy is measured through a set of 4 items.

Evolution of Work on Financial Literacy:

The importance of financial literacy as a study variable is confirmed by the fact that financial literacy emerged as a niche topic in 2007 and since then, hundreds and thousands of research articles in behavioral finance have used it as a study variable.

In today's world, it is a critical and important global policy priority. It is prioritized by central governments and central banks or majority of the countries throughout the world since the 2007 financial crisis.

Exploring Interconnections

Based on the rationale presented in the conceptual definition, the following hypothesis can be stated:

H3: Following a climate risk salience shock, investors develop strong climate risk perceptions and engage in sustainable investment behavior that is amplified further through higher financial literacy.

The Integrated Model

Moderated mediation

The combine (moderated mediation) model answers the critical and the most important part of this study i.e. how and under what conditions Climate risk perceptions among investors influence sustainable investment behavior.

This is the most unique and distinctive part of the study which focuses on the complex interplay between Pro-environmental attitude and financial literacy i.e. the attitudinal and knowledge based variables respectively.

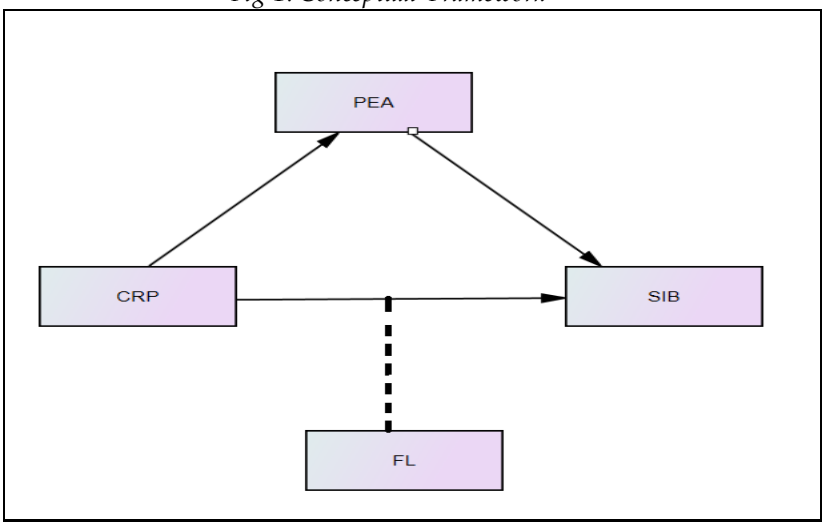
Conceptual Definition

While the previous sections measured the effect of moderator and mediator in isolation, this section combines the effect of both to test the complete theoretical model. Moderated mediation occurs when the strength of the mediation mechanism (the pathway through Pro-environemtal attitude) itself depends on the level of the moderator (financial literacy).

Operational Definition

Having established the moderation and mediation effects in isolation, the combined effects can be measured through AMOS. The model will simultaneously estimate the effect of both.

Fig 1: Conceptual Framework



Where, CRP refers to the Climate Risk Prescriptions and is the independent construct.
SIB refers to the Sustainable Investment Behavior and is the dependent construct.
FL refers to Financial literacy and it is the proposed moderator.
PEA refers to the Pro-environmental attitude and it is the proposed mediator.
The dotted line measures the impact of moderator in the proposed model.

Methodology

This section will outline the systematic approach that will be used to investigate the impact of climate risk perception on investor behavior in emerging economies like Pakistan. The methodology is designed to test the two moving forces of moderation and mediation, the effect of which is captured at a later stage through the moderated mediation model analyzed in AMOS.

The section also sheds light on the measurement of each variable and various proxies and scales used for this.

Research Setting

This research was conducted among retail investors in Pakistan. They represent a diverse segment of investment professionals engaged in the financial system of Pakistan. For this particular study, retail investors were specifically chosen for two main reasons.

Firstly, they constitute a very large segment of investors in Pakistan apart from the large scale institutional investors and their investment decisions are often guided by behavioral and attitudinal dimensions similar to the ones discussed above.

Secondly, this segment was much easier to approach based on connections in the corporate sector.

The research is set within the large retail sector of Pakistan registered with the Pakistan Stock Exchange (PSX). Specifically, the investors showed varying attributes in three major domains:

1) Age
2) Education
3) Years of investing experience

A filter question was applied in the very beginning of the questionnaire regarding whether they were active investors and have made at least 1 investment in the past 2 years or not. The responses that signaled a NO (which were very few) were filtered out and a sample of 243 responses was obtained.

Research Paradigm

The study adopts a Positivist research paradigm.

The assumption here is that reality exists externally and it can be measured. To operate in this particular paradigm, various frameworks have been used to collect primary data. The philosophy is selected because of the following important considerations:

- Objectivity:

Quantifiable data has been used.

- General to specific approach:

The research is built on a deductive approach. For that, 3 hypotheses have been established through already existing frameworks like the CAPM, Prospect theory, Ambiguity aversion theory and other logics established through examination of previous literature.

- Quantifiable:

For every Construct, 4 items were included. Each item set was composed of a 5-point likert scale based on the following pattern: 1=Strongly Disagree, 2= Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree

Research Design

The study uses a quantitative, causal research design based on questionnaire methodology. The event is the climate shock which shapes the investors' perceptions regarding climate risks and triggers the investors' financial behavior pushing them to choose between a continuing investing in their regular portfolio firms or transforming their portfolio to make it more green.

- Moderated Mediation Model: The simultaneous testing of Pro-environmental attitude mediates the relationship between risk perception and investor behavior and whether the shock translates into a strong perception or not.

Population, Sampling and Sampling Technique:

To evaluate the investor's dilemma, the data collection follows a structured approach:

Population:

The target population consists of retail investors working in corporate sector of Pakistan. These investors belong to various companies, major ones of which include Finca microfinance bank, Faletti's hotel, Arif Habib ltd, Avari Hotel, etc. However, it was not limited to the employees in these companies only. For instance, a female investors who were housewives and had primarily mad small scale investments through their savings also filled the questionnaire.

Sampling Technique

Purposive (judgmental) sampling technique and Snowball sampling technique have been employed here. This non-probability sampling approach has been used to ensure maximum participation. Based on limited contacts, the purposive technique had to be employed along with snowball technique to ensure that the questionnaire reached maximum targeted respondents.

Sampling

After the exclusion of non-active investors and only including active investors who had made at least 1 investment in the past 2 years, the sample reached a total of 243 responses.

Time period

Sampling was done for about 6 weeks. Data collection in the first 2 weeks was slow, however, after the incorporation of snowball sampling technique, it picked pace and the final 243 responses were collected approximately by the end of the sixth week on google forms.

Measurement instruments

To empirically test the integrated model, various frameworks have been used. These instruments translate the effects of climate risk and investor behavior into quantifiable metrics.

Independent Variable

The measurement of climate risk was done with 4 item construct. Each item was based on a question with 5 point Likert scale which was developed by Bohm and Mader (2009).

Mediating Variable

The measurement of Pro-environmental attitude consists of 4 item construct. Each item was based on a question with 5 point likert scale developed by Dunlap et al. (2000).

Moderating Variable

The measurement of financial literacy was carried out with 4 item construct. Each item was based on a question with 5 point likert scale.It was Adapted from Lusardi and Mitchell (2011).

Dependent Variable

The measurement of financial literacy is explained as follows: 4 item construct. Each item was based on a question with 5 point likert scale.by Riedl, and Smeets (2017).

Sample analysis

This study is conducted using primary data collected through questionnaires. Since the research question is centered on the behavior of investors in emerging economies like Pakistan, the questionnaires were filled by investors belonging to different age groups and different portfolio sizes. The sample had young investors such as university students who had just opened their accounts with the Pakistan Stock Exchange and had less than 2 years of investing experience. At the other extreme, the investors belonged to the 55+ age group who had more than 10 years of investing experience.

The analysis was done using SPSS and AMOS to investigate the hypothesized relationship between the variables.

The following outcomes were obtained:

Descriptive statistics:

This section is further divided into two parts. One deals with the demographics of the study. For that, Age groups, years of investing experience and Education level have been considered. Simple size corresponds to 243 respondents. Analysis revealed the following results:

The results depict that maximum percentage of the questionnaire belonged to people falling within the 31-45 age bracket, followed by the 45-60 age bracket. Results for years of investing experience indicate that most of the people had moderate experience ranging from 2 to 5 years. They were neither under-experienced nor overly experienced to show various kinds of biases. Finally we could conclude that educational barriers in this particular study do not exist since most of the people who filled the sample at least hold a master's degree, followed by a graduate degree.

Table 1: Demographics

Characteristic	Classification	Frequency	Percentage
AGE	18-30	37	15.2%
	31-45	112	46.1%
	45-60	91	37.4%
	60+	3	1.2%
Years of Investing Experience	Less than 2	48	19.8%
	2-5 years	108	44.4%
	6-10 years	69	28.4%
	More than 10 years	18	7.4%
Education	Under-graduate	12	4.9%
	Graduate	46	18.9%
	MS/M.Phil.	178	73.3%
	PHD	7	2.9%

Data Normality Analysis

The second part of descriptive analysis deals with data normality analysis. For this, the data file in SPSS was subjected to descriptive analysis where mean, standard deviation, skewness and kurtosis were checked. For the data to be normal, we follow the rule devised by Blumer in 1979. According to this rule,

skewness estimated values must lie between -1 and +1, while kurtosis estimates should lie between -2 and +2. Skewness and kurtosis values for each item were checked, the following values were reported:

Table 2: Descriptive Statistics

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
CRP1	243	3.527	.9194	-.111	.156	-.521	.311
CRP2	243	3.428	.8708	-.156	.156	-.205	.311
CRP3	243	3.638	.8483	-.254	.156	-.298	.311
CRP4	243	3.284	.8706	.020	.156	-.463	.311
PEA1	243	3.593	.8496	-.293	.156	.086	.311
PEA2	243	3.494	.8301	-.046	.156	-.539	.311
PEA3	243	3.741	.8447	-.390	.156	-.144	.311
PEA4	243	3.416	.8838	-.194	.156	-.307	.311
FL1	243	3.259	.8830	-.097	.156	-.359	.311
FL2	243	3.214	.8102	-.269	.156	.258	.311
FL3	243	3.424	.8414	-.471	.156	.247	.311
FL4	243	3.053	.8487	-.307	.156	-.085	.311
SIB1	243	3.510	.8737	-.219	.156	-.140	.311
SIB2	243	3.440	.8279	-.139	.156	-.152	.311
SIB3	243	3.621	.8652	-.264	.156	-.188	.311
SIB4	243	3.329	.9263	.022	.156	-.239	.311
Valid N (listwise)	243						

All of the above values indicate that the data is normally distributed and the values are well within the range.

Reliability Analysis

An internal consistency analysis was conducting using Cronbach's alpha as the benchmark for this analysis. The corrected item-total values ranged from 0.544 to 0.684. This indicates that all items contribute significantly towards the overall construct. These values further depict that each item is significantly correlated with the total scale score.

According to Nunnally and Bernstein (1994) in their Psychometric Theory, inter-item correlations should be at least 0.3 to prove that they contribute towards the scale (Nunnally and Bernstein, 1994).

The Cronbach's alpha values if item deleted ranged from 0.889 to 0.896, suggesting that removal of any specific item would not significantly lead to the improvement in of overall scale. This suggests that the all the items belonging to four variables i.e. Climate risk perception, Sustainable Investment Behavior, Financial Literacy and Pro-environmental Attitude are all internally consistent and stable.

Table 3: item-total statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CRP1	37.543	42.266	.638	.892
CRP2	37.642	42.305	.678	.890
CRP3	37.432	43.122	.619	.893
CRP4	37.786	43.218	.591	.894
PEA1	37.477	42.449	.684	.889
PEA2	37.576	43.138	.634	.892
PEA3	37.329	43.230	.612	.893
PEA4	37.654	43.161	.586	.894
FL1	37.811	42.633	.636	.892
FL2	37.856	43.454	.621	.893
FL3	37.646	43.403	.598	.894
FL4	38.016	43.901	.544	.896

Although the item in financial literacy scale (FL4) showed the lowest values for cronbach's alpha compared to other items, and its deletion could increase the cronbach's alpha to 0.896, but, this improvement is negligible. Therefore, FL4 could be retained. The instrument is therefore reliable for subsequent analyses.

Table 4: Correlations

		AVG_CRP	AVG_PEA	AVG_FL	AVG_SIB
AVG_CRP		1	.422**	.388**	.479**
			.000	.000	.000
		243	243	243	243
AVG_PEA		.422**	1	.406**	.592**
		.000		.000	.000
		243	243	243	243
AVG_FL		.388**	.406**	1	.226**
		.000	.000		.000
		243	243	243	243
AVG_SIB		.479**	.592**	.226**	1
		.000	.000	.000	
		243	243	243	243

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4 shows the relationship corresponding to the Pearson Correlation Coefficients between the four constructs namely

- Climate Risk Perception (CRP)
- Sustainable Investment Behavior (SIB)
- Financial Literacy (FL)
- Pro-environmental Attitude (PEA)

It shows the association between attitudinal and psychological factors and the importance of the factors in shaping the overall investment behavior of individuals.

All correlations are significant at 0.01 level (1%) indicating robust associations across the constructs.

The correlation between Climate Risk Perception (CRP) and Sustainable Investment Behavior (SIB) is 0.479, which is positively significant. This means that people with a higher climate risk perception, or more specifically, people with the ability to perceive climate risk are more likely to engage in sustainable investment behavior. For CRP and PEA, the correlation is again positively significant and demonstrates a value of 0.422. This indicates that stronger climate risk perception is associated with stronger pro-environmental attitude. People in such a case are more likely to engage in ESG initiatives and attitudes that promote low carbon emission, low pollution and ethical behavior. For CRP and FL, the correlation value is 0.388, which is again positively significant. This indicates a moderate linkage. Greater financial literacy is associated with greater awareness regarding climate risk and people are more likely to shape their climate risk perceptions in a better and educated way when they possess the necessary and required financial education.

Pro-environmental attitude and Sustainable Investment Behavior show the strongest correlation in the table. There is a strong positive relationship between these two variables suggesting that individuals with stronger Pro-environmental attitude are more likely to adopt Sustainable Investment Behavior. Financial literacy also tends to support Pro-environmental attitude. A correlation between these two of 0.406 again shows a positively significant correlation. Finally, FL and SIB also show a weak (0.226) but positive and significant correlation. This confirms that FL does predict SIB but in a weaker way compared to the other attitudinal variables.

Hence, the correlation matrix confirms that attitudinal variables are more strongly related to sustainable investment behavior. This could be confirmed from the fact that Pro-environmental attitude (PEA) appears as the strongest and most influential predictor. Literature on Financial literacy suggests that while financial knowledge is important and significant but it may not drive sustainable investment behavior alone in a strong way unless accompanied by strong attitudes. This is because people do possess the knowledge but implying that knowledge in investing behavior takes more than just education. It requires people to evaluate their attitudes and perceptions as well.

Multicollinearity Analysis:

Multi-collinearity occurs when the predicting variables are highly associated with each other in simple linear regression, meaning, that one variable could be easily predicted by the other variable with

great accuracy. Multicollinearity is specifically analyzed to check the importance of each single variable and that its importance is not obscured by other predictors in the model.

Table 5:

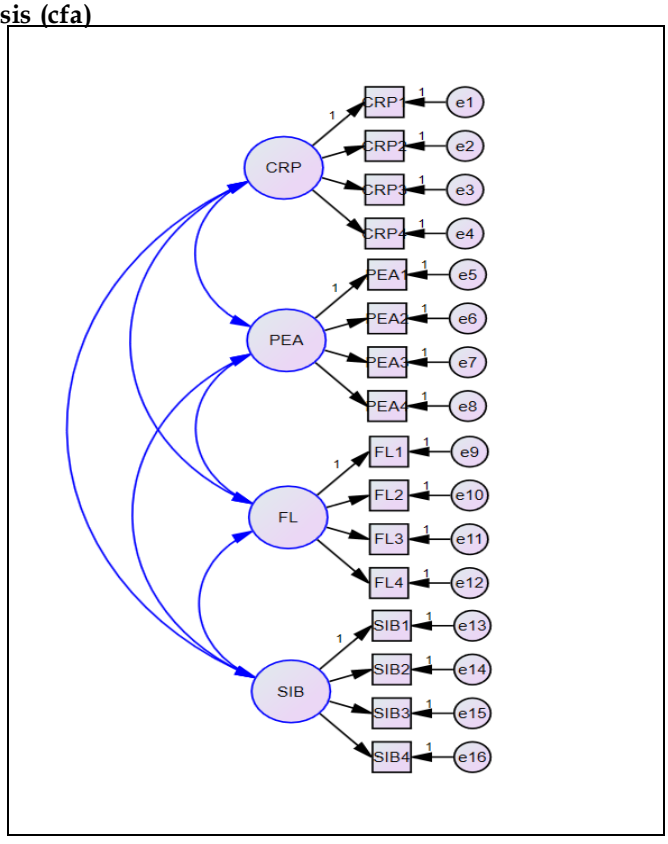
Variable	VIF
Climate Risk Perception	1.306
Pro-environmental Attitude	1.328
Financial literacy	1.286

To analyze multicollenarity, we look at the VIF values of each of the predicting variables. In SPSS, the results were obtained using linear regression, treating SIB as dependent variable while CRP, FL and PEA as the predictors. The requirement for collinearity was checked and the results obtained are depicted in table 5.

According to Hair et al. in their book Multivariate data analysis, the threshold value for VIF is 10. All of the values for the variables in table 5 are value below the cutoff value of 10. This indicates that variables are not highly correlated with each other. Multicollinearity is not a concern in this regression model and the variables retain their unique essence. All variables contribute unique explanatory power to the model.

The analysis confirms that the regression model is free from multicollenarity concerns. This strengthens the validity of regression analysis ensuring that the variables namely Climate Risk Perception, Pro-environmental Attitude and Financial literacy could be analyzed and interpreted reliably.

Confirmatory factor analysis (cfa)



Confirmatory factor analysis is a specific technique within structural equation modeling that is used to validate a specific measurement model. To check whether the observed items correctly validate the latent constructs, confirmatory factor analysis is used. AMOS Graphics has been specifically used for this technique.

Firstly, the model demonstrated in the figure depicts the following factor loadings:

Table 6:

			Estimate
CRP1	<---	CRP	.846
CRP2	<---	CRP	.871
CRP3	<---	CRP	.874
CRP4	<---	CRP	.845
PEA1	<---	PEA	.864
PEA2	<---	PEA	.845
PEA3	<---	PEA	.852
PEA4	<---	PEA	.848
FL1	<---	FL	.854
FL2	<---	FL	.834
FL3	<---	FL	.841
FL4	<---	FL	.823
SIB1	<---	SIB	.874
SIB2	<---	SIB	.826
SIB3	<---	SIB	.885
SIB4	<---	SIB	.850

The recommended threshold for factor loadings is generally >0.4 (hair et al., 1998, 2010, 2014). The factor loadings for all of the items are well above this threshold, depicting a strong model and confirming good convergent validity.

Table 7:

Parameter	Value Obtained	Cutoff Value
CMIN/DF	1.158	<3
RMR	0.027	Closer to 0
GFI	0.947	≥0.9
AGFI	0.927	≥0.8
CFI	0.995	≥0.9
RMSEA	0.026	<0.08

To evaluate the overall model fitness, 6 major parameters have been discussed in table 7.

Firstly, CMIN/DF is a structural equation modeling model fit index. It refers to the minimum sample discrepancy ratio. To check how well the observed data fits the theoretical model, we look at this parameter. A model with the ratio of 3.0 or less is an acceptable model.

Secondly, the root mean square residual (RMR) is very close to zero, which means that the residuals between the observed and predicted correlations are minimal.

Thirdly, the GFI and AGFI i.e. goodness-of-fit and adjusted goodness-of-fit are also important parameters to check model fitness. Higher values depict a better fit. For both the parameters, the values are above the minimum required value, depicting strong model fit and adjustment for model complexity.

Fourthly, the CFI i.e. comparative Fit Index is again far above the cutoff value of 0.9. This indicates that the proposed model is explaining the data better than the null model.

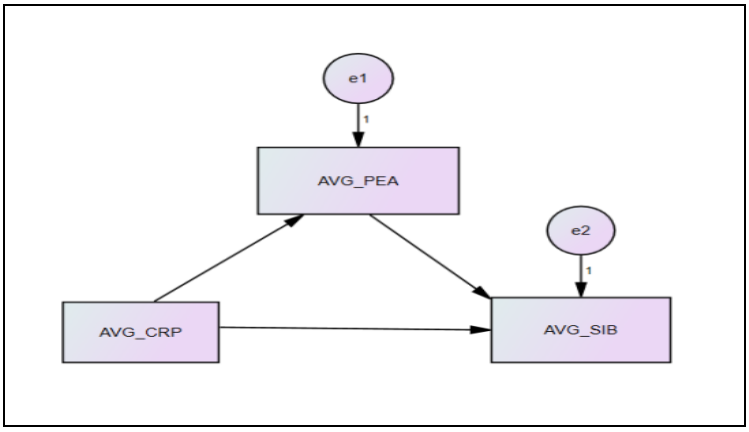
Lastly, the RMSEA values are well below the cutoff value again. This suggests that the proposed model has a very close fit to the population covariance structure.

Testing the hypothesized model

The hypothesized model has including the four variables have been tested using through 2 steps.

1. In the first step, simple the effect of mediator is tested in AMOS.
2. In the second step, a moderated mediation model has been used. This model is tested to understand the impact of Pro-environmental attitude as mediator while simultaneously investing under what conditions the moderation exists.

Evidence for Partial Mediation:



For this, the following mediation model has been tested in AMOS:

The analysis reported the following findings

Path	Direct Effect (β)	Indirect Effect (β)	Total Effect (β)	Significance
CRP → PEA	0.346 (0.339 std.)	–	–	p < 0.001
PEA → SIB	0.325 (0.316 std.)	–	–	p < 0.001
CRP → SIB	0.161 (0.153 std.)	0.112 (0.107 std.)	0.274 (0.261 std.)	Direct: p =0.014; Indirect: p < 0.01

The findings report that the model supports Partial Mediation.

The climate risk perception (IV) directly predicts pro-environmental attitude (β=0.339, p<0.001), which in turn significantly predicted sustainable investment behavior (β=0.316, p<0.001). Climate Risk Perception also had a direct effect on Sustainable investment behavior (β=0.153, p<0.014).

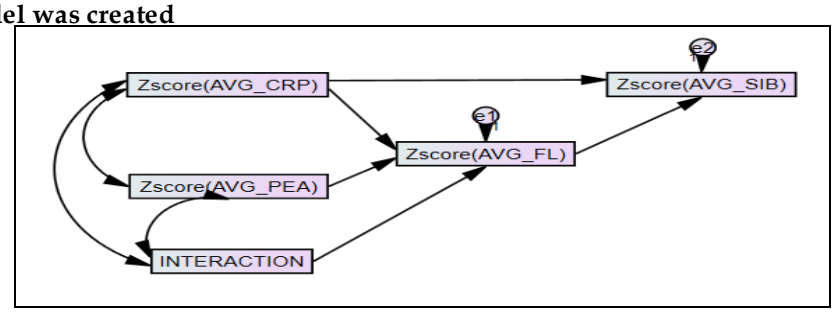
The analysis also reported indirect effects of Climate risk perception on sustainable investment behavior. The indirect effect or CRP on SIB was (β=0.107, p<0.01). Hence, these results report partial mediation, suggesting that Pro-environmental Attitude partially explains the relationship between Climate Risk Perceptions and Sustainable Investment Behavior.

Testing Moderated Mediation

In the second test, a moderated mediation model has been used. This model is tested to understand the impact of Pro-environmental attitude as mediator while simultaneously investing under what conditions the moderation exists.

To run this model, the Z scores of respective variables have been used. These Z scores were created in SPSS. The interaction term (CRP x FL) was also created in SPSS.

The following model was created



Mediation Model

The moderated mediation model was tested with Climate risk perceptions as the independent variable, Sustainable investment behavior as the dependent variable, financial literacy as the moderator and Pro-environmental attitude as the mediator.

The results revealed that Climate risk perception had a significant positive impact on Sustainable investment behavior (β=0.266, p<0.001). This finding confirms the fact that people who perceive climate risk strongly are more likely to engage in investment activities that support environmental, social and governance perspectives to contribute towards sustainable finance and vice versa. The moderator itself i.e. financial literacy did not directly predict sustainable investment behavior, but it mainly played its role by moderating the strength of the independent variable. This is confirmed by the fact reported by the analysis that the interaction is significant. The interaction term significantly predicted the relationship (β=0.150). This confirms that moderation was present. The relationship between CRP and FL was conditional on the interaction effect.

PATH	STANDARDIZED β	SIGNIFICANCE
CRP→SIB	0.266	P<0.001
Interaction term → FL	0.150	P=0.018
CRP → SIB (Total Effect)	0.262	P<0.001

Discussion:

The findings of this study reflect a complex interplay and interaction between attitudinal and psychological variables namely, pro-environmental attitude, financial literacy and climate risk perceptions. Together they play an important role in predicting and shaping the sustainable investment behavior of retail investors.

Consistent with hypothesis 1, climate risk perceptions shaped investors sustainable investment behavior. The coefficient was significant and positive confirming that the more risk the investors perceived; the more likely they were to engage in sustainable investment behavior. This also confirmed the fact that investors were sensitive to both physical and transition climate related risks. This also aligns with the previous studies in literature that climate risk has transformed into a systematic risk that needs immediate attention, comparable to the traditional market risks measured under the Capital Asset Pricing Model framework (CAPM). This evidence also supports the fact that climate risk is not firm specific but an important macro-economic factor influencing asset prices and portfolio strategies.

Mediation through Pro-environmental Attitude

The mediation pathway was validated successfully, confirming the fact that climate risk perceptions not only directly influenced the sustainable investment behavior of investor, but it also played it role by environmental attitude. The findings confirm that pro-environmental attitude amplified investors' perceptions. Investors who perceived climate risk more strongly due to pro-environmental attitude i.e. attitude involving ecological considerations strongly engage in a more sustainable investment behavior.

This mediation pathway confirms that attitude serves as a pathway and bridge between risk perceptions and actual behavior, reinforcing the importance of behavioral dimensions in financial decision making.

Moderation through Financial Literacy

The moderated-mediation framework analyzed in AMOS revealed that the interaction term for financial literacy was significant and positive, confirming that financial literacy strengthens the pathway from climate risk perceptions to sustainable investment behavior. Investors with higher financial literacy are better equipped to interpret climate related disclosures, assess transition risks such as carbon taxes, government regulations and policies. These investors were also capable of assessing the long-term viability of green investments.

Integrated Model and Investor Dilemma

The combined moderated mediation model reveals that sustainable investment behavior is most evident and pronounced when both "attitudinal" and "knowledge" factors are strong i.e. pro-environmental attitude and financial literacy respectively. This integrated model addresses the investor dilemma in existing research: "whether to continue investing in traditional, climate exposed stocks or to adopt a green approach and shift towards sustainable investment.

Implications

For emerging economies like Pakistan, these results hold considerable importance and significance. Retail investors represent a very large portion of financial and investment sector in such economies and their collective behavior could influence capital allocation towards sustainable investment. Such countries must strengthen and pay attention towards financial literacy programs for youth specifically and generally for the entire population to accelerate the transition towards green investment.

Limitations

Despite the valuable insights generated, this study is subject to several limitations that should be acknowledged:

Sample Scope: The research was conducted among retail investors in Pakistan. While this group represents a significant segment of the financial system, the findings may not fully capture the perspectives of institutional investors or policymakers whose decisions often shape broader market dynamics.

Geographical Context: The study is limited to an emerging economy context. Climate risk perceptions and sustainable investment behavior may differ substantially in developed markets where regulatory frameworks, disclosure standards, and investor awareness are more advanced.

Measurement Constraints: The constructs of climate risk perception, pro-environmental attitude, financial literacy, and sustainable investment behavior were measured using self-reported survey items. Such measures are prone to biases, including social desirability bias and subjective interpretation of questions.

Cross-Sectional Design: The research design is cross-sectional, capturing investor perceptions and behaviors at a single point in time. This limits the ability to establish causality or observe how perceptions and behaviors evolve in response to ongoing climate shocks or policy changes.

Moderated Mediation Complexity: While AMOS modeling allowed for testing moderated mediation, the complexity of real-world investor decision-making may involve additional variables not captured in this study, such as cultural values, political trust, or access to green financial products.

Disclosure and Data Availability: Climate-related disclosures in Pakistan remain limited compared to international standards. This lack of transparency may have influenced investor perceptions and constrained the accuracy of responses regarding sustainable investment behavior.

References

Agovino, M., Casaccia, M., Ciommi, M., Ferrara, M. and Marchesano, K. (2019) 'Agriculture, climate change and sustainability: The case of EU-28', Ecological Indicators, 105, pp.525–543.

Ahmed, R., Chen, X.H., Hoang, Y.H. and Do-Linh, C. (2024) 'Climate change effects and their implications for the financial markets: Evidence from the United Kingdom', Journal of Environmental Management, 366, p.121782.

Andersson, M.B. (2022) Analysis of climate- and financial volatility measures and their relation. Master's thesis (Mathematics-Economics). Aalborg University, Denmark.

Bender, J., Bridges, T.A. and Shah, K. (2019) 'Reinventing climate investing: Building equity portfolios for climate risk mitigation and adaptation', Journal of Sustainable Finance and Investment, 9(3), pp.191–213.

Blyth, W., Bradley, R., Bunn, D., Clarke, C., Wilson, T. and Yang, M. (2007) 'Investment risks under uncertain climate change policy', Energy Policy, 35(11), pp.5766–5773.

Bohm, G. and Mader, S. (2009) 'Emotional reactions to environmental risks: Consequentialism-based appraisals and ethical concerns', Journal of Environmental Psychology, 29(4), pp.452–461.

Campiglio, E. (2016) 'Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy', Ecological Economics, 121, pp.220–230.

De Jong, M. and Nguyen, A. (2016) 'Weathered for climate risk: A bond investment proposition', Financial Analysts Journal, 72(3), pp.34–39.

Di Febo, E. and Angelini, E. (2025) 'Transition risk in climate change: A literature review', Risks, 13(4), p.66.

Dunlap, R.E., Van Liere, K.D., Mertig, A.G. and Jones, R.E. (2000) 'New trends in measuring environmental attitudes: Measuring endorsement of the New Ecological Paradigm', Journal of Social Issues, 56(3), pp.425–442.

Dutta, A., Bouri, E., Rothovius, T. and Uddin, G.S. (2023) 'Climate risk and green investments: New evidence', Energy, 265, p.126376.

Ellsberg, D. (1961) 'Risk, ambiguity, and the Savage axioms', Quarterly Journal of Economics, 75(4), pp.643–669.

Hansen, L.P., Roberds, W. and Sargent, T.J. (2019) 'Time series implications of present value budget balance and of martingale models of consumption and taxes', in Hansen, L.P. and Sargent, T.J. (eds.) Rational Expectations Econometrics. Boca Raton, FL: CRC Press, pp.121–161.

Ibrahim, M.R. (2022) 'Climate risk, financial stability, and global capital allocation: A predictive analytics approach to assessing climate-related financial risk in international investment markets', Journal of Business and Management Studies, 4(4), pp.264–276.

Kahneman, D. and Tversky, A. (1979) 'Prospect theory: An analysis of decision under risk', Econometrica, 47(2), pp.263–291.

Krueger, P., Sautner, Z. and Starks, L.T. (2020) 'The importance of climate risks for institutional investors', Review of Financial Studies, 33(3), pp.1067–1111.

Levy, J.S. (1992) 'An introduction to prospect theory', Political Psychology, 13(2), pp.171–186.

Li, W., Qiao, Y., Li, X. and Wang, Y. (2022) 'Energy consumption, pollution haven hypothesis, and Environmental Kuznets Curve: Examining the environment–economy link in Belt and Road Initiative countries', Energy, 239, p.122559.

Lusardi, A. and Mitchell, O.S. (2011) 'Financial literacy around the world: An overview', Journal of Pension Economics and Finance, 10(4), pp.497–508.

Marshall, B.R., Nguyen, H.T., Nguyen, N.H., Visaltanachoti, N. and Young, M. (2021) 'Do climate risks matter for green investment?', Journal of International Financial Markets, Institutions and Money, 75, p.101438.

NGFS (2020) Guide for Supervisors: Integrating Climate-Related and Environmental Risks into Prudential Supervision. Paris: Network for Greening the Financial System / Banque de France.

Nunnally, J.C. and Bernstein, I.H. (1994) Psychometric Theory. 3rd edn. New York: McGraw-Hill.

Rao, A. and Kumar, S. (2025) 'Climate resilience through finance: The divergent roles of institutions and markets', Finance Research Letters, p.108008.

Riedl, A. and Smeets, P. (2017) 'Why do investors hold socially responsible mutual funds?', Journal of Finance, 72(6), pp.2505–2550.

Sandsmark, M. and Vennemo, H. (2007) 'A portfolio approach to climate investments: CAPM and endogenous risk', Environmental and Resource Economics, 37(4), pp.681–695.

Sharpe, W.F. (1964) 'Capital asset prices: A theory of market equilibrium under conditions of risk', Journal of Finance, 19(3), pp.425–442.

Sun, L. et al. (2024) 'State of China's climate in 2023', Atmospheric and Oceanic Science Letters, 17(5), p.100519.

Treynor, J.L. (1962) Toward a Theory of Market Value of Risky Assets. Unpublished manuscript.

Van Dijk, M. (2020) Assessing Climate Risk for Investment Portfolios. Rotterdam: Erasmus Platform for Sustainable Value Creation.

Xing, Z. and Wang, Y. (2023) 'Climate risk, climate risk distance and foreign direct investment', International Journal of Climate Change Strategies and Management, 15(1), pp.41–57.

Xu, W., Huang, W. and Li, D. (2024) 'Climate risk and investment efficiency', Journal of International Financial Markets, Institutions and Money, 92, p.101965.

Business transformation projects-The role of artificial intelligence and communication in enhancing strategic performance (RAICESP)

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Keywords
Artificial intelligence, complex communication techniques, AI, requirements, strategic business transformation projects, performance, enterprise and business architecture, decision-making

Abstract

This chapter's targeted focus is on the usage of Artificial Intelligence (AI) Subdomains (AIS) and especially Complex Communication Technics (CCT) in enhancing business performance. Knowing that enhancing business performance needs frequent Business Transformation Initiatives or Projects (BTIP). BTIPs are complex because there are many standard and AI tools and methodologies that are difficult to integrate with the enterprise's legacy constructs. Therefore, the BTIP adopts an In-House Implemented (IHI) RAICESP-based Transformation Framework (simply Framework) and the Framework integrates a Natural Language (NL) Processing (NLP) integration environment to define, manage, integrate, and improve RAICESP's Features (RAICESPF). The RAICESP needs an interdisciplinary approach and advanced Polymathics basics. The hyper-evolution of technologies and managing RAICESPs has started from casual communication, to written documents (by domain specialists), and today BTIPs use AI, CCT, and modelling methodologies to avoid the misinterpretation of verbal communication and written documents or prose. RAICESPs' models present concise business scenarios and solutions. The evolution of AIS and NLP Integration Environments (NLPIE), has the aim of improving RAICESPs and related features' management in general, but it reestablishes the "old" pseudo prose-age, in which requirements' definitions were documented in prose format and their generation by AISs makes features and requirements management even fuzzier, therefore how to manage such an evolution? Or is it rather a regression? And the main research question is: How can a BTIP manage and enhance RAICESPs' and common features and requirements' implementations without regressions? The probable answer would be "Using refinement, modelling, and architectural methodologies" to support the CCT, which is difficult to integrate with automated AISs, NLPIEs… This chapter proposes a Framework, CCT, and a realistic set of RAICESPs' management recommendations.

Introduction

The BTIP and the roles of AIS (AIS) and lingual components like NL, Large Language Models (LLM), Small Language Models (SML), and others, for managing, implementing, and capturing Enterprises' various needs and requirements like the RAICESP are of strategic importance; knowing that BTIPs are considered complex change and transformation projects. The usage of AISs and associated lingual components results in more complex BTIPs and associated RAICESPs' management, because (Cranmer, 2023; Vasudevan, & Reddivari, 2025):

- AISs include a wide range of heterogeneous AI topics and especially Generative AI (GenAI).
- GenAI is used to automate capturing user needs or RAICESP Elements or artifacts (RAICESPE) Generation (RAICESPG) in various APplication or Domains (APD), and AIS's contexts.
- In this chapter, it is assumed that AIS and the resulting RAICESPG clone the Human Factor (HF) and its Brain (HFB).
- The word 'cloning' is over-valuated, because the RAICESP manages and generates RAICESPEs and then 'converts' them to a well-defined format.
- To simplify the over-complex BTIP and RAICESP, it is recommended to use a Polymathic AIS (PAIS) concept, where GenAI is its central component.
- The RAICESP applies an avant-garde and Polymathic approach and uses Enterprise Architecture (EA) and AI-based Aggregated Models (EAA_Models).

- Presents a Mathematical Model (MM) based performance model.
- RAICESP and common Requirements management and engineering are central phases and they affect all BTIP aspects and performances.

EAA_Models include RAICESPG's elements, different requirement management formats, and adapted conversion-interfaces. RAICESPG processes use different AISs, like Deep Learning (DL) and Machine Learning (ML), which must be pretrained models to enable 'usable models'. Such models are pretrained on gained actions and experiences and are stored as Learning Processes for Requirement Management (LP4RM) that are related to data collections that are accessed through Dynamic In-Memory DataSets (DIDS). PAIS is used for AI-based integrations and interactions required to interrelate different fields like DL, ML, NLP, DIDSs, and others (Cranmer, 2023).

Figure 1. The PAIS' approach and AIS' interactions.



The PAIS is a "generalized intelligence" vision, which is antagonistic to today's popular commercial-products vision, which privileges a specialist AIS approach that is applied in specific and precise BTIP context. PAISs have many capabilities, like: 1) NLPIEs' integration and interfacing; Image-text recognition processes; 2) Dynamic Decision-Making Processes (DDMP); 3) Generating EA Models (EAM), and EAA_Models; and Heuristics-reasoning, which are used in different APDs' Requirement Management Engineering (RME) processes. AISs are related to Artificial Generic Intelligence (AGI), as presented in Figure 1, that is supported by the Information and Communication System (ICS) to: 1) Run LP4RM for RAICESPG and RAICESPEs; 2) Ensure needed performance for RAICESPGs; and 2) Manage experience-based LP4RMs with HF Intelligence (HFI). PAIS helps AISs based on BTIP (and hence the RAICESP) in integration processes and to use interdisciplinary approaches. BTIP starts with a Digital Transformation (DT) sub-project, which should be the 1st strategic goal of the BTIP or RAICESP Vision and Roadmap (RVR); to enable BTIP's or AIFs-based (re)engineering to implement IHI solutions and not external AIS commercial products, which guarantee too-fast progress and high costs. Simultaneously, the PAIS privileges Polymathic capabilities other than strictly AISs (Envisioning, 2025). External AI services and products based on RAICESP solutions are incompatible with IHI-solutions, which use EAA_Models to integrate 'loosely-coupled' external solutions. PAIS interacts with the RAICESP to enable frequent BTIP changes, and to enable also:

- The usage of IHI-concepts for the RAICESPs' and AISs' integrations.
- The management of RAICESPs' delimiters/interfaces, and RAICESPGs' operations.
- AISs-based RAICESPG processes to automate requirements management, and RAICESPEs by using DL/NL, NLP, ML, and other AISs.
- To manage LP4RM Repository (LPR) that persists requirements' management' related experiences, choreographies, and solutions.
- The LPR tries to proactively predict BTIP's problem-types, risks, and possible eXtremely High Failure Rates (XHFR).
- Robust BTIP's architecture(s), and EAA_Models to offer solutions by using EA-methodologies.
- Decision-Making (DM) Systems (DMS) which try to process and solve problem-types, and to mitigate risks and to execute enhancements' RAICESPs' Actions (RAICESPA).

- A specific research mixed-method and Polymathics for complex undertakings, like the RAICESP.
- RAICESPAs are applied in all RAICESP's actions, which are requested by EAA_Models and previewed in the RVR, to successfully achieve BTIP's goals and objectives.
- RAICESPAs are used in choreographies like Business Processes (BP) Models (BPM), or other types of WorkFlows (WF) modules, and ICS' components.
- RAICESPAs are a collection of semi-manual and automated actions.

The focus is on BTIPs and for that reason the author advises the reader to refer to his (IHI) Polymathic Transformation Framework (IHIPTF) related chapters/works, and guides, like: The IHIPTF-Guide (Trad, 2024a); The IHIPTF-Glossary (Trad, 2024b); A related core-syllabus (Trad, 2024d); The AHMM4PROJECT (Trad, 2024e); The AI-based transformations concept (Trad, 2024f); and this chapter's abbreviations section which can be found at the chapter's end.

RDP for RAICESPs' Management

Introduction and Basics

This RDP's related methodology, implementation (or prototype), and chapter use the following artefacts, assumptions, facts, and conditions (Trad, 2023a, 2024f):

- The Research-Question (RQ) is: "How can the RAICESP support BTIPs, RAICESPEs, and RAICESPGs ?". And the related Auxiliary-Question (AQ) is: "How can GenAI, AISs, and PAIS support RAICESPGs' and RAICESP's automated (re)generation processes?".
- Uses a Polymathic research mixed-method approach, which is a qualitative heuristics concept.
- The use of sets of configured, initialized, and hard-linked Critical Success Factors (CSF), Critical Success Areas (CSA), Key Performance-Indicators (KPI), and ICS' source code (NLPIE, or ICS' programming language) VARiables (VAR).
- A selected CSA maps (1 to 1) to RAICESP's important sections (this chapter is built on sections); and the 1st CSA (and hence the 1st section) is the RDP section.
- The evaluation is enabled and checked by the Applied Holistic Mathematical Model (AHMM) for RAICESPE (AHMM4RAI) and Framework's components.
- The evaluation and processing approaches are supported by the DMS and Knowledge-Management System (KMS) (simply Intelligence).
- The selected CSFs, CSAs, KPIs, and VARs are BTIP's sets of Factors; and these Factors are evaluated by Intelligence's IHI Dynamic Heuristics-Decision-Tree (IDHDT).
- Uses generated services (that map to IDHDT actions), to process and solve BTIP's and RAICESP's problem-types, and to offer solutions.
- It is assumed (which is a hypothesis that relates to the mentioned RQ), that BTIP's 'generated' services are stocked in Blocks to be called by ICS', RAICESPEs', and AIS' requests.
- It is assumed that BTIP's Refined, Unbundled (and transformation) Processes (RUP) of Legacy Requirements' Management (LRM), ICS's components, and other resources, were successfully terminated; and that the needed services were generated.
- Non-conventional modelling techniques like EA Modelling (or Models, EAM), RAICESPE Modelling (RAICESPEM), Composite AI Models (CAIM), ICS Models (ICSM), and intelligence interfaces.
- The used CAIMs contain EAMs, RAICESPEMs, and other types of models (which are simply EAA_Models). That implies that an EAA_Model is a mixture of the models.

Advanced Constructs

As shown in Figure 2, the RDP contains the following steps and phases (Trad, 2023a, 2024f):

- The Polymathic Literature Review Process (PLRP) that is an in-depth checking and analysis of the used resources. It has proven that there aren't any similar frameworks and concepts that use terms and techniques like RAICESPG, RUP, AHMM4RAI, EAA_Models... And more specifically the Polymathical approach.
- There aren't any relevant scholar-references which analyze the presented chapter's RQ, hypotheses/assumptions, and CSAs (or sections).
- BTIPs and RAICESPGs are very risky and have XHFRs, that has already been proven in previous

author's RDPs and PLRPs. And this major fact is the most relevant one that supports this chapter's and RDP's flow and conclusions.

- RQ's most important gap and weakness is that there is a major lack of Polymathic skills, concepts, profiles, and hence frameworks, that are essential for AISs, RAICESPGs, and it is recommended to apply the PAIS approach.
- The PLRP consulted resources like: 1) Articles, books (and chapters), and resources associated with RAICESPEs, RAICESPG, (P)AISs, EAA_Models, CAIMS, EAMs, ICSMs, AHMM, and RUPs; 2) Author's previously published chapters, consulting projects, and Framework; 3) RAICESP's architecture models and feasibility; 4) Various RAICESPE and RAICESPG topics; and 5) The application of the Polymathic Empirical Engineering Research Model (PEERM).
- A significant research gap was confirmed, and that implies that there is a need for RAICESP's research-analysis.

RDP's main phases are: 1) Setting up the Framework; 2) Phase "1" uses CSA's Decision-Tables (CSA_DT), and is RDP's heuristics-based evaluation-phase; and 3) Problem-types' processing and solving-phase.

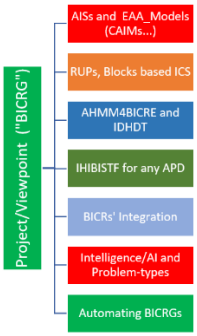


Figure 2. The RAICESPE and RAICESPG Viewpoint.

The Framework-Framework

BTIP's (and RAICESP's) main aim is to provide solutions (in the form of recommendations), patterns/concepts, and an RVR. Where the RVR includes BTIP's timeline that depicts the integration of RAICESP's components, like RAICESPE's WFs (RAICESPEWF). The RAICESP uses a well-established method, the Architecture Development Method (ADM) (The Open Group, 2011) that is The Open Group's Architecture Framework (TOGAF) main method. TOGAF is an BTIP's transformation-enabler. TOGAF's ADM-based Framework contains various Sections (FrameworkS): 1) Supports BTIPs and RAICESP's integrations; 2) Offers Framework's Platform (FrameworkP) and infrastructure; 3) Offers Framework's Cases (FrameworkC); 4) Offers RUP's transformed Blocks (FrameworkB); 5) Offers Framework's Dictionary (and Syllabus) (FrameworkD); and 6) Has an implementation/development Framework Environment (FrameworkE). The BTIP and RAICESP, need FrameworkSs, which provide the following:

- The FrameworkB that offers pools of (generated) Blocks (and unbundling concepts), and relates to existing EA methodologies, artefacts, and legacy resources, like TOGAF's ADM.
- The FrameworkCs illustrate BTIPs' and RAICESP's Applied Case-Studies (BACS) that support the Conceptual Proof of Concept's (CPoC).
- The FrameworkD is BTIP's reference dictionary; and some abbreviations can be found at the end of this chapter.
- The FrameworkE presents a transformation-concept and associated environment.
- The FrameworkM is a methodology which enables BTIPs and RAICESPs to interface with ICSs ' and AISs' components, and external methodologies.
- The FrameworkP shows BTIPs and RAICESPs ' usage of ICS platforms and infrastructures.

The FrameworkM applies EAA_Models to support BTIPs and standard methodologies, like TOGAF, Unified Modelling Language (UML), and others. The RAICESP requires all the presented sections to be used, but where the FrameworkM, FrameworkC, and FrameworkE are the most strategic ones.

The PEERM and RDP's Central Phases

This RDP's applicable phases are: 1) Phase "1" (Ph1) uses CSA_DTs, and is the RDP's empirical phase, which evaluates selected CSAs, CSFs, and their outcomes are summarized in Figure 21. This RDP's and chapter's CSAs are: a) The RDP for the RAICESP; b) The usages of distributed ICS, EA, EAA_Models, and basic technologies; c) The roles of AISs, NLP, AIA, and GenAI; d) The roles of RAICESPEs, RAICESPGs, and RAICESP; and e) BACSs and CPoC usages; and 2) Phase "2" (Ph2), presents how to solve a concrete RAICESPE problem-type(s), by using of Intelligence and its embedded IDHDT. This RDP applies the PEERM, which is optimal for BTIPs, RAICESP, AISs, and NLPIEs. The CPoC's final outcome is synthesized in Figure 6; and the Framework supports the RAICESP's implementation and offers a set of solutions and recommendations, which include an RVR. As already mentioned, the RDP applies the IHI Research Mixed-Method Approach (IHIRMMA) that is different from popular and conventional (that are mainly quantitative and statistical) disciplines, and is mainly a qualitative research model. The IHIRMMA includes (Easterbrook, Singer, Storey, & Damian, 2008; Quinlan, 2015): 1) The IDHDT that is a heuristics reasoning engine; 2) Specific and limited usages of Quantitative (Qn) Methods (QnM) for risks' mitigations; 3) The dominant Qualitative (Ql) set of Methods (QlM) for RAICESP's and POTP's common problem-types solving; 4) The IDHDT based dynamic LP4RMs, that are based on the pseudo-Action Research's (AR) learning approach; and 5) The AHMM4RAI, which supports and checks RAICESP's and enables its operations, like calling the IDHDT's and Intelligence's actions and processes. The RDP, IHIRMMA, IDHDT, and other mentioned components are complex, and they use performance-intensive processes that need powerful ICS', EA's, EAA_Models' very performant distributed architectures and basic technologies.

The Optimal Usages of Distributed ICS, EA, EAA_Models Architectures and Basic Technologies

The Basic Concepts

In this CSA's presents an integration concept for an enterprise's ICS, EA methodology, and EAA_Models resources to deliver an optimal platform and infrastructure. Knowing that ICSs, RAICESP, AIFDs, and BTIPs heavily use EAA_Models (that include EAMs, ICSM, CAIMs, and other models), repositories (for services/Blocks and resources) are exchanged using different formats. The mentioned exchanges require robust RAICESP Performance Measurement (RAICESPPM) (and management) on different BTIP levels and include:

- The optimization of ICS' modules and components' performances like central processors, memories, comm-buses, multi-threading…
- The optimization of DIDS' usage to improve the data-accesses performances.
- The optimization of Central Processing Units' (CPU) usage concepts.
- The optimization of EAA_Models' performances by applying well-designed diagrams.
- The checking of ICS' and related components' availabilities and scalabilities.

RAICESPPM is, in fact, an enterprise's performance measurement. The mentioned optimization processes use the AHMM4RAI and its internal MetaModels, where the AHMM4RAI ensures integrity-checking, Gap-Analysis (GAPA), Risk mitigation-management, and other operations. A MetaModel is a set of related DIDSs, QlMs, and QnMs; and modules like GAPA use the Framework's Factors Management System (FMS) and the Polymathic Rating-Weighting Concept (PRWC) for weightings' evaluations. The AHMM4RAI is linked to MetaModels, which can identify and set the initial collections of Factors to support the RAICESP in applying the PRWC, FMS, and Factors to be used by NLPIEs and DIDSs.

Using and Integrating DIDSs

RAICESPGs use IHI DIDS (IDIDS) based Architecture (IDIDSA) which improves the classical (or legacy) and "slow" Boolean Algebra based Architectures (BAA). The IDIDSA organizes ICS' resources, which are generally very busy processing static IDSs and large strings, which implies too frequent and unnecessary type and content conversions, which can be hindered. Therefore, IDIDSA enhances AISs', RAICESPG's, and hence ICS' performances. IDIDSA's main characteristics and capabilities are:

- It can enhance a BAA and simplify ICS' architectures.

- Improves all ICS' processing and platform operations.
- Enables the processing of EAA_Models and other types of operations and models.
- Enhances ICS' Programming Languages (PL) usage and performance…
- An IDIDSA abstracts and simplifies RAICESPG's integration, interfacing, and management.
- RAICESPGs Processing (RAICESPGP) enhancements and management, by using interface classes like the RAICESPGP_Class, where RAICESPGP's abstractions are mapped to concrete PL classes.

The RAICESPGP's abstractions, entities, and attributes have the following descriptions, characteristics, and constraints:

- W is a Weighting set and used by variables (VAR).
- VARs are evaluated, and then the resulting performance value V is returned.
- …
- IDA represents IDIDSA's artefacts.
- MDL represents various types of models.
- ICO represents ICS', RAICESPG's, and AIS' operations.
- PLA represents Programming Languages (PL) Activities and NLP also.
- ….
- Δ is the mathematical sign for GAPA.
- PHS represents a BTIP phase.
- Itr represents a PHS iteration.
- PRC represents RAICESPGP's processing value.
- EVAL represents PRWC's processing value.
- E1 and E2 are intermediary variables.
- ….
- $PRC(PHS)=IDA+\sum MDL+\sum ICO+\sum PLA\ldots$ (1.1)
- …
- $EVAL(PRC)=\sum PRC(PHS)$ (1.2)
- …
- $E1=EVAL(PRC[Itr-1])=\sum PRC[Itr-1](PHS)$ (1.3)
- $E2=EVAL(PRC[Itr])=\sum PRC[Itr](PHS)$
- …
- $\Delta(RAICESPGP(Itr))=E1-E2$ (1.4)
- …
- $BTIP\_Status=\sum\Delta(RAICESPGP(Itr))$ (1.5)

The Distributed RAICESPGP

The RAICESPGP needs a distributed ICS or the Cloud, and such a Cloud-based RAICESPG(P) is a collection of deployed-hosted RAICESPGPs on the 'On Premises Hosting Model', which the enterprise manages RAICESPGPs (Charles, 2017; The Open Group, 2021). RUP unbundles and transforms the enterprise's siloed legacy components and resources into AIS-enabled components in RAICESPG's context. RUP-based transformations enable the auto-generation (and refinement) processes, which are RAICESPG's basic activities. RAICESPG can also regenerate applications' roadmaps, RVR, and various types of cartographies. RAICESPG's auto-generation processes use existing EA modelling language environments like the Archimate Modelling Language (AML) (The Open Group, 2025). For the RDP, the AML is used for RAICESPG's activities like auto-generation, refinements, and classifications; applying the various types of RAICESPE Diagrams (RAICESPED) and other assisting diagrams (Engelsman, Jonkers, & Quartel, 2010; Togaf-Modeling, 2020). The distributed ICS (or Cloud) enables IDIDSA and EAA_Models implementation for all APDs

Cloud-based RAICESPGs use AIS engines like the Google Cloud Platform's (GCP) AI-Engine, include ML models (MLM) and support : Prepare, Build, Validate, and Deploy activities (Green, 2020; Sullivan, 2020). RAICESPGs require efficient technologies that include (Gomstyn, Jonker, & McGrath, 2024): 1) Distributed ICS resources like CPUs, memory, hard-disk, and others; 2) Real-Time (RT) Operating

Systems (OS); 3) Serverless RAICESPG-platforms; and 4) RAICESPG-functions for event-driven and serverless installations. Distributed ICSs are very important for applying RAICESPGs for different APDs.

RAICESPGs and APDs

RAICESPGs in APD contexts can offer: 1) A generic-platform approach based on "On-demand" self-services, requirement management, resource planning, availability, and Cloud-services models: 1) Infrastructure as a Service (IaaS); 2) Platform as a Service (PaaS); and 3) Software as a Services (SaaS). These are enforced by AI(FS) as a Service (AIaaS). BTIPs uses AIaaS to support RAICESP's activities in a specific APD; and for an APD, RAICESPG's evolution can be evaluated using the PRWC. SaaSs and AIaaS-based RAICESPG ensure: Scalable; Secured; and Reliable Cloud-platforms that can (IBM, 2025): 1) Synchronize and streamline RME processes; 2) Manage RAICESP's activities; 3) Balance APD's efficiencies and performances; 4) Ensure RME's continuous developments; 5) Enhance sustainability; 6) Automate RAICESPGs and software integration processes; 7) Support accessibility of quality of DIDSs; 8) Streamlines RAICESPEs with applications and their components; 9) Enforce governance, compliance and audits; 10) Supports the management of innovative requirement management-concepts to generate RAICESPEDs. RME is an engineering method (and process) that extracts, defines, documents, and maintains BTIP's or it modules' requirements or needs, which also includes related relations, associations, methods/functions, and constraints. It is an APD activity and not a classical Software Engineering (SE) one, and is a very critical BTIP phase, because it ensures that the final transformed ICS and components meet the defined needs/requirements. The requirements are defined by an actor, which can be an APD analyst, user, or stakeholder. And RME's main characteristics are (Engelsman, Jonkers, & Quartel, 2010; Sajna, 2025):

- The elicitation sub-phase is responsible for gathering information about the final ICS' requirements management from different actors.
- The analysis sub-phase is responsible for analyzing, clarifying, and refining gathered requirements management and information.
- The specification sub-phase is responsible for documenting requirements management by using AML diagrams (or others) in a synchronized, concise, and unambiguous way.
- The validation sub-phase is responsible for ensuring that the depicted or documented requirements' management is accurate and can be integrated in the ICS.
- The management sub-phase is responsible for tracking, storing, and controlling well-organized requirements' management changes that are managed by BTIP's implementation lifecycle.
- Map RME artefacts (or RAICESPEs) to other BTIP resources.
- In essence, an RME bridges the gap between real-world problems and functional software or system solutions and components.
- It ensures that the BTIP or the final product is technically robust but that it also meets users' requirements, management/needs, and expectations.
- Uses modelling languages like the AML to create or generate RAICESPEDs.

RAICESPEDs and AML

The RAICESP uses the Requirement Management and Engineering Process (RMEP) that interacts with EA methodologies like TOGAF and its ADM, to enable the implementation of requirements management, and can also include (Engelsman, Jonkers, & Quartel, 2010).:

- A generic requirement management cycle which is repeatable in ADM's phases and contains 3 steps: 1) Problem-type(s) investigations; 2) Proposition of possible (or alternative) solution(s); and 3) The selection, validation, and of the selected solution(s).
- A framework like the Framework that sets applied RME techniques in the critical cycle, and it enables the configuration of RMEPs so they fit in the enterprise by (re)implementing LRMs and using ADM's phases.
- To use the AML, which should be enforced to enable support for requirements management modeling. Knowing that AML complements EA like TOGAF, by applying a modeling-language.
- The RME cycle is similar to problem-chains that have two distinct views on EAMS: 1) The designed

artifact or RAICESPE that can represent a solution for a given problem; and 2) Is a "frame of reference" that delimits requirements management's design (or solution area).

RAICESPEDs and RMEs Cycles

The RME starts with the request for 'organizational change' or BTIP, as such complex undertakings cannot be treated as starting from scratch (or greenfield), but must transform legacy resources like LRMs, as shown by the EA/architecture model A1. This means that requirements' management (or goals) defined the 'requirements model M' must be defined as 'relative' to EA/architecture A1, to enable the requested changes. Therefore, EA/architecture A1 behaves as a problem-type oriented RME. Then, a new version of EA/architecture A2 is designed and implemented to support requirements management and goals integration in model M. This means that EA/architecture A2 is a design artifact that results from a solution-oriented RME. The RME decomposes requirement management in 3 steps (Engelsman, Jonkers, & Quartel, 2010):

- Problem-type investigation focuses on the problem-type, like 'organizational change', by analyzing the causes and by defining goals to manage these changes.
- Investigate solution possibilities or alternatives to refine defined goals to find possible or realistic solutions. And also analyses to predict gaps between refined goals and realizations.
- Validates possible solutions and tries to select the 'optimal' one.

The RME can have a generic approach, and its cycles can be repeated in TOGAF's ADM phases, and the related identification, analysis, and refinements of possible solutions come in the 2nd-step". That needs methodologies like EA. All these operations must be pre-defined in Vision and Roadmap Viewpoint's (VRV) architecture vision.

AISs, NLP, AIA, and GenAI Support

AISs, NLPIEs, LLMs, and Unified Communication

This CSA describes the applied AISs, NLPIEs, LLMs, GenAI, and unified communication that are needed to support RAICESPGs and EA/ADM's automated processes. Such complex processes are needed to facilitate RME's and ADM's phases interactions and to avoid XHFRs. And the mentioned fields are stubs for future RAICESPGs-related processes.

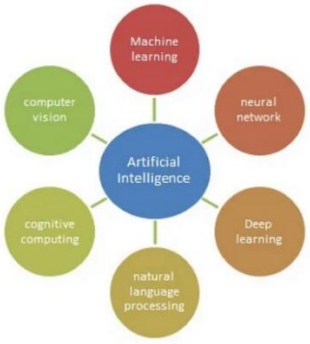


Figure 3. AISs' used subjects (Rancho Labs, 2021).

The PAIS can be built on modelled and inter-related AISs that support RAICESPGs through automation processes. Such processes use NLP scripts and Models (NLPM), DDMP… As shown in Figure 3, AISs' main topics are (Rancho Labs, 2021; Garanhel, 2023; Riedl, 2023; Trad, 2022; Lisowski, 2025; Khan, 2024):

- NLP processes NLs and processes IDIDSs by applying: Classifications; Searching; and analyzing data from input streams.
- LLMs are applied for different types of NLs to mimic HF's interpretations.
- NLPs and LLMs are different and are changing HFs' interactions with AISs and RAICESPGs.
- LLMs are AI-Models which can analyze, understand, and apply RAICESPGs.
- ML applied algorithms to support ICS' components to support: Supervised; Unsupervised; or Reinforcement Learning actions for requirements management.

- Deep Learning (DL) uses Data-Analysis (DA) for (self)learning, and offers usable results.
- DA processes IDIDSs and interfaces structured data storage.
- BigData (BD) manages huge data-volumes and applies the 3 Vs: Volume, Velocity, and Variety.
- The Model Context Protocol (MCP), is a unified communication-environment for AISs and Agentic AI (AIA).
- AIAs support RAICESPGs by: Generating RAICESPEDs; Generating Code; Summarizing reports; and Communicating HFs.
- NLPIEs and related NLP-Scripts manage ICS' resources and NLPMs, which in turn analyze and understand NLs to generate RAICESPEs.
  AIA WFs (AIAWF) support RAICESPGs' processes by applying automated-choreography.

Using AIAs, AIAWFs' for RAICESPGs

The BTIP, RAICESP, and RAICESPGs use the AIA, which offers (Stryker, 2025; FabriXAI, 2025; Winland, Bozorg, & Stryker, 2025):

- Application Programming Interfaces (API) management.
- Tasks-operations management that requires designing WFs.
- Prompts to support AIAWFs' actions to enable GenAI Models (GenAIM).
- A Multi-AIA (MAIA) interface which supports RAICESPGs and related problem-types.
- To share experiences and enhance linked LP4RMs.
- AIAWFs deliver decisions with non-HF's commanding and synchronize RAICESPGs.
- AIAWFs offer a concept for complex problem-types that require an iterative approach.
- AIAWFs major steps are: 1) Understanding APD's problem-types and gathering information for RMEs; 2) Applying checking and diagnostics for RAICESPEs; 3) Using tools for RAICESPEDs; and 3) Finalizing and learning.
- An EAA_Models based AIA Architecture(s) (AIAA).
- AIAAs support "thinking", learning, based on IDIDSs, and refine RAICESPE
- Continuous processes to tune RAICESPGS by improving LP4RMs and GenAI's processing.
- Adapts autonomously to new contexts based on LP4RMs, and delivers RAICESPEDs.

Using LP4RMs and Applying GenAI for RAICESPEDs

For different APDs, high-quality RAICESPEDs are important for supporting BTIPs and for ensuring less labor-intensive processes, minimizing HF's interventions (and expertise), improving maintenance processes, and continuous enhancements of RMEPs. The RAICESP is supported by GenAI and LLMs, which enable enhancements, by (Khan, 2024): 1) Streamlining RAICESPG processes; 2) Offering AIAWFs which support DIDS-processing, retrieval, and evaluations; 3) Reengineer requirements' management and RAICESPEs; 4) Refine LRMs to deliver RAICESPEDs; 5) Intelligence offers RT-actions deliver insights: 6) Improves RAICESPEs' and RAICESPGs' effectiveness; 7) Uses the NLP, to optimize DIDS; 8) Offers multi-tasking, and specialized analysis; and 9) Offering deployment-processes for RMEs. GenAI is applied to generate or create new requirements management content, which can include: texts and/or images, based on defined conversion patterns. And then LLMs generate HF-like texts, and can be supported by Small Language Models (SLM) which carry out specific tasks that require less effort and IDIDSs. And at last, the Retrieval-Augmented Generation (RAG) enhances the process models by extracting detailed information. There are various GenAI tools that can support in RAICESPGs by using (Engelsman, Jonkers, & Quartel, 2010; Sajna, 2025; Generativeai, 2025):

- Text Generation (TG), which applies MLMs to generate new texts based on requirement management patterns.
- Image Generation (IG), which applies DL-algorithms that generate requirement management diagrams.
- Video or presentation Generation (VG) uses algorithms to generate requirements management-related presentations as videos.
- Technological-transformations (or BTIPs) which apply AISs and GenAI that are changing how EA and RME-tasks are done.

- Governance, which has profoundly changed by AISs' usage that incorporate also AML, and frameworks to manage requirements' management.
- Iterative ADM phases and GAPA for RMEs, because according to 'Harvard Business Review' more than 50% of BTIPs face failure because of weak management.
- RAICESPEDs that capture user needs and transform them into requirements management.
- RAICESPG classifies and prioritizes requirements management and automates the RME, which is an iterative process in which actions are executed in all ADM phases.
- The RMEP combines other RME-processes which run simultaneously. It analyzes and documents the collected requirements' management.
- Common error detection and corrections; such errors can be: 1) Scope-creep, which are the result of "minor changes" that can cause major problems; 2) Over-engineering can have negative impacts on requirements' management; 3) Insufficient information and feedback; and 4) Various types of resistances
- Integration of RME in SE processes improves communication and inputs.
- AIS to RMEPs is efficient and hence implies that the transformed ICS becomes trustworthy.

Enabling AIS for RAICESPGs

AIS are AI-systems that have the following Factors, robustness, fairness, explainability, interpretability, transparency, safety, and security. The mentioned Factors (or qualities) generate trust and confidence in AI-systems among BTIP's actors like engineers and users. And offer the following (Gomstyn, Jonker, & McGrath, 2024).:

- Mitigates potential risks that are related to EAA_Models and CAIMs, such risks which can negatively influence users, enterprises, and others.
- Guides enterprises in their development, integration, and evaluation of AISs, and there are frameworks to support such activities like the ones from: 1) The National Institute of Standards and Technology (NIST) AI Risk Management Framework; 2) EU's Ethics Guidelines for Trustworthy Artificial Intelligence; and 3) Organization for Economic Co-operation and Development (OECD) AI Principles.
- A better understanding of how ICSs and AISs are crucial for trusting their efficacy, but AISs, MLMs, and DL models are used as black boxes with practically no transparency.
- Proactive detection of CAIMs that underperform or generate harmful outputs, which undermine trust.
- Offering guiding-principles and goals for AIS which can include: Accountability, Explainability, Fairness, Interpretability (and transparency), Privacy, Reliability, Robustness (and security), and Safety.
- Accountability entails holding AIS actors accountable for the proposed AI solution.
- Explainability verifies CAIM's outputs and delivers explanations.
- Fairness is the equitable treatment of users, people, and groups.
- Privacy is about the protection of personal (or sensitive) data-information that is used.
- Reliability is intended to function without failures for a defined period.
- Robustness and security offer protection mechanisms to block adversarial attacks and unauthorized access, minimizing cybersecurity risks and vulnerabilities.
- Safety refers to AISs which protects HF's life, health, property, and environment.
- The list of potential risk categories that can harm: People, Enterprise, and Ecosystem.
- Detect and prevent dire scenarios and consequences by mitigating risks.
- Clarifying the differences between the terms AIS, Ethical AI (EAI), and Responsible AI (RAI), which are frequently interchanged.
- AIS is an AI-system or AFSs that establish trust in an enterprise or BTIP.
- EAI is an AI-system that has ethical considerations, which reflect HF values and moral perceptions.
- RAI is an AI-system that encompasses and embeds ethics in AISs and AIAWFs.

A BTIP can apply a specific strategy to achieve AIS, where AI-systems, AI-algorithms, and DIDS respect AIS principles by applying (Gomstyn, Jonker, & McGrath, 2024).: 1) Assessing AIAWFs; 2) Continuous monitoring for problems detections; 3) Risk management by using a risk-management framework; 3) Applying automated documentation; 4) Using AI governance frameworks; and 5) Building an IHI concept for AIS and EAI. An enterprise or a BTIP must establish an EAI for AIS (EU, 2019).

RAICESPEs, RAICESPGs , and the RAICESP

Integrating and Respecting AIS

AIS minimizes major problems and uses the associated framework. But managers are not aware of potential risks that are related to AISs; and The BTIP and RAICESP are considered as AIS undertakings when they have met the following principles and uses a 4 steps framework to enable the use of AISs in an ethical, lawful and robust manner, and these steps, principles, and benefits are (Abercrombie, 2024):

- In step 1 of 4, the BTIP defines AIS's and RAICESPG's strategies, design concepts, and planning schemes; having the focus on analyzing an HF-oriented BACS to assess risks and impacts.
- In step 2 of 4, the BTIP defines data and DIDS' strategies; Reliable quality-data is AIS' kernel.
- In step 3 of 4, the BTIP defines and sets up the required algorithms, logic, and instructions for implementing the AISs, DDMPs, and RAICESPGs.
- In step 4 of 4, the BTIP defines deployment and governance strategies and processes.

Integrating and Respecting AIS based RAICESP artefacts

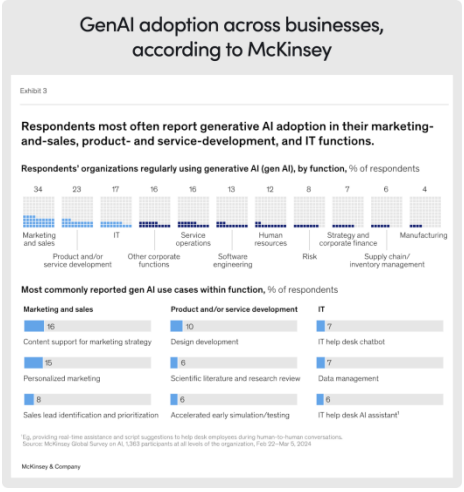


Figure 4. The holistic approach to GenAI (Matuszewska, 2024).

AISs like GenAI, ML, and DL use autonomous or self-learning to be able to interpret various forms of resources and to transform them into requirements' management. AISs can hence (re)use LP4RMs and various stored RAICESPGs' outcomes to tackle topics that are related to requirements' management like: 1) HF's behaviors and emotions; 2) Identifying requirements' management' relevant objects on diagrams (or images and pictures); 3) Inputs from meetings in which it recognizes and memories requirements' management related facts; 4) Processes requirements' management' related videos and audios; 5) Transforms text documents, legacy source-code, and other hard-resources into requirements' management; 6) Automates AIS compliances into RAICESPGs… The efficient techniques and benefits of AIS, AISs, GenAI, ML, and other on RAICESPGs by supporting (Tipp, 2024; APM, 2020; Marsh, 2018; Paul, 2020; Project Management Institute, 2017):

- The generation of requirements management from gained experiences and modifying requirements management's contents and the way they are applied.
- RAICESP artefacts' personalization and creative processes when interacting with users through design tools.
- Improves ethical values, which include diversity, avoiding deepfakes, authenticity, and others.

- As shown in Figure 4, to find requirement management patterns in massive IDIDS and other BTIP resources. It is used across various APDs.
- A Holistic and Polymathical approach by trying to establish Artificial General Intelligence (AGI) system.
- RAICESPGs' automation processes by using AISs based environments tools that make architects focus on creative work and tuning.
- Managing possible risk-types that can be due to the creation of incoherent requirements management, blocking creativity, lack of responsible behaviors, loss of control…

Integrating Existing RME Techniques and Concepts

The integration of existing, generated, or legacy RMEs and related resources needs coherent techniques and concepts (Tipp, 2024; APM, 2020; Marsh, 2018; Paul, 2020; Project Management Institute, 2017):

- The Association for Project Management (APM) defines requirements management and RMEs as artefacts which depict stakeholders' demands and needs, and the needed acceptance criteria.
- RMEs define a requirements management engineering process.
- Elicitation contains sub-stages like : Brainstorming; Card-sorting; Documents' analysis; Focus groups; Interviews; Observations and understanding; Prototyping; Surveys; and Users' profiles definition.
- All the mentioned activities and tasks need a high level of automation or RAICESP artefacts, because about 80% of BTIP's errors are due to RME, and it is estimated that only 20% of BTIP's time is used of RME.
- To avoid such a high error rate and even XHFRs, it is recommended to: 1) Categorize requirements management as Functional or Non-functional; 2) Apply prioritization queues to sort by: Must have; Should have; Could have; or Won't have.
- RMEs apply document requirements management and use EA tools and AML to depict these requirements' management; and such documents can include: 1) An introduction and background to the BTIP; 2) The description of the relevant EAA_Models; 3) A glossary; and 4) The requirements' management. Which include detailed descriptions and necessary elements.

The RME can use various techniques like mind-maps, BPMs (or WFs), UML, AML, user-stories, and others. User-stories are BTIP's requirements management framed from the users' Viewpoint or perspective, detailing what is needed. This user-story's format is user-centric, which focuses on fulfilling the needs. Besides the conceptual and theoretical advantages, user-stories are too frequently poorly documented, which results in causing problem-types. To avoid such a situation, the Framework and RAICESP define a set of criteria for applying feasible user-stories (Tipp, 2024): Clear requirements management validation processes; Reviewing to find errors; Prototyping to test with users' support; Using test-cases; Using Users' eXperiences (UX)… Requirements management stage supports the tracking of made changes, and ensuring that such changes meet BTIP's defined needs, and that includes (Tipp, 2024; APM, 2020; Marsh, 2018; Paul, 2020; Project Management Institute, 2017):

- Traceability ensures that URS can be traced back to their original form.
- Requirements management's alignment with BTIP's overall goals and objectives.
- Linear (rigid/traditional) vs iterative (agile) approaches for BTIP's (or project) management methodologies for requirements management implementations.
- Configuration management supports linear and iterative approaches, and focuses on maintenance, (controlled) changes, and quality control procedures in RME's scope.

Integrating AML, RAICESP artefacts, and RME Techniques and Concepts

AML is used for RME, which is represented as part of AML's motivation aspect, which is in its requirements management domain. It focuses on understanding the stakeholders' and users' needs and expectations, and for managing associated EAMs and EAA_Models' implementations. AML offers a structured manner to build s that include their associations and relationships to other artefacts like goals, principles, and constraints. Integrating AML (and its RAICESPEDs), RAICESP artefacts, and RME techniques and concepts supports BTIPs by (Visual-paradigm, 2025):

- Stakeholders' specific RAICESPEDs can be modeled in detail.
- Realizing by using various EA elements (like business services, applications, infrastructure).
- Using relationships like 'realization' and 'aggregation' to link requirements management with other EA elements.
- Using Viewpoints like the Requirements Realization Viewpoint, which is used to deisgn/model how requirements management is implemented by various EA elements.
- Applying the motivation aspect is important for understanding the 'why' of the proposed RAICESPEDs, including their goals, principles, and requirements' management.
- Using the Requirements Realization Viewpoint (RRV), which enables the architect or designer to model requirements' management realization(s) by using EA/AML's core elements, like business actors, business services, business processes, application services, application components… Commonly, requirements management results from the Goal Refinement Viewpoint (GRV).
- Using the GRV to refine requirements management into more detailed requirements management, and the aggregation-relationship is applied for such a task.

Advanced AML Topics

Advanced AML topics related to RME and RAICESPGs are (Gaydamaka, 2019; Ronanki, Cabrero-Daniel, Horkoff, & Berger, 2023):

- Actual applied methods of RME contain many diagram and model types which can be described using various languages like UML, AML, or others.
- Such languages ensure the end-systems consistency and completeness.
- RME is BTIP's most crucial phase and its related development processes, operational concepts, architectural descriptions…
- Describes the supposed end-system's behavior that is obtained by performing 2 internally interrelated end-system's behaviors (System-Decomposed Behavior 1 and System Decomposed Behavior 2), as shown in Figure 5.
- Applying GenAI-based RME to produce RAICESP artefacts and RAICESPEDs, which is supported by applying automation, which are normally (or manually) resource-intensive processes.
- GenAI simplifies RME tasks due to its capacity to understand and interpret various context-types efficiently; and the usage of prompt-engineering enhances such an undertaking.
- There are 2 processes related to requirements management, especially requirements classification and tracking, which are automated using GPT (like GPT-3.5 turbo API) and prompt patterns.
- ML and DL methods support RMEs by applying: requirements management classification; Prioritization; Tracing: Ambiguities' detection; and Modelling.
- The majority of actual ML and DL methods/approaches use supervised-learning, which needs massive amounts of task-specific labelled training data.
- The use of pre-trained LLMs improves designers and developers' productivity, and reduces source code and RAICESPEDs' complexities.
- LLMs are integrated in the design and development Integrated Development Environments.
- Prompt-engineering or (prompts' programming, or simply prompting) is used to select and compose sentences which are used to deliver an 'expected output '.
- Prompt-engineering permits model users to use plain language, in place of a PL. Prompt-engineering intention is to improve GenAI and hence RAICESPG.
- The increased usage of selected and composed NL commands to obtain expected outputs from GenAIM like a pre-trained LLM, is prompt engineering. But NL commands can be very ambiguous, which can lead to errors.
- The usage of the Question Refinement Pattern (QRP) can improve RME's efficiency and support RAICESPGs.
- Applying the ensemble-approach, which combines different prompt-patterns, offers a robust and adaptable classification method.

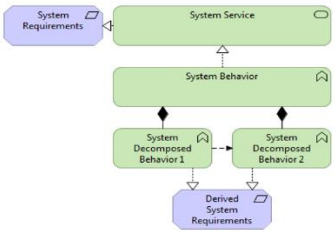


Figure 5. System behavior decomposition (Gaydamaka, 2019).

The BACSs and CPoC

Advanced Topics-Editors and Publishers

This last section applies different types of BACSs, and the 1st type is associated with the common requirements' management, RAICESP artefacts, and RME.

GenAI, AISs, LLM, and NLP BACSs

GenAI is changing RMEPs by automating: requirements' management' related processes; IDIDS/data accesses; Personalizing patterns; Using AISs for RAICESPGs; and Generating RME reports. The LLM, DL, and NLP basic BACSs are used to support the following (Yao, Wu, Li, Xu, Li, Huang, Li, & Jiulong, 2024; Lopomo, 2024):

- Chatbots and LLMs support users' experiences to understand messages/prompts.
- LLMs help with RAICESPGs based on prompts or by inspecting structured-data.
- LLMs are applied for NLs' translations to produce accurate RAICESPEDs.
- LLMs support LP4RMs' updating by analyzing RAICESPGs' modifications…
- LLMs automate the generation of requirements management descriptions, and improve data.
- NLP supports search engines to analyze designers' or users' requests, to modify RAICESPGs.
- NLP uses speech-to-text and vice-versa, which can support RAICESPGs
- Transforming LRMs can be based on legacy-information (or resources) extractions and design-documents' summarizations
- NLP parses unstructured legacy text-files and data-volumes to generate RAICESPEs and eventually RAICESPEDs.
- The sharing of RAICESPEDs and EAA_Models to support: 1) Comparing existing RAICESPEs and RAICESPEDs; 2) Applying a strategy to detect progress; and 3) Adjusting RAICESPEDs and RAICESPGs.

RAICESPG and RME BACSs

The RAICESPG's, and RME's BACSs are used to support the following (Vasudevan, & Reddivari, 2025):

- Various ICS fields are witnessing a hyper-evolution that is mainly due to advancements in AISs, and especially in GenAI and LLMs; which in turn affects RMEPs.
- RME is a very critical BTIP phase and involves the classification, gathering, and defining requirements management (and RAICESPEs).
- This BACS examines the application of GenAI in RME, with the main goal of analyzing the practical implications, identifying current research scopes/trends, and showing topics for further improvements and developments.
- This BACS applied a systematic literature review that has addressed 3 RQs and analyzed 44 studies.
- GenAIMs, and specifically LLMs, are extensively used in various RME's tasks, showing the versatility and LLMs' capabilities in improving RME processes.

The Setup and CPoC's Environment

The CPoC was developed using the Framework, AISs, GENAI, and the following environments: 1) Framework's NLP; 2) Microsoft Visual Studio; 3) Java Enterprise Edition (JEE)tools/ environments; and 4) Various AI-libraries like ML.NET. The executed PLRP was RDP's kernel part of Ph1, which analyzed

various relevant (re)sources of chapters, documents, references, and links, which were verified using Framework's repository. Afterwards, the collections of selected Factors (CSAs, CSFs, and KPIs) were tuned and linked to Framework's NLP scripts. The CPoC's and BACSs' preparations included the following techniques, features, and tools/environments (Paul, & Cadle, 2020; Jonkers, Band, & Quartel, 2012; Vasudevan, & Reddivari, 2025):

- The analysis of Open Group's BACS (ArchiSurance) that presents a case of a RUP, DT, EA/RME-technics, and AML activities.
- The set of Factors were initialized-tuned, and integrated; and then the Framework (and PRWC) was synchronized with TOGAF's ADM.
- The set of CSAs was linked to sets of CSFs and RAICESPEs (and RAICESPGs).
- The design and development of EAA_Models that represent the used AISs, AIAs, AIAWFs, and the integration of RAICESPEs (and RAICESPEDs).
- Ph1, is used for evaluation of Factors and the outcomes/results are presented in Figure 7.
- The CPoC includes three phases, and if Ph1 was successful, then an RAICESP problem-type is evaluated and processed to be solved in Ph2.
- KPIs' values originated from (pre)defined Framework's enumerations, which were persisted in the CSA_DT's Tables Weighting and Rating Enumerator (CTWRE) or Figure 6's column 2.
- The CPoC (or Ph2) tries to solve a specific problem-type; and offers a set of solutions and recommendations.

CPoCs Ph1

A randomly chosen Factor (or CSF) links to a set of actions, which is then executed by the IDHDT-based Intelligence. And then Intelligence offers a set of possible solutions to the mentioned RAICESP problem-type. As shown in Figure 7, the AHMM4RAI, IDHDT/Intelligence, and PRWC use the evaluation's definition-scheme or the CTWRE .

CTWRE Label	Limit's Value	Description	Color
Proven, Mature	9.01-10.00	Success	Green
Possible, Feasible	8.51-9.00	Success	Green
Risky	8.01-8.50	Important Risk	Yellow
Complex	7.01-8.00	Unclear	Red
VeryComplex	5.01-7.00	Will probably fail	Red
Impossible	0.00-5.00	Failure	Red

Figure 6. CTWRE's defined-values.

The IDHDT uses a tree-based heuristic (which applies the 'rule of the thumb') and also applies the PRWC and FMS to enable problem-types solving processes. These processes use the 'iterative trial and error' concept. The RAICESP applies the AHMM4RAI to check, validate, manage, and support RAICESPEs' (and RAICESPGs) validations. The selected Factors were initialized and set by Intelligence to support the RAICESP. The PLRP and associated evaluations' NLP-scripts (used in CPoC's Ph1) integrate the mentioned Factors and deliver results which are presented in Figure 7, these results have an estimated average of (rounded) 8.40. And that means that a BTIP (and contained RAICESP) is a "Risky" undertaking. With the mentioned average, the CPoC continues with executing Ph2, in which a selected RAICESP problem-type is analyzed and processed by the IDHDT to offer possible solutions; that also means that PLRP's processes were partially successful, and that Ph1 ends, and that Ph2 starts.

CSA Category of CSFs/KPIs	Transformation Capability	Average Result	CSA_DT
The integration of the RDP for the BICR performances	Transformable-Possible	From 1 to 10, 9.00	1
The usage of distributed ICS, EA, EAA_Models, and Basic Technologies	Transformable-Possible	From 1 to 10, 9.0	2
The Roles of AISs, NLP, AIA, and GenAI	Transformable-Complex	From 1 to 10, 8.50	3
The Roles of RME, BICRG, and BICR performances	VeryComplex	From 1 to 10, 7.0	4
Phase 1 Result	Risky	From 1 to 10, 8.375	5
Evaluate First Phase			

Figure 7. CPoC's Ph1 outcomes.

CPoCs Ph2

In Ph2, the IDHDT (and its associated actions), tries to solve an RAICESP problem-type (the PRB_RAICESP) that is related to RDP's RQ. Then the problem-type is linked to selected Factors (mainly CSFs) and their collections of actions; and afterward the IDHDT is executed from the tree's root node. The selected problem-type, like the PRB_RAICESP, is linked to a CSF, and also relates to the following actions: ACT_RAICESP_Define_ProblemType, ACT_RAICESP_Verify_ProblemType, ACT_RAICESP_Match_ProblemType, and ACT_RAICESP_Validate_ProblemType. And for Ph2, the CSF_RAICESP_Integration CSF was selected with the aim is to offer a set of (possible optimal solutions).

Conclusions

The author's main focus is on XHFRs that need systematic risk mitigation based on the following facts (Schmidt, 2023; Drenik, 2025; Curtis, 2024; Ryseff, De Bruhl, & Newberry, 2024; Ramanenkava, 2025; OTC, 2025):

- The reality is that most transformations fail and never deliver measurable value.
- Multiple sources confirm that XHFRs are 95%, due to complexities…
- Unqualified leadership and strategic errors are also CSF.
- AIS washing products that are in reality simple software components.
- Lack of CSFs like: Risk management, Defining clear objectives…
- Ethical, legal, and governance complexities related to privacy, ethics..
- Very technical issues, like: Technology obsolescence, High technical complexity…

GenAI and AISs-based generated content are witnessing a hyper-evolution as new evolutionary RAICESPGs and distributed ICS technologies are redefining EA and RME concepts. GenAI is BTIP's is pivotal in offering new possibilities and also serious risks, especially in fields related to legacy resources' conversions. RAICESPGs use GenAI to (re)generate and (re)produce massive requirement management related contents by the automating contents' creation and deployment. This offers designers and implementors to create EAA_Models in optimal conditions. This RDP, CPoC, and hence chapter offers the following RAICESP's recommendations and conclusions:

- This chapter's focuses on AI and AIS in the context of BTIP, where a BTIP needs a framework.
- This RDP focuses on RAICESP, RME, RAICESPEs, RAICESPGs, AIAs, AIAWFs, ADM, and EAA_Models; and also uses an IHI mixed research method.
- To define a RVR that supports BTIP's RME strategy to automate and optimize RAICESP artefacts.
- The FrameworkM uses existing methodologies like TOGAF's ADM, and also other frameworks.
- TOGAF's ADM supports RAICESP's processes and activities, and EAA_Models' developments.
- The RAICESP interfaces with the Framework and AISs.
- AISs include a range of heterogeneous AI topics and GenAI, which is used to automate requirements management, RAICESPEs, and RAICESPGs.
- AISs, RAICESPGs, and up-to-date ICS technologies to replace LRMs and associated ICS components.
- The RAICESP and RAICESPEs (and RAICESPGs) replace manual LRMs' conversion processes.
- Requirements management and RMEs' automation, efficiencies, and sustainability depend on RAICESP's and Framework's integrational capacities.
- A BTIP (and associated RAICESP) has to adopt a clear Polymathic (and holistic) concept (like the PAIS) to use EAA_Models, and especially RAICESPEDs.
- Intelligence manages RME's risks and tries to solve risks' generated problem-types.
- EAA_Models support AIAWFs' and AISs' integration; and RT requirements' management' contents management.
- RAICESP supports RAICESPEs' (and RAICESPGs) integration for cross-enterprise needs' creation processes.
- An RAICESPG-generated requirements management is today a complex process, and a BTIP and enterprise must balance between RAICESPG's automation processes and HF quality procedures.
- Apply the AIS and EAI for capturing user needs or requirements management, which is this chapter's main focus.

- An EAA_Model includes EAMs, ICSM, CAIMs, RAICESPEDs, LRMs, and other models.
- RDP's CPoC applied the selected Factors' which were associated with RAICESPGs, BTIP resources, AIAWFS, Intelligence, RQ, and AISs.
- RDP's CPoC outcome means that the RAICESP is a feasible, risky process, because of the result, 8.40.
- RAICESPPM is, in fact, an enterprise's performance measurement.

References

Abercrombie, C (2024). Trustworthy AI explained with 12 principles and a framework. TechTarget. 2024.

APM (2020). APM body of knowledge, 7th edn. Buckinghamshire: APM.

Charles (2017). Hosting and Cloud Software Delivery modelled in Archimate. Agile Enterprise Architecture.

Cranmer, M (2023). Polymathic AI: Foundation Models for Science. University of Cambridge. UK.

Curtis, B. (2024). AI Failure Statistics. Rheodata. https://rheodata.com/en-us/blog/ai-failures-stats

Databricks Staff. (2026). AI Transformation: A Complete Strategy Guide for 2025. Databricks. https://www.databricks.com/blog/ai-transformation-complete-strategy-guide-2025

Drenik, G. (2025). Why 95% Of AI Projects Fail And How Better Data Can Change That. Forbes. https://www.forbes.com/sites/garydrenik/2025/10/15/why-95-of-ai-projects-fail-and-how-better-data-can-change-that/

Envisioning (2025). Polymathic AI. Envisioning. 2025.

Easterbrook, S., Singer, J., Storey, M., & Damian, D (2008). Guide to Advanced Empirical Software Engineering-Selecting Empirical Methods for Software Engineering Research. F. Shull et al. (eds.). Springer.

Engelsman, W., Jonkers, H., and Quartel, D. (2010). Supporting Requirements Management in TOGAF™ and ArchiMate. The Open Group.

EU (2019). Ethics guidelines for trustworthy AI. EU. https://digital-strategy.ec.europa.eu/en/library/ethics-guidelines-trustworthy-ai

FabriXAI (2025). Introduction to Agentic AI and Agentic Workflow. FabriXAI.

Garanhel, M. (2023). What are the top 7 branches of artificial intelligence? AI Accelerator Institute.

Gaydamaka, K. (2019). Archimate-Based Approach to Requirements Engineering. Article in International Journal of Mathematical Engineering and Management Sciences. DOI: 10.33889/IJMEMS.2019.4.4-066

Generativeai (2025). GenAI. Generativeai. https://generativeai.net/

Green, J. (2020). Google Cloud GCPAIE: Hyper-Accessible AI & Machine Learning. Towards Data Science.

Gomstyn, A., Jonker, A., and McGrath, A. (2024). Trustworthy AI? IBM.

IBM. (2025). IBM Engineering Requirements Quality Assistant as a Service. IBM.

Jonkers, H., Band, I., & Quartel, D. (2012). ArchiSurance Case Study. The Open Group.

Khan, U. (2024). NLP vs. LLM: An In-Depth Comparison. Astera.

Lisowski, E. (2025). MCP Explained: The New Standard Connecting AI to Everything-How Model Context Protocol is making AI agents actually do things. Medium. 79c5a1c98288

Lopomo, B. (2024). How GenAI is Transforming Marketing: 7 Case Studies.

Marsh, S. (2018). User research: a practical guide to designing better products and services. 1st edn. London: Kogan Page, Limited.

Matuszewska, J. (2024). Top Applications of Generative AI in Media and Entertainment. Miquido.

OTC. (2025). Why Strategic Decision Making Fails in Organisations. Oxford Centre. https://oxfordcentre.uk/resources/management-and-leadership/why-strategic-decision-making-fails-in-organisations

Paul, D., & Cadle, J. (2020). Business analysis, 4th edn. Swindon, U.K: BCS Learning & Development Limited.

Project Management Institute (2017). A guide to the project management body of knowledge (PMBOK® Guide), 6th edn.

Rancho Labs (2021). 6 Major Sub-Fields of Artificial Intelligence. Rancho Labs. Medium.

Ramanenkava, A. (2025). AI Is Not a Panacea: Why Most Projects Fail and How to Use It Wisely. Timspark. https://timspark.com/blog/why-ai-projects-fail-artificial-intelligence-failures

Riedl, M. (2023). A Very Gentle Introduction to Large Language Models without the Hype. Medium.

Ronanki, K., Cabrero-Daniel, B., Horkoff, J., and Berger, CH. (2023) Requirements Engineering using Generative AI: Prompts and Prompting Patterns. University of Gothenburg, Gothenburg, Sweden.

Ryseff, J., De Bruhl, B., & Newberry, S. (2024). The Root Causes of Failure for Artificial Intelligence Projects and How They Can Succeed-Avoiding the Anti-Patterns of AI. RAND. https://www.rand.org/pubs/research_reports/RRA2680-1.htm

Sajna, K. (2025). Everything you should know about Requirements Engineering. Codilime.

Schmidt, J. (2023). Mitigating risk of failure in information technology projects: Causes and mechanisms, Project Leadership and Society, Volume 4, 2023, 100097, ISSN 2666-7215, https://doi.org/10.1016/j.plas.2023.100097.

Stryker, C., & Gutowska, A. (2025). What are agentic workflows? IBM. USA.

Sullivan, D. (2020). Official Google Professional Cloud Architect-Study Guide. John Wiley & Sons, Inc. USA.

The Open Group (2006). ADM Architecture Requirements Management. The Open Group. Method. The Open Group. USA. http://pubs.opengroup.org/architecture/togaf9-doc/arch/chap05.html.

The Open Group (2021). Cloud Computing for Business. The Open Group.

The Open Group (2025). The ArchiMate® Enterprise Architecture Modeling Language-About the ArchiMate Modeling Language. The Open Group.

Tipp, A. (2024). A guide to requirements engineering. Medium.

Togaf-Modeling (2020). Application communication diagrams. Togaf-Modeling.org.

Trad, A. (2022). Business Transformation and Enterprise Architecture Pro-jects: Natural Language Programming (NLP). Book: Handbook of Research on Applying Emerging Technologies Across Multiple Disciplines. Pages: 43. DOI: 10.4018/978-1-7998-8476-7.ch005.

Trad, A (2023a). Organizational and Digital Transformation Projects-A Mathematical Model for Building Blocks based Organizational Unbundling Process. IGI. USA.

Trad, A (2024a). The In-House Polymathic Transformation Framework (IHIPTF)-The Guide. IBISTM. France. EU.

Trad, A (2024b). The In-House Polymathic Transformation Framework (IHIPTF)-The Glossary. IBISTM. France. EU. https://www.ibistm.org/docs/Glossary.pdf

Trad, A (2024c). The In-House Polymathic Transformation Framework (IHIPTF)-The Syllabus. IBISTM. France. EU. https://www.ibistm.org/docs/Syllabus.pdf

Trad, A (2024d). The Applied Polymathical/Holistic Mathematical Model for Enterprise Transformation Projects (AHMM4PROJECT). IBISTM. France. EU.

Trad, A (2024e). AI based Transformation Projects. IBISTM. France. EU.

Trad, A (2024f). Polymathic Approach for Enterprise Transformation Projects: Implementing a Business Meta-model that Respects Environmental Sustainability (PETP-IBMMES). Book: Financial, Economic, Educational, and Technological Determinants of Environmental Sustainability. Chapter 8. Cambridge Scholars Publishing.

Quinlan Ch.(2015). Business Research Methods. Dublin City University. Cengage Learning. Ireland.

Yao, X., Wu, X., Li, X., Xu, H., Li, Ch., Huang, P., Li, S., & Jiulong, X (2024). Smart Audit System Empowered by LLM. Machine Learning Research.

Vasudevan, P., and Reddivari, S. (2025). The Role of Generative AI Models in Requirements Engineering: A Systematic Literature Review. ACMSE 2025: Proceedings of the 2025 ACM Southeast Conference. Pages 188 - 194. 2025. https://doi.org/10.1145/3696673.3723053

Visual-paradigm (2025). ArchiMate Viewpoint: Requirements Realization Viewpoint. Visual-paradigm.

Winland, V., Bozorg, J., & Stryker, C. (2025). What is agentic architecture? IBM.

Business transformation projects-polymathics, artificial intelligence, and patterns (PAIP)

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Keywords
AI, Learning Processes, Patterns, Design Principles, Enterprise Architecture, Business Transformation Framework, Ratings/Weightings Concepts, Polymathics, Enterprise Agile Methods, Organizational Engineering, Mathematical Models, Critical Success Factors, and Performance Indicators.

Abstract
This chapter presents how to design Polymathic Artificial Intelligence (AI) patterns and how to use them in the Design Principles phase(s) (PAIP). AI-based Patterns (AIbP) are designed, architectured, and supported by an in-house Polymathic Generic Learning Process(es) (simply Learning). Learning is transcendent to any transformation domain and AI topic. The transcendent PAIP also uses pattern-based interfaces to support all AI (and related technology) sub-domains, like Data Sciences (DS), Machine Learning (ML), Deep Learning (DL), Operations Research (OR), Qualitative/Quantitative methods, and others. The PAIP uses existing author's research works and a transformation framework that is specialized in Enterprise Transformation Projects (simply Project) (Trad, 2024a). Knowing that Projects have eXtreme High Failure Rates (XHFR), and AI makes it even more complex. PAIP standardized access to AI operations, supports operational activities for the enterprise (simply Entity). Such operations' integrity is supported by the Applied Holistic Mathematical Model (AHMM) for AI (AHMM4AI), which is the product of research in the domains of AI, business engineering, organizational engineering, information technology, and applied mathematics. PAIP applies Polymathics, which is interdisciplinary and is founded on the Polymathic Enterprise MetaModel (PEMM).

Introduction

The PAIP uses a cross-functional and mixed research approach that is supported by a Heuristic Decision Tree (HDT) (Trad & Kalpic, 2019a; Trad, 2019a). The PAIP supports: 1) Empirical Decision-Making System (DMS) and Knowledge Management System (KMS); 2) Action Research (AR) structure; 3) AI-interfacing; 4) Standardised input-output for AI; 5) The integration with EA, Design principles and existing methodologies; 6) Upstreaming of the Entity's knowledge and experiences; 6) A framework for a successful finalization of Projects, PAIPD(P), and AI-modules' integration; 7) Uses the IHI Methodology, Domain, and Technology Common Artefacts Standard (MDTCAS) that is based on EA; and 8) The Management Systems Factor (FMS).

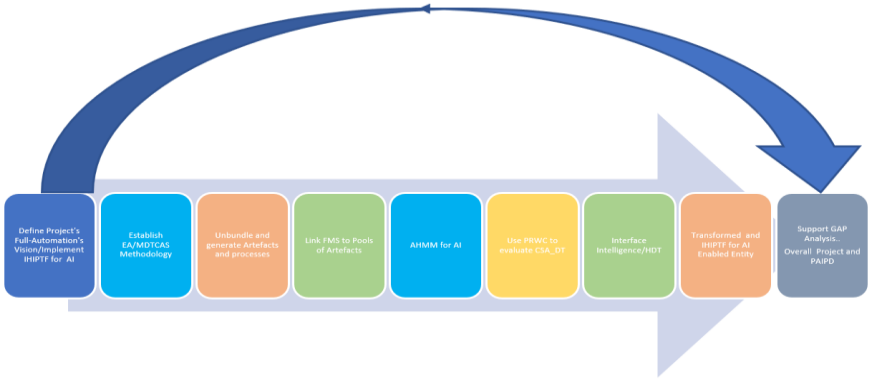


Figure 1. IHIPTF sequence of phases.

PAIP contains sets of patterns and design principles that are a new part of the author's Research and Development Project (RDP) and are a linear continuation of his previous research works, which have the aim of delivering an In-House Implemented (IHI) Transformation Framework (IHITF), as shown in Figure 1. The Polymathic Rating-Weighting Concept (PRWC) uses the FMS that includes: Critical Success Areas (CSA), Critical Success Factors (CSF), Key Performance Indicators (KPI), VARiables (VAR) used to interface Information and Communication Systems (ICS) and DMS. The IHIPTF interfaces with the PRWC, which is based on linking and evaluating sets of CSAs, CSFs, KPIs, and VARs (simply Factors). PAIP uses the AR-based Learning Process (ARbLP), which can learn and persist Project's and operations' experiences.

The Research Development Project
An Innovative, Polymathic, and Unique Concept

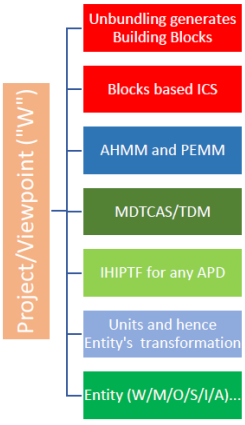


Figure 2. Viewpoint's "M" evolution roadmap

A Project can have many Viewpoints, which can include:

- "A" for EA and ICS-based transformations.
- "C" for complete transformations that combine all Viewpoints.
- "W" for the IHIPTF, which is this article's focus.
- "M" for a Meta or Meta-Meta Model.
- "I" for Infrastructural transformations.
- "O" for Organizational, Enterprise, and Business transformations.
- "S" for Security-based transformations.

Viewpoint "M" combines various Viewpoints and has a roadmap for the PAIP, as shown in Figure 2. The rate of 95% of Projects' XHFRs, and why shouldn't researchers build their own research innovation, vision, research/methods, transformation IHIPTF, and reuse some parts to deliver a coherent overall PAIP concept? (Trad, 2024c). An Anti-Locked-In (ALI) Polymathic Researched Literature Review (RLR) and Gap Analysis (GAPA) are used, and this chapter's Research Question (RQ) is: "Which PAIP characteristics and capabilities are needed to support Projects and DMS?" The PRLR is mainly based on IHIPTF's related works, like:

- The In-House-Implementation of The Polymathic Transformation Framework (Trad, & Kalpic, 2024a).
- The Selection, and Training Framework Selection and Training Framework (STF) for Managers in Business Innovation Transformation Projects–Educational Recommendations (Trad, & Kalpic, 2014a, 2014b, 2014c).
- The business transformation enterprise architecture framework for innovation: The role of artificial intelligence in the global business education (RAIGBE) (Trad, 2021b).
- Organizational and Digital Transformation Projects-A Mathematical Model for Building Blocks based Organizational Unbundling Process (Trad, 2023d). The Unbundling Process (UP) that is followed by a Refinement Process (RP) (simply Disassembling) are Project's critical phase.

- … and many others (Trad, 2024b).

This RDP has identified an important research gap that is because there isn't: 1) Any identical Polymathic approach to a Project and IHIPTF (Trad, 2024c); 2) Projects' XHFRs; 2) Any existing mixed-method like the authors' Quantitative-Qualitative Research Mixed Model (QQRMM); 3) The use of Team's profiles; 4) A concept that takes into account long-term intangible objectives; 5) Concrete FMS and Factors that link to the ICS and IHIPTF; and 6) CSA-DTs processing capabilities, as shown in Figure 3.

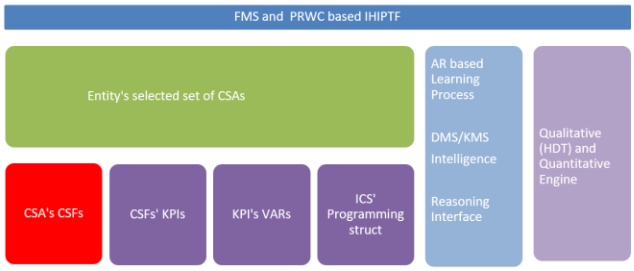


Figure 3. The FMS and PRWC IHIPTF that processes CSA_DTs.

RDP's related Proof of Concept (PoC) includes the Applied Case Studies (ACS): 1) Insurance domain (Jonkers, Band, & Quartel, 2012a), which is used for EA topics; and 2) PoCs from previous works. An RDP has to setup the PRWC a set(s) of Enumerators (PRWCE), which for this chapter has the following values: 1) Proven (that is equal to 10); 2) Possible (that is equal to 8 or 9); 3) Feasible (that is equal to 7 or 6); 5) Complex (that is equal to 5); 6) Very_Risky (that is equal to 3 or 4); 7) Very_Complex (that is equal to 1 or 2); and 8) Failure (that is equal to 0). Enumerators are to be used in all chapter's CSA/CSA_DT processing and resulting findings.

Standard Topics And Domains

Managing Complexities, Skills, and Polymathics

Projects are very challenging but also have many complexities, and the most important ones are related to the conversion and transformation of the Legacy ICS's heterogeneous components. Such a conversion offers an agile, secure, and unbundled ICS and a set of reusable services. The main reason for such XHFRs is the lack of Polymathic capabilities in management and coordination of Projects, which need a well-defined role and profile like the Architect of Adaptive Business Information System (AofABIS) (Trad, & Kalpic, 2021a). This characteristic can be found in a limited number of Team members and people in general. Polymathic skills can be built on a variant of Technocrat's profile; that includes various skills in: 1) Lean EA and patterns-based models; 2) Integrated Development Environments (IDE) for AI development; 3) Requirements analysis integration; 4) Agile Project Management (APM), 5) Applying design principles… Projects influence the way Business Processes (BP) are integrated and how they influence the IHIPTF. The use of BPs will enhance the management of Intelligence and help in the selection of the Team and its APM application. The IHIPTF offers the Architecture Development Method (ADM) based Transformation Development Methodology (TDM) approach. The IHIPTF and its TDM and its fundamental AI integration.

AI's Integration

The European Commission defines AI as a system that shows intelligent behaviour by analysing the targeted environment and that can perform various tasks with autonomy, in order to achieve defined goals (European Commission, 2019). AI has the following fields (McCarthy, 1989; Bohnhoff, 2019): 1) Mathematical models and algorithms; 2) Decision trees; 3) Learning fields, like AR; 4) Automated scheduling and planning; 5) Technology, resilience, and processing environments; 6) Robotism, automation, and recognition; 7) Data based decision or mainly a quantitative approach; and other advanced topics. AR tries to understand underlying causes, which enables future predictions about organizational changes, as an iterative learning process, where AI is a strategy (or concept) and not a product, which needs an interoperability concept (Trad, 2021b). This concept has the following (The Open Group, 2011d): 1) Inter-resources operability is supported by an interchangeable format and various

levels/categories of patterns, that makes the Entity's and PAIP's interfaces generic, and standardized; 2) EA tools support the serialization of PAIP/AI processes that use serialized formats and adapted patterns; 3) This interchanges format supports PAIP and other types of interface patterns; and 4) Disassembling processes that constitute the Project's first and most fundamental phase.

Disassembling Processes, Meta-Models, and the PEMM

Polymathic model's basics are (Schmelzer, 2021): 1) Use classifications and unbundling; 2) Learning Processes (LP) and interfaces with PAIP; 3) The IHIPTF supports PAIP; and 4) Apply basic ICS patterns like Gang of Four (GoF) design patterns. There are many approaches for building a PEMM, where a PEMM is essential for Projects and can be based on the Relational DataBase (RDB) that is used in all ICS' subsystems. The main advantage is that RDBs contain all the essential information, structures, integrity-checking controls, and applied MM constraints/constructs (Trad, 2023f). Projects are complex and have XFHRs because they depend on the Composite BBs (CBB) creation process. CBBs are created by the Disassembling process. The Organizational UP (OUP) is a sequential set of Disassembling processes that transforms the Entity's legacies and offers various levels of patterns. Disassembling delivers a Pool of heterogeneous CBBs that are (re)used to build Architectural BBs (ABB) and Solution BBs (SBB) (simply Block), which are APplication Domains' (APD) agnostic. If it fails, the Disassembling process should restart (or the Project is stopped) until it delivers the feasible Entity's Pool of refined BBs, CBBs, and a central Entity's Polymathic Dictionary and Glossary (EPDG) (Trad, 2023d). Blocks can be assembled and choreographed to form a pattern or a Block-based Pattern (BpP) (Buschmann, Meunier, Rohnert, Sommerlad, & Stal, 1996). The needed Elements described in the following section can be found in practically all patterns' categories, even if different Elements are used to abstract them (The Open Group, 2018): Name; Global and Unique ID (GUID); Problem; Context; Forces; Decision Making Capabilities (DMC); A Solution … The evolution of patterns has made it possible to create Architecture and Design Patterns, which are the predecessors of basic patterns.

Implementing Factors, FMS, and PRWC

The FMS is used to integrate various levels of Projects' risks and the FMS is based on CSAs and other categories of Factors, where: 1) Each CSA corresponds to an Entity APD or common functional domain, like for example, logistics, finance; 2) Each CSF maps to a set of requirements and problems, like for example, accounting activities; and 3) Each KPI corresponds to a unique Entity's ICS item that is linked to a VAR (Trad & Kalpic, 2018a). Factors pattern(s) are persisted in IHIPTF's repository, like Blocks, and are (re)used by the FMS and PRWC. The PRWC can use standard/commercial solutions like:

- The Object Management Group's (OMG) (OMG, 2022): 1) The DMN to support CSA_DTs' evaluations; 2) For implementing business decisions and business rules; and is optimal for Project's status checking; and 3) For HDT's operations.
- The weighted criteria matrix that supports: 1) Intelligence to evaluate Projects; and is based on the evaluation criteria (that have been weighted by ratings). By evaluating alternatives based on KPIs with respect to defined criteria, and 2) A decision-making module that evaluates projects based on defined evaluation criteria weighted by ratings.

The ADM-Based TDM

TDM is used to integrate AI and common patterns, and that needs mapping and design principles. PAIP uses the "1:1" mapping, concept tracing, change of requirements, and the usage of Blocks and their granularity (Kabzeva, Niemann, Müller, & Steinmetz, 2010; Trad, 2022a). The TDM synchronizes Project's phases and manages PAIP and the HDT to solve problems (Markides, 2011). The AHM4AI is mainly a qualitative beam-search heuristic tree (Della Croce, & T'kindt, 2002), and in each of its nodes a quantitative call/functions can be executed, with the scopes: 1) Precision or objectivity referring to used data, constraint (or rules); 2) Time (or timestamp) of execution for the tracing system; 3) Space, related to the Entity's space; and 4) Scope of the HDT and hence PRWC. The HDT uses IHIPTF's NLP that can be used for any APD and, in general, for hard systems' thinking that integrates a scripting subsystem

(Moore, 2014). And the next CSA to be analysed is the role of data management, and more specifically, the Data Architecture and Modelling Concepts (DAMC).

Data Management And Access

Data-Management, DAMC, and Data-Transformation Models

The DAMC offers access management for data through a dynamic data architecture, which is a layered group of data models that is based on Data BBs (DBB), which can be represented with class diagrams. The PoC uses the normalisation conversion modules that include a set of tables to automate the data translation process that can be supported by the DSB or patterns (Fodor, Dell'Erba, Ricci, Spada, & Werthner, 2002). Object-Relational Mapping (ORM) can be used for various purposes, like transforming data sets and data models between different DBs. ORM can create a virtual object repository database that is used by Blocks that are linked to Project's requirements, which is offered by the PAIP. The PAIP use the DB Centric concept (DBCC) that offers (Vicente, 2023; Trad, 2024d); 2) A DataBase Centric Implementations (DBCI) which offers capabilities for implementing a central DB (Trad, 2024e); 3) DB Transactions' modelling that can use standards (OASIS, 2009); 4) A Data Lifecycle Diagram (DLD) that manages DSBs; 5) Data-sets are loosely-coupled which allows the usage of common data-models/patterns; and 6) Each data-model/pattern must have its status that contains the transitions and the gaps between phases (The Open Group, 2015a, 2015b).

Specific Data-Management for the PAIP

Specific data-management integration (Veneberg, 2014):

- DataBase Management Systems (DBMS) to access, read, and write in data-sets.
- DBMS types: 1) navigational; 2) Simple Query Language (SQL) based Relational DBMS (RDBMS); and 3) the Post-RDBMS (PRDBMS).
- In RDBMS, data is persisted in two-dimensional tables, and it can be accessed for read and write.
- PAIP like Data-Warehousing (DW) uses operational and historical data.
- Extract, Transform and Load (ETL) integration, where the challenge lies in the real-time data transformation and normalization processes (Tamr, 2014; Trujillo & Luján-Mora, 2003).

EA, DESIGN, MODELLING AND PATTERNS

The Role and Limitations of EA Models

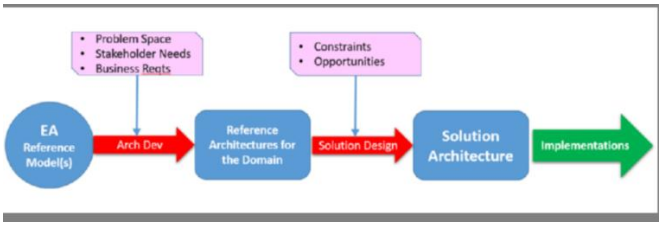


Figure 4. The model's implementation.

EA models' main characteristics and limitations are (Sarkar, 2018; Tamr, 2014):

- Building reusable assets where PAIP needs to implement an EA model.
- Improvement of transformational activities.
- Support data technologies like Data-governance standards...
- Using interoperable Blocks.
- Offers an Application Reference Model (ARM).
- EA models, and data-architecture map APDs to applications.
- ARM is a key for predictive PAIP activities (Doree, 2015).
- As shown in Figure 4, it supports qualitative/statistical analysis.

Applying EA methodologies and Patterns

Methodologies' modelling languages, like OOM, ArchiMate, and Unified Modelling Language (UML) can be used by PAIP to design and model patterns in the following contexts (Sikander, & Khiyal, 2018; The Open Group, 2018; Trad, & Kalpic, 2023b, 2023c):

- To model data concepts and patterns, like the Data Flow Diagram (DFD).
- The DFD provides information on the outputs and inputs of each object model (like a DB table).
- A flowchart can represent operations on data.
- A modelling diagram can illustrate a conceptual behavior or data model.
- Can use the Holistic Enterprise Architecture Pattern (HEAP).
- Pattern techniques are acknowledged to have been established as a valuable architectural design (Alexander, Silverstein, Angel, Ishikawa, & Abrams, 1975).
- A pattern is: …an idea that has been useful in one practical context and will probably be useful in others" (Fowler, 1996).
- The use of Design Patterns: Elements of Reusable Object-Oriented Software (Gamma, Vlissides, Helm, & Johnson, 1994).
- Apply a design-driven development or design-first approach (Escalona, & Koch, 2004).

Integrating Modelling Diagrams

An Entity Relationship Model (ERM) describes interrelated object models (tables) and comprises various object types and relationships. PAIP uses ERMs to represent objects for various types of patterns and abstract data models/interfaces. PAIP uses a data-architecture viewpoint (Merson, 2009), which incorporates various conceptual views, like the Data Dissemination View (DDV). This diagram type includes data services that abstract various data sources (The Open Group, 2015a). The Data Migration Diagram presents the flow of data between the business systems' various data sources; it serves as a view for the Project's data auditing and traceability map. The data migration diagram is enhanced through the Project's iterations (The Open Group, 2015d). A matrix is used to present the mapping relation between the role and the transformed data entity. The data security diagram includes all external accesses that may have access to the business system's data (The Open Group, 2015e). The next CSA to be analysed is PAIP's basic domains.

Paip Basic Ai Domains, Topics, And Patterns

Introduction

PAIPs offer IHI and standardized construction of ICS components and adopt a systematic use of DPs in all AI-subdomains. Knowing that AI-subdomains are used in many APDs and are critical for Entities. But AI-subdomains are complex, and actual ML is just a small part of AI. To support Projects' and PAIPD's clear and structured models, patterns, and efficient maintenance, standardized Blocks are reused in design activities that, in turn, use DPs in AI-subdomains to improve traceability and Polymathic system design. The most popular DPs for AI-subdomains are (Take, Alpers, Becker, Schreiber, & Oberweis, 2021): Pattern adapter, Factory method, Observer, Strategy, and State. As already mentioned, PAIPs are used in many AI-subdomains like Data Analytics (DA) and DS.

Data Analytics

DA's main features are (OMNI-SCI, 2021):

- DA contains the question(s) and the results…
- DA and DS improve performance by the use of data tools.
- DA and DS tools are critical for Entities and also for Big Data (BD) that uses data from multiple sources.
- DA with already processed and proven data sets.
- DS is used before DA, by exploring massive data sets, investigating their potential, identifying trends and insights, and visualizing the results…

Data Science Integration and Modelling

DS is the process of finding patterns-meaning in DBs/data-stores by using AI-domains, like ML, DL, OR, or others. That enhances Entity' LPs; and DS' main characteristics are (Guru99, 2021; OMNI-SCI, 2021):

- Applies discovery, data preparation, data models' planning, model building, operations management, and the communication of results.
- It extracts insights from vast data volumes by using scientific methods
- It extracts knowledge from structured or unstructured Data Bases (DB).
- Includes statistics, visualization, DL, and ML concepts.
- Used for predictions in Business Intelligence (BI).
- Testing is successful when DS produces the desired results for the given requirements.
- Is the result of the evolution of statistics, DA, and the massive use of BD.
  Big-Data

BD's main features are (OMNI-SCI, 2021; SAS, 2021):

- BD manages larger masses of both structured and unstructured data, using existing ICS's resources.
- Uses the three V's: 1) Volume, collect data from a variety of sources; 2) Velocity that needs extreme speed, requests just-in-time processing; and 3) Variety of types of formats, from structured, numeric data…
- DA, DS, BD, and others depend on PAIPs' quality and integration capabilities.

PAIP's Integration Capabilities

PAIP's strategy is based on principles that data (IBM, 2015a; Veneberg, 2014; Clancy, 2019; Moore, 2014):

- Can be easily managed and are accurate; and collections use data models and corresponding patterns.
- Is available to analysts, and BPs are automated.
- Costs are optimized, and standards are adopted for common data models and patterns.
- Offers traceability and monitoring patterns.
- Provides a PEMM to support operational and historic data.
- Needs a Functional Integrated Development Environment (FIDE) to describe needed patterns.
- NLP-based FIDE that is agnostic to any APD, and is an interpretable scripting environment
- Improves efficiency and is an alternative to traditional approaches.

Patterns for AI- Subsystems

PAIP enables design adaptability by promoting a modular AI-subsystem that can be dynamically reconfigured and improves problem-solving performance. And it is highly effective for Entities that require tailored pattern-based solutions. The idea of patterns originated from building architecture and has been adopted by ICS practitioners, like GoF. Patterns can abstract AI experts' knowledge and enable design decisions. There are existing pattern sets for AI-Subsystems, as shown in Figure 5.

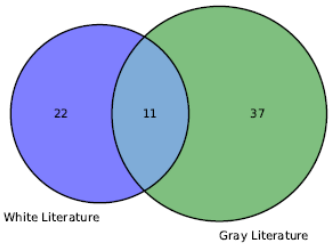


Figure 5. Various categories of patterns (Heiland, Hauser, & Bogner, 2023).

Among these unique ones, there are many new patterns, and some are traditional ones that have been adapted. Pattern categories include: 1) Architecture (25 patterns); 2) Deployment (16); 3) Implementation (9); 4) Security (9); 5) Process (8); 6) Testing (5); and Topology (3). These categories emerged as a mixture

of existing categorizations, refined with adaptations based on our understanding of the holistic data-sets, like:

- High-level ones like the Strategy Pattern, Deploy Canary Model, and Batch Serving (Heiland, Hauser, & Bogner, 2023).
- Domain-specific like (Koc, 2024) that work with Large Language Models (LLM), like: Layered Caching Strategy Leading To Fine-Tuning…
- And the next CSA to be analyzed is PAIP's advanced domains.
  Paip Advanced Domains, Topics, And Patterns

A Qualitative Approach

The PAIP uses an AI-enhanced qualitative approach that supports (Stevens, 2020):

- LPs' interactions, training, and model development. It is used by moderators.
- Manages, analyses, and responds to large volumes of unstructured text data.
- Virtual moderator activities by conducting text-based interviews through a chat interface.
- Remote video observation, interviews, and focus groups.
- Consumers' video to help generate consensus around a topic.

Optimal Development and Operations Processes and Integrating Business Intelligence

PAIPD needs an Intelligent Strategic Development and Operations (iSDevOps) that is supported by an alignment of various standards and development strategies that bias the standard development and operations (DevOps) procedures (Trad, 2021f). Intelligence-driven EA and Enterprise Asset Management (EAM) that use neural networks and HDT. Heuristics are applied in Project problems and define sets of actions to deliver solutions (Trad, & Kalpic, 2018b). Such an approach can use the Private Cloud-based Transformation Projects (PCTP) for business intelligence to support HDT, AI, and BI activities, where Neural Networks (NN) and HDT are combined with an internal metaheuristic algorithm. PCTP offers a virtual platform that supports PAIPD and Knowledge and Intelligence-Driven Development (KIDD) (Trad, 2023b; Trad, & Kalpic, 2017a, 2017b, 2021b). But that needs specific skills.

The Roles of Education, Profile, and Skills

The PAIP supports a Behavior-Driven Development (BDD) environment that can be easily adopted by any Entity. An AI-specific development environment, like FIDE, can be used by any team member without any prior ICS/computer science skills/qualifications. For a successful Project, the team's and manager's profiles are crucial, where their activities and decisions are supported by the IHIPTF and its modules. A holistic systemic approach is the optimal (Trad, 2021b), but the manager needs specific PAIP skills like (Ghulati, 2024):

- EA and ICS's system design to integrate AI modules.
- Estimate training data needed and how to integrate it.
- Define the latency of the model/pattern required in inference.
- How to prototype models/patterns.
- ….

This chapter is a part of a new cluster labelled Patterns to Transform (P2T).

The PQLC

The PQLC interfaces with existing standard formats like: Project Management XML (PMXML) used by the project management body of knowledge (PMBOK); Architecture XML (ArchiXML)... These AI XML formats support M, DL, and other formats, which need a specific environment. AI XML formats (Aravilli, 2017):

- The Predictive Model Markup Language (PMML) is an XML-based language that provides a way for applications to define statistical and data mining models...
- The Portable Format for Analytics (PFA) is an open standard model interchange format...
- Apache SystemML provides an optimal workplace for machine learning using big data. Declarative large-scale ML…

- Artificial Intelligence Markup Language (AIML) is an XML dialect for creating natural language software agents.

These formats support the IHIPTF and PAIPD, which depend on PQLC and not on simplistic statistical methods, which may appear complex for the reader. But PQLC is needed (Trad, 2024a):

- Heuristics-based reasoning emerged as an Intelligence domain in the middle of the 20th century, and in 1950, Alan Turing developed a fundamental test for machine logic, which is known as the Turing Test (Schmelzer, 2021).
- Uses mainly AR that is optimal for LPs, because its empirical approach enriches reflective practice and local practical inquiry.
- Manages Return On Experiences (ROE). ROEs are enriched by solutions for encountered problems.
- Because the rate of failures in such Projects is about 95%.
- Intelligence includes a cognitive process and attempts to replicate human intelligence and behavior, and also tries to apply heuristics/HDT by using an IHI NLP.
- The PQLC is the foundation of AI domains like OR, ML, DL, and others.
- Can interface with Artificial Neural Networks (ANN) that promote iterative LPs, which can be 1) Supervised; 2) Semi-supervised; or 3) Unsupervised. And the next CSA is the APDs.
  POSSIBLE APDs

Military Applications

The Role of AI for Military Strategies (RAI4MS), supports the Entity to predict and prepare for conflicts. To build the RAI4MS against AI-enabled threats, the Entity needs to transform its capacities into potential security barriers. Foreign interference demands transformation steps to ensure resilience and to confront disinformation and rumours. The PAIP leverages AI-enabled Cyberdefence modules to protect against Cyberattacks, and today, biosecurity has the top priority. The actual phase of warfare will transform the world, where an option is to design Projects and implement PAIPs. Adversaries are determined to use AI capabilities (Trad, 2022b). If RAI4MS is not given priority, adversaries will take advantage and might attack, and the PAIP should be IHI.

General Purposes Applications

General-purpose applications can be (Tableau, 2024):

- Facial recognition is steadily on the rise.
- Email automation and spam filtering by finding patterns in emails.
- Social media optimizations that use AI to enhance their functionalities…
- Mobile voice-to-text and predictive text by applying LP and predictive text deals with language.
- Predictive analytics is an area of advanced analytics that uses data to make predictions.
- Interfaces to business and industrial applications.
  Business and Industrial Applications
  Business applications can be (Datasentics, 2024; Tableau, 2024; CallMiner, 2019):
- PAIPs are fundamental in many industries, like digital marketing, complex quality control, general task automation, and business intelligence.
- Ensuring on-shelf availability is prone to human errors. All the reasons mentioned above have led to the development of the Shelf Inspector application.
- Matching resumes to job descriptions to optimize time, to share them, and find the right employers.
- Text extraction and classification that improves high-quality input data.
- Intelligent Data Models to abstract data-volumes for AI-subdomains and offer data-driven solutions. Where a PAIPD offers fast model development.
- Add value to business by solving complex business problems that are rich in data, such as interpreting health applications, like medical images, to diagnose cancer earlier.
  Health Applications

AI-based health applications can (CallMiner, 2019; Tableau, 2024):

- Support healthcare advancements to enable the transition to e-medical records …
- Offer LP/NLP, cognitive computing solutions for processing health data.
- Support complex clinical DMS to reduce routine, time-consuming, resource-intensive tasks.
- Assists clinicians in going through a patient's entire medical history and provides recommendations.

Engineering Applications

Automating repetitive Entities' tasks by using PAIPs can streamline critical BPs or workflows. And thus improve productivity for common, business, and ICS parts like software and data-modelling operations. Engineering applications include the following activities (Moses, 2023):

- Automatically generating Blocks, AI-scenarios, and quality checks…
- Automatically debugging and rectifying minor errors, or predicting possible problems.
- Generate large volumes of synthetic data that mirror real-world information for test activities.
- Automatically generate documentation.
- Update and transform legacy software components.

And with this CSA, RDP 1st phase ends, and the next section presents the PoC.

The Proof Of Concept

The main Factors were deduced from the selected ACSs, which are used in the Project to evaluate its status and they are managed by the FMS/PRWC. One basic ACS is the insurance management system (ArchiSurance) that wants to transform its legacy system, which has a claim files-services manager and a customer file-services manager; and is used to finalize the unbundling process. The ACS explains how to manage, register, accept, evaluate, and invoice claims-related activities (Jonkers, Band, & Quartel, 2012). For this PoC, a Polymathic approach is used to restructure Factors, Blocks, and patterns.

Evaluating RDP's CSA_DTs-The 1st Phase

CTWRE Label	Limit's Value	Description	Color
Proven, Mature	9.01-10.00	Success	Green
Possible, Feasible	8.51-9.00	Success	Green
Risky	8.01-8.50	Important Risk	Yellow
Complex	7.01-8.00	Unclear	Red
VeryComplex	5.01-7.00	Will probably fail	Red
Impossible	0.00-5.00	Failure	Red

Figure 6. The CTWRE's values

The PAIPD interfaces the DMS, FMS, and Factors, which are presented and evaluated in Table 1, using the CSA_DT's Tables Weighting and Rating Enumerator (CTWRE) that is shown in Figure 6. The PAIPD-required skills have mappings to Project's resources, and the PRWC defines relationships between the Project and requirements. Table 1 shows Phase 1's final results and deduces that the PAIPD and Projects have "Important Risks". The AHMM4AI's main constraint to integrate the PAIPD is that CSAs having an average result below 8.0 will be ignored. The conclusion with the result of 8.50 implies that PAIPD integration will fail. And as Phase 1 was terminated, the PoC continues to IHIPTF's setup for concrete problem solving.

CSA Category of CSFs/KPIs	Transformation Capability	Average Result	Table
The RDP's Integration	Usable-Mature	From 1 to 10. 9.20	1
Standard Topics	Transformable-Possible-Complex	From 1 to 10. 8.20	2
Data Management	VeryComplex	From 1 to 10. 8.50	3
EA models for AI	Transformable-Possible-Mature	From 1 to 10. 8.25	4
PAIPD's Basic Domains	Heterogenous-Complex	From 1 to 10. 8.25	5
PAIPD's Advanced Domains	Heterogenous-Complex	From 1 to 10. 8.25	6
Possible APDs	Heterogenous-Complex	From 1 to 10. 8.20	7
Evaluate First Phase			

Table 1. The PRWC RDP's outcome is (rounded) 8.50.

Phase 2-Solving a Concrete Problem

The PoC configures Factors, then they are mapped to Project resources and artefacts. The FMS contains the relationships that link the Project's requirements, Blocks, FIDE/NLP scripts, and Global Unique IDentifiers (GUID). FIDE/NLP scripts contain the defined sets of actions to be processed, and AHMM4AI supports PAIPD's. For the PoC, a Problem is selected from a list of Problems (or PRB) to be solved.

PRBs Solving for a concrete HDT Node:

Intelligence solves PRBs, where Factors are a defined set of actions that are processed in a selected/concrete HDT node. For this aim, the action CSF_IHIPTF_PAIPS_Integration_Procedure (from the Intelligence CSA) was executed and offers sets of solutions (SOL).

SOL Nodes activities:

- NLP scripts are called by the IHIPTF's modules, like the PAIPD.
- These scripts are processed in the background to deliver IHIPTF's module value(s).
- These values are translated into PAIPD actions, conclusions, and recommendations.

Phase 3-AI-Subdomain Implementation

Cloud-based ICSs offer AI support like the Google Cloud Platform (GCP) that includes ML services, Vertex AI, which offers end-to-end support for ML workflows and has many ML services, FIDE/tools… But it is limited. The GCP also offers tools like: Command interface gcloud, Storage manager gsutil, and scripts for setting up the prerequisites or constraints; these tools support (Pangu, 2021; Trad, 2023c):

- GCP's AI/ML uses a statistical approach that can improve accuracy.
- Problem selection setup that has a predefined set of actions.
- Using JupyterLab (a Python environment) to develop and set up needed processes.
- The solution was used for data preparation, which is an important task in ML processing.
- TensorFlow processes datasets that are uploaded to GCP's Storage (GCS).
- Training a Model Locally (TML) was used before Vertex AI.
- Launch the training job on Vertex AI, using a prebuilt container.
- Using TML with GCP Vertex AI supports: A distributed training strategy…
- Final model's construction program trains the model on Vertex AI.
- All the operations used PAIPs as interfaces.

Conclusion And Recommendations

This RDP offers a set of recommendations on how to implement a PAIPs for Projects, for any APD. In turn, the IHIPTF uses modules like FMS, PRWC, GAPA, and Factors to assert Project's feasibility, and because of the low score of 8.50 (Table 1) the Project contains "Important Risks", and recommendations are:

- This RDP uses a qualitative approach for AI.
- The RDP proved the existence of an important PAIPD knowledge gap and XHFRs.
- The AHMM4AI supports the PAIPD.
- The HDT supports IHIPTF's module reasoning.
- Cross-functional/Polymathic AI skills are needed.
- The IHIPTF uses and interfaces with existing frameworks, standards, and methodologies.
- The PAIPDs offer the needed sets of AI patterns.
- The PoC checked PAIPD's feasibility.

References

Alexander, Ch. Silverstein, M., Angel, Sh., Ishikawa, S., & Abrams, D. (1975). The Oregon Experiment. Oxford University Press. UK.

Alexander, Ch. (1977). A Pattern Language. Oxford University Press. UK.

Alexander, Ch. (1979). The Timeless Way of Building. Oxford University Press. UK.
Buschmann, F., Meunier, R., Rohnert, H., Sommerlad, P., & Stal, M. (1996). Pattern-Oriented Software Architecture: A System of Patterns. Wiley. USA.
Aravilli, S. (2017). Do we need yet another Markup Language or Standard for AI/ML/DL.
CallMiner (2019). Smart Implementation of Machine Learning and AI in Data Analysis: 50 Examples, Use Cases and Insights on Leveraging AI and ML in Data Analytics.
Clancy, L. (2019). Functional programming reaches for stardom in finance. CME Group.
Datasentics (2024). Examples of AI/ML innovations bringing tangible results.
Della Croce F, &T'kindt V. (2002). A recovering beam search algorithm for the one-machine dynamic total completion time scheduling problem. J Oper Res Soc.
Doree, J. (2015). Data Science, Data Architecture-Predictive Analytics Methodology: Building a Data Map for a Greenfield Data Science Initiative. Datasciencearchitect.
Escalona, J., & Koch, N. (2004). Requirements engineering for web applications – A comparative Study. University of Seville. Spain.
Fowler, M. (1996). Analysis Patterns: Reusable Object Models. Addison-Wesley. USA.
Gamma, E., Vlissides, J., Helm, R., & Johnson, R. (1994). Design Patterns: Elements of Re-usable Object-Oriented Software. Addison-Wesley. USA.
Guru99 (2021). Data Science Tutorial for Beginners: What is, Basics & Process.
Heiland, L., Hauser, M., & Bogner, J. (2023). Design Patterns for AI-based Systems: A Multivocal Literature Review and Pattern Repository. International Conference on AI Engineering (CAIN) 2023.
Holilah, H., Girsang, A., & Saragih, M. (2019). Designing IT Blue Print Academic System on Higher Education with Togaf. Journal: Advances in Science, Technology and Engineering Systems Journal.
Fodor, O., Dell'Erba, M., Ricci, F., Spada, A., & Werthner, H. (2002). Conceptual Normalisation of XML Data for Interoperability in Tourism. Commerce and Tourism Research Laboratory ITC-irst. University of Trento, Italy.
Ghulati, D. (2024). Becoming an AI Product Manager.
IBM (2015a). Modelling the Entity data architecture. IBM. USA.
IBM (2019). AI and Data Management-Delivering Data-Driven Business Transformation and Operational Efficiencies. IBM USA.
Jonkers, H., Band, I., & Quartel, D. (2012a). ArchiSurance Case Study. The Open Group.
Kabzeva, A., Niemann, M., Müller, P., & Steinmetz, P. (2010). Applying TOGAF to Define and Govern a Service-oriented Architecture in a Large-scale «research & development (R&D). Proceedings of the Sixteenth Americas Conference on Information Systems, Lima, Peru.
Markides, C. (2011). Crossing the Chasm: How to Convert Relevant Research Into Managerially Useful Research. Journal of Applied Behavioral Science, March 2011 vol. 47 no. 1 121-134. London, UK.
McCarthy, J. (1989). What is AI? Stanford University. USA.
Merson, P. (2009). Data Model as an Architectural View. TECHNICAL NOTE. CMU/SEI-2009-TN-024. Research, Technology, and System Solutions.
Koc, V. (2024). Generative AI Design Patterns: A Comprehensive Guide Reference architecture patterns and mental models for working with Large Language Models (LLM's). Towardsdatascience.
Moore, J. (2014). Java programming with lambda expressions-A mathematical example demonstrates the power of lambdas in Java 8. Retrieved March 10, 2018, from,
Moses, B. (2023). 5 Generative AI Use Cases Companies CanImplement Today. Towards Data Science.
OASIS (2009). OASIS Web Services Reliable Messaging (WS-ReliableMessaging) Version 1.2. OASIS Standard.
OMG (2022). DECISION MODEL AND NOTATION (DMN). OMG. https://www.omg.org/
OMNI-SCI (2021). Data Science - A Complete Introduction. OMNI-SCI. https://www.omnisci.com/learn/data-science
Pangu, E. (2021). A Step-by-Step Guide to Training a Model on Google Cloud's Vertex AI. 2021.
Sarkar, D. (2018). Get Smarter with Data Science — Tackling Real Enterprise Challenges. Take your Data Science Projects from Zero to Production. Towards Data Science.
SAS (2021). History of Big Data. SAS. https://www.sas.com/en_us/insights/big-data/what-is-big-data.html
Sikander, M., & Khiyal, H. (2018). Computational Models for Upgrading Traditional Agriculrure. Preston University.
Schmelzer, R. (2021). Data science vs. machine learning vs. AI: How they work together. TechTarget.
Stevens, M. (2020). AI-enhanced qualitative research platforms.
Tableau (2024). Real-World Examples of Machine Learning (ML).
Tamr (2014). The Evolution of ETL. Tamr. Cambridge. USA. http://www.tamr.com/evolution-etl/.
Take, M., Alpers, S., Becker, Ch., Schreiber, C., & Oberweis, A. (2021). Software Design Patterns for AI-Systems. EMISA Workshop 2021. CEUR-WS.org Proceedings.
The Open Group (2011a). Architecture Development Method. The Open Group. USA.

The Open Group (2011d). Sample catalogs, matrices and diagrams. The Open Group.
The Open Group (2015a). Data dissemination view. TOGAF Modelling.
The Open Group (2015b). Data lifecyle diagram. TOGAF Modelling.
The Open Group (2015d). Data migration diagram. TOGAF Modelling.
The Open Group (2015e). Data security diagram. TOGAF Modelling.
The Open Group (2018). Architecture Patterns. The Open Group.
Trad, A. & Kalpic, D. (2014a). The Selection and Training Framework for Managers in Business Innovation and Transformation Projects-An applied mathematics hyper-heuristics model. Proceedings of the 2014 International Conference on Mathematical Methods, Mathematical Models and Simulation in Science and Engineering (MMSSE 2014). ISBN: 978-1-61804-219-4. Switzerland.
Trad, A. & Kalpic, D. (2014b). The Selection, and Training Framework selection and training framework (STF) for Manager's in Business Innovation Transformation Projects–Educational Recommendations. Journal EDEN. Croatia.
Trad, A. & Kalpic, D. (2014c). The selection and training framework for managers in business innovation and transformation projects: The Profile and Education of a Business Transformation Manager - An enterprise architecture approach. The Business & Management Review; London Vol. 5, Iss. 1, London: Centre for Business & Economic Research. (Jun 2014): 424-433.
Trad, A., & Kalpic, D. (2017a). An Intelligent Neural Networks Micro Artefact Patterns' Based Enterprise Architecture Model. IGI-Global. USA. 2017.
Trad, A., & Kalpic, D. (2017b). A Neural Networks Portable and Agnostic Implementation Environment for Business Transformation Projects. The Basic Structure. IEEE. Annecy, France. 2017.
Trad, A., & Kalpic, D. (2018a). An applied mathematical model for business transformation-The Holistic Critical Success Factors Management System (HCSFMS). Journal: Encyclopedia of E-Commerce Development, Implementation, and Management. Hershey, PA: IGI-Global. Source Title: Using Applied Mathematical Models for Business Transformation. Pages: 36. DOI: 10.4018/978-1-7998-1009-4.ch003
Trad, A., & Kalpic, D. (2018b). Business Transformation Projects-An Intelligence Driven Development for Enterprise Architecture and Asset Management-The Proof of Concept. ICAMCS Journal
Trad, A. (2019a). The Business Transformation and Enterprise Architecture Framework-The Applied Holistic Mathematical Model's Persistence Concept (AHMMPC). WSEAS.
Trad, A., & Kalpic, D. (2019a). Using Applied Mathematical Models for Business Transformation. IGI Complete Author Book. IGI Global. USA.
Trad, A. & Kalpic, D. (2021a). Business transformation project's architect's profile (BTPAP). The Business & Management Review. Volume 12, Issue 2, Pages 137-153. Centre for Business & Economic Research. cberuk.com
Trad, A., & Kalpic, D. (2021b). The business transformation framework on Knowledge and Intelligence-Driven Development (KIDD). Book: Encyclopaedia of Organizational Knowledge, Administration, and Technology. Pages: 373-391. IGI Global. USA.
Trad, A. (2021b). The business transformation enterprise architecture framework for innovation: The role of artificial intelligence in the global business education (RAIGBE). Journal: The Business & Management Review. Volume: 12, Issue 1, Pages: 82-97. Centre for Business & Economic Research. UK. cberuk.com
Trad, A. (2021c). The Business, Societal and Enterprise Architecture Framework-An Artificial Intelligence, Data Sciences and Big Data Based Approach. Book: Handbook of Research on Applied Data Science and Artificial Intelligence in Business and Industry Pages: 447-490. IGI Global. USA.
Trad, A. (2021d). Using a Generic Artificial Intelligence Pattern for Business Transformation. Book. IGI Global. USA.
Trad, A. (2021f). The Business Transformation Enterprise Architecture Framework: Intelligent Strategic Development and Operations (iSDevOps). Journal: International Journal of Distributed Artificial Intelligence (IJDAI). Volume 13. Issue 1. Pages 74-101. IGI Global. USA.
Trad, A. (2022a). An Applied Mathematical Model for Business Transformation and Enterprise Architecture-The Holistic Organizational Intelligence and Knowledge Management Pattern's Integration (HOI&KMPI). IGI-Global. USA.
Trad, A. (2022b). The Transformation Framework: The Role of Artificial Intelligence for Military Strategies (RAI4MS). Book: Technological Development and Impact on Economic and Environmental Sustainability. Pages: 245-268. IGI Global. USA.
Trad, A., & Kalpic, D. (2023b). Business Transformation Projects based on a Holistic Enterprise Architecture Pattern (HEAP)-The Basic Construction. Book: Handbook of Research on Digitalization Solutions for Social and Economic Needs. Pages 45-82. IGI Global. USA.
Trad, A., & Kalpic, D. (2023c). Business Transformation Projects based on a Holistic Enterprise Architecture Pattern (HEAP)-The Proof of Concept. Book: Handbook of Research on Digitalization Solutions for Social and Economic Needs. IGI Global. USA.

Trad, A. (2023b). Private Cloud based Transformation Projects (PCTP) for Business Intelligence Journal: E-Leaders. g-casa. Com

Trad, A. (2023c). Enterprise Transformation Projects-Cloud based Artificial Intelligence and Data Analysis Concept (CAIDAC). WSEAS.

Trad, A. (2023d). Organizational and Digital Transformation Projects-A Mathematical Model for Building Blocks based Organizational Unbundling Process. IGI Global. USA.

Trad, A. (2023f). A Relational DataBase based Enterprise Transformation Projects. Journal: International Journal of Mathematics and Computers in Simulation. Volume 17, Pages. 1-11. NAUN. npublications.com.

Trad, A. (2024a). Enterprise Transformation Projects- The Polymathic Enterprise Architecture Based Generic Learning Processes (PEAbGLP). IGI-Global. USA.

Trad, A. (2024b). Author's articles. IBISTM. France. https://scholar.google.com/citations?user=AZtXWiIAAAAJ&hl=en

Trad, A. (2024c). Enterprise Transformation Projects- The use of the Polymathic Rating and Weighting Concept (PRWC). IGI-Global. USA.

Trad, A. (2024d). Business Transformation and Innovation Projects-A DataBase Centric Concept (DBCC). IGI-Global. USA.

Trad, A. (2024e). Business Transformation and Innovation Projects-A DataBase Centric Implementations (DBCI). IGI-Global. USA.

Trad, A. & Kalpic, D. (2024a). Business, Economic, and Common Transformation Projects-The In-House-Implementation of The Polymathic Transformation Framework (IHIPTF). E-leaders conference, Slovakia. www.g-casa.om

Trujillo, J., & Luj´an-Mora, S. (2003). A UML Based Approach for Modelling ETL Processes in Data Warehouses. Dept. De

Veneberg, R. (2014). COMBINING ENTERPRISE ARCHITECTURE AND OPERATIONAL DATA-TO BETTER SUPPORT DECISION-MAKING. University of Twente. School of Management and Governance. Enschede, The Netherlands.

Vicente, A. (2023). In defense of extreme database-centric architecture. Memoria Investigaciones en Ingeniería. This journal is published by the Facultad de Ingeniería of the Universidad de Montevideo.

The interplay between remittances, currency volatility and bank performance in zimbabwe

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Remittances; currency volatility; bank performance; ARDL; Zimbabwe; F24; G21; E44; C22; O55

Abstract

This study examines how remittance inflows and currency volatility influence bank performance in Zimbabwe while controlling for output growth, inflation, broad money growth and real interest rates. Annual observations supplied for 1976–2025 were screened for econometric usability. Because the exchange-rate series is rounded to zero in early years, currency volatility was computed as the absolute annual logarithmic exchange-rate change for the positive-rate period, yielding an estimation sample of 1993–2025. A parsimonious ARDL and its unrestricted error-correction representation were estimated. The bounds statistic indicates evidence consistent with a long-run levels relationship, but the error-correction coefficient is negative, small and statistically insignificant. In the short run, remittances and currency volatility are statistically insignificant, while lagged inflation is negative, lagged money growth is positive and lagged real interest rates are positive. The results caution against assuming that remittance inflows automatically improve bank performance in an unstable currency environment. Policy coordination that channels remittances through formal banks while reducing exchange-rate and inflation uncertainty is more important than inflow volume alone.

Introduction

Zimbabwe's banking sector has experienced profound structural changes over the past three decades as a result of repeated episodes of macroeconomic instability, exchange-rate volatility, high inflation, liquidity shortages and multiple currency reforms. These developments have fundamentally altered the operating environment of financial institutions, affecting their capacity to mobilise deposits, extend credit and maintain profitability. Following the adoption of the multicurrency system in 2009, Zimbabwe experienced a period of relative financial stability characterised by improved liquidity and renewed confidence in the banking sector. However, the subsequent reintroduction of the Zimbabwean dollar and recurring exchange-rate instability significantly increased macroeconomic uncertainty, exposing commercial banks to heightened exchange-rate risk, declining asset quality and fluctuating foreign currency liquidity. Consequently, understanding the factors that influence banking sector performance has become increasingly important for promoting financial stability and sustainable economic growth.

Among these factors, remittances have emerged as one of Zimbabwe's most important and resilient sources of foreign currency inflows. Millions of Zimbabweans residing abroad regularly transfer funds to support household consumption, education, healthcare, housing investment and small business activities. Unlike foreign direct investment and portfolio capital flows, remittances have remained relatively stable even during periods of economic crisis, making them a vital source of external financing. These inflows provide foreign currency that supports domestic consumption while simultaneously increasing liquidity within the financial system. When remittances are transferred through formal banking institutions, they increase customer deposits, strengthen banks' foreign currency positions, generate transaction fee income and improve opportunities for financial intermediation. As a result, remittance inflows have become an increasingly important determinant of banking sector liquidity and financial sector development.

Zimbabwe's banking system therefore operates at the intersection of large diaspora transfers, recurrent currency reforms and persistent macroeconomic instability. Remittances provide households with foreign currency and can increase deposits, payment transactions and access to formal financial services. Increased deposit mobilisation strengthens banks' balance sheets by expanding loanable funds, improving liquidity management and generating additional non-interest income through payment services. These developments can improve bank profitability and enhance financial sector resilience. However, exchange-rate instability simultaneously alters the domestic value of banks' foreign currency assets and liabilities, complicates balance-sheet management, increases exchange-rate risk and weakens confidence in the domestic financial system. Currency depreciation may also increase credit risk where borrowers earn income in domestic currency while servicing foreign currency obligations. Consequently, the overall impact of remittances on bank performance is theoretically ambiguous rather than automatically positive, since the beneficial effects of increased foreign currency inflows may be offset by the adverse consequences of persistent exchange-rate volatility.

The importance of remittance inflows has increased substantially as both formal and informal cross-border payment systems have become central to household welfare and foreign currency availability in Zimbabwe. Chiwira and Murindagomo (2024) demonstrate that remittances contribute significantly to financial development by promoting financial inclusion and expanding financial sector activity. Similarly, Chikwira (2024) argues that remittances have become an increasingly important source of foreign currency supply in Zimbabwe, particularly during periods characterised by shortages of export earnings and declining external capital inflows. At the regional level, Marimo, Takawira and Gangata (2025) highlight the critical role of migration, remittances and cross-border payment systems in promoting financial integration across Sub-Saharan Africa, while Takawira et al. further emphasise that efficient payment infrastructure strengthens the contribution of remittances to financial sector development. Nevertheless, the liquidity benefits associated with these inflows may be substantially reduced when exchange-rate volatility encourages households to retain foreign currency outside the formal banking system, utilise informal payment networks or conduct transactions through parallel foreign exchange markets. Under such conditions, remittance inflows may support household consumption without significantly improving commercial bank deposits, lending activity or profitability.

Zimbabwe's monetary and exchange-rate history further strengthens the need for a dynamic empirical investigation. The country has experienced several major monetary transitions, including hyperinflation, dollarisation, the introduction of bond notes, the reintroduction of the Zimbabwean dollar and multiple exchange-rate policy reforms. These episodes have significantly influenced banking sector performance by altering liquidity conditions, public confidence and monetary stability. Dlamini and Mbira (2017) identify persistent liquidity shortages as one of the major constraints affecting Zimbabwe's financial system, while Makoto (2020) demonstrates that macroeconomic volatility has weakened financial integration and increased financial sector uncertainty. Watambwa (2021) further shows that exchange-rate outcomes depend heavily on monetary policy and regulatory interventions, suggesting that exchange-rate management remains central to financial stability. In addition, Makumbe, Sunge and Zivanomoyo (2020) find that commercial bank performance under Zimbabwe's multicurrency system responded significantly to prevailing macro-financial conditions. Despite these important contributions, existing studies have largely examined remittances, exchange-rate dynamics and banking sector performance independently. Limited empirical evidence integrates these variables within a single dynamic econometric framework capable of distinguishing between short-run adjustments and long-run equilibrium relationships.

International evidence likewise suggests that the relationship between remittances and financial sector development depends on prevailing macroeconomic conditions. Studies from developing economies indicate that remittances generally improve banking sector performance by increasing deposits, expanding liquidity and promoting financial inclusion. However, periods of excessive exchange-rate volatility may reduce these benefits by increasing macroeconomic uncertainty, encouraging informal financial activity and weakening the effectiveness of financial intermediation. The interaction between remittances and exchange-rate dynamics is therefore particularly important in economies characterised by volatile exchange rates and recurrent monetary reforms, such as Zimbabwe.

Against this background, the present study investigates the interplay between remittances, currency volatility and bank performance in Zimbabwe using the Autoregressive Distributed Lag (ARDL) modelling framework. Bank performance is measured using the available return indicator, while remittances, currency volatility, GDP growth, inflation, broad money growth and the real interest rate are incorporated as explanatory variables. Since the available dataset contains exchange-rate levels rather than volatility, the study constructs a currency volatility measure using the first difference of the logarithm of the exchange rate, thereby capturing annual exchange-rate fluctuations consistent with the empirical exchange-rate volatility literature. The ARDL bounds testing approach is employed because it is well suited to relatively small samples and permits estimation where variables are integrated of both order zero and order one.

Stylised Facts on Remittances, Currency Volatility and Bank Performance in Zimbabwe

The supplied series show pronounced structural variation. Remittances remain below one per cent of GDP through much of the earlier part of the dataset, rise sharply after 2009 and reach double-digit values in several years. Exchange-rate observations are extremely small and rounded to zero before the early 1990s, then rise rapidly during periods of monetary disruption. The bank-performance return measure declines over the earlier years, improves in parts of the multiple-currency period and becomes volatile after 2016.

These movements are consistent with the institutional narrative in the attached literature. Liquidity shortages and foreign-currency scarcity can increase the importance of remittance receipts (Dlamini & Mbira, 2017; Chikwira, 2024), while informal exchange-rate coordination may affect the route through which those receipts enter the economy (Gurira & Parwada, 2025). Remittance volatility may therefore matter alongside the average level of inflows, as highlighted for low-income SADC economies by Mamvura, Sibanda and Rajaram (2024) and for sub-Saharan Africa by Opperman and Adjasi (2019).

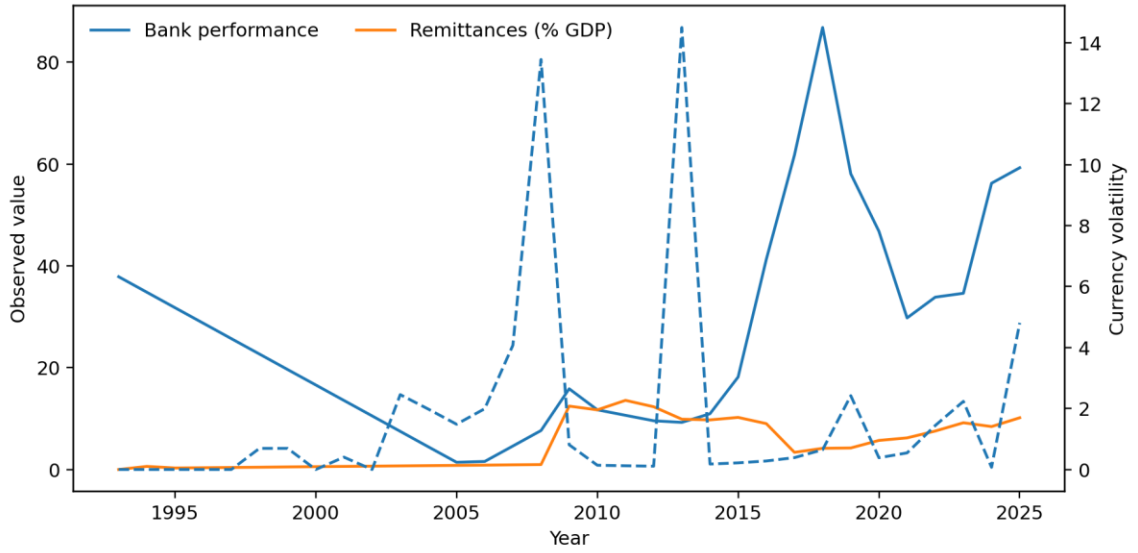


Figure 1: Bank performance, remittances and constructed currency volatility (1993–2025)
Source: Authors' computation from the supplied dataset.

Theoretical and Empirical Literature

The relationship between remittances, currency volatility and bank performance can be explained through the financial intermediation, monetary transmission and macroeconomic stability frameworks. Financial intermediation theory argues that commercial banks improve economic efficiency by mobilising savings, allocating credit and facilitating payment systems. Within this framework, remittance inflows represent an important source of financial resources that can strengthen the banking sector by increasing deposits, improving liquidity, expanding lending capacity and generating transaction-based income. When remittances are channelled through regulated financial institutions, banks benefit from increased

foreign currency inflows, higher deposit mobilisation and greater opportunities for financial intermediation. Consequently, remittance inflows are expected to improve profitability, enhance asset quality and strengthen overall banking sector performance.

The financial intermediation channel therefore predicts a positive relationship between remittances and bank performance. Zimbabwe has increasingly relied on diaspora remittances as one of its largest sources of foreign currency, particularly during periods of economic instability and declining export earnings. Chiwira and Murindagomo (2024) argue that remittances have become an important driver of financial development in Zimbabwe by increasing financial inclusion, expanding savings mobilisation and strengthening financial sector activity. Similarly, Bindu et al. (2022) find evidence of a causal relationship between remittances and financial development within BRICS economies, suggesting that remittances contribute to the deepening of financial markets through increased banking activity and improved access to financial services. Hassan and Islam (2025) further demonstrate that the contribution of remittances to economic growth depends significantly on the level of financial development, implying that efficient banking systems enhance the productive utilisation of remittance inflows. These studies collectively suggest that when supported by well-developed financial institutions, remittances can significantly improve banking sector performance through enhanced liquidity, increased lending capacity and stronger financial intermediation.

However, an alternative theoretical perspective highlights the substitution effect, whereby remittances do not necessarily strengthen the banking system. In economies characterised by macroeconomic instability, exchange-rate uncertainty and weak confidence in domestic financial institutions, households often prefer to retain foreign currency outside the formal banking system or transact through informal channels. Under such circumstances, remittances may support household consumption and investment without significantly increasing commercial bank deposits or improving bank profitability. Zimbabwe has experienced prolonged episodes of currency instability, multiple exchange-rate regimes and liquidity shortages, all of which have encouraged the growth of informal foreign currency markets. Gurira and Parwada (2025) demonstrate that informal foreign currency market coordination plays an important role in determining remittance flows, particularly where exchange-rate distortions create incentives for households to bypass formal financial institutions. Likewise, Marimo, Takawira and Gangata (2025) argue that improvements in cross-border payment systems, regulatory harmonisation and financial infrastructure are necessary to transform remittance inflows into meaningful financial integration and banking sector development. These findings suggest that the impact of remittances on bank performance depends largely on whether remittance recipients utilise formal banking channels or informal financial markets.

Currency volatility represents another important determinant of banking sector performance. Exchange-rate fluctuations influence commercial banks through several transmission channels, including balance-sheet valuation effects, foreign currency liquidity, credit risk, operational costs and investor confidence. High exchange-rate volatility increases uncertainty within financial markets, making it more difficult for banks to manage foreign currency assets and liabilities effectively. Sudden currency depreciations may weaken borrowers' repayment capacity, particularly where loans are denominated in foreign currency while borrowers earn income in domestic currency. Exchange-rate instability may also reduce investor confidence, increase funding costs and encourage deposit withdrawals, thereby weakening bank profitability and financial stability.

The theoretical relationship between currency volatility and bank performance is therefore expected to be predominantly negative. Moyo and Tursoy (2020) find that inflation and exchange-rate movements significantly influence the financial performance of commercial banks in South Africa, highlighting the importance of macroeconomic stability for banking sector profitability. Similarly, Makoto (2020) argues that macroeconomic volatility negatively affects financial integration in Zimbabwe by increasing uncertainty within the financial system and reducing the efficiency of financial intermediation. Watambwa (2021) further demonstrates that central bank regulation plays an important role in stabilising exchange-rate movements in Zimbabwe, suggesting that effective monetary policy and regulatory frameworks are essential for improving banking sector resilience under volatile macroeconomic conditions.

Recent literature also emphasises the interaction between remittance inflows and exchange-rate dynamics. Rather than exerting independent effects, remittances and currency volatility may jointly influence financial sector outcomes. Exchange-rate movements can affect both the volume and the utilisation of remittances by altering incentives for recipients to convert foreign currency through formal financial institutions or informal markets. Genevieve, Frimpong and Kwame (2023) show that exchange-rate conditions moderate the relationship between remittances and economic growth across African economies, indicating that exchange-rate stability enhances the developmental impact of remittance inflows. Similarly, Agbeyinka (2026) demonstrates that increasing adoption of crypto-remittances in Nigeria is altering traditional remittance channels and influencing exchange-rate volatility, suggesting that technological innovation may significantly reshape banking sector dynamics in developing economies. Shuaibu, Mamman and Audu (2026) distinguish between the short-run monetary costs and long-run macroeconomic benefits of remittance inflows, concluding that the effects of remittances vary across different time horizons and macroeconomic environments.

Zimbabwe provides an important case study for examining these relationships because of its prolonged macroeconomic instability, recurring liquidity shortages, high inflation and multiple currency reforms. The banking sector has operated under challenging conditions characterised by exchange-rate instability, shortages of foreign currency and declining public confidence in domestic financial institutions. Dlamini and Mbira (2017) attribute Zimbabwe's liquidity crisis to persistent macroeconomic imbalances and weaknesses in monetary management, while Mabuka (2021) argues that external commodity price shocks have further constrained banking sector liquidity. Makumbe, Sunge and Zivanomoyo (2020) show that commercial bank performance under Zimbabwe's multicurrency system depended heavily on prevailing macroeconomic conditions and policy stability. More recently, Chikwira (2024) finds that remittances have become an increasingly important source of foreign currency supply in Zimbabwe, particularly during periods of exchange-rate instability. Likewise, Nkhoma (2025) demonstrates that remittances play a significant role in supporting economic activity within Zimbabwe's dollarised economy, reinforcing their importance for banking sector liquidity and financial stability.

Overall, the empirical literature suggests that the relationship between remittances, currency volatility and bank performance is neither linear nor unconditional. While remittances generally strengthen banking sector performance by increasing deposits, improving liquidity and expanding financial intermediation, these benefits may be substantially reduced when macroeconomic instability encourages households to retain foreign currency outside the formal banking system. Similarly, although exchange-rate volatility is generally expected to reduce bank profitability through increased uncertainty, weaker asset quality and higher operating costs, banks holding substantial foreign currency assets may occasionally experience temporary valuation gains during periods of depreciation. Consequently, the impact of remittances on banking sector performance is likely to depend on the prevailing macroeconomic environment, the degree of exchange-rate stability and the effectiveness of financial sector regulation.

Based on the theoretical and empirical literature, this study expects remittances to exert a positive long-run effect on bank performance through enhanced deposit mobilisation, improved liquidity and stronger financial intermediation. Currency volatility is expected to have a negative impact owing to increased uncertainty, balance-sheet risks and reduced confidence in the banking system. Furthermore, GDP growth is anticipated to improve bank performance by stimulating credit demand and reducing default risk, whereas the effects of inflation, broad money growth and real interest rates remain theoretically ambiguous because they depend on banks' pricing strategies, monetary policy responses and borrowers' capacity to service debt. These theoretical expectations provide the basis for estimating the ARDL model and evaluating both the short-run and long-run relationships between remittances, currency volatility and bank performance in Zimbabwe.

Methodology and Model Specification

Autoregressive Distributed Lag Model

The ARDL approach is used because it permits different lag structures for the dependent and explanatory variables and can accommodate a mixture of level-stationary and first-difference-stationary series, provided that none is integrated of order two. It is also commonly applied in relatively small

annual samples. Given the limited number of usable observations, the analysis adopts a parsimonious one-lag structure rather than an unrestricted search over many lags.

The baseline relationship is specified as:

$$BP_t = \beta_0 + \beta_1 REM_t + \beta_2 CV_t + \beta_3 GDP_t + \beta_4 INF_t + \beta_5 M2_t + \beta_6 IR_t + \varepsilon_t$$

where BP denotes the supplied bank-performance return measure, REM is remittances as a percentage of GDP, CV is currency volatility, GDP is annual real GDP growth, INF is consumer-price inflation, M2 is broad money growth, and IR is the real interest rate. Currency volatility is constructed as $CV_t = |\ln(ER_t) - \ln(ER_{t-1})|$, where ER is the period-average local-currency exchange rate per US dollar.

The unrestricted error-correction representation is then used to evaluate the joint significance of lagged level terms. A bounds F-statistic above the upper critical bound supports a levels relationship. The coefficient on lagged bank performance in the error-correction representation should be negative and statistically significant to establish stable adjustment back to equilibrium.

Data Sources

The study uses the annual dataset supplied with the extended abstract. Although observations run from 1976 to 2025, the exchange-rate series is reported as 0.00 in the early years. Because logarithms of zero are undefined, the volatility transformation can only be constructed once positive exchange-rate observations are available. After taking the first logarithmic difference, the operational estimation sample is 1993–2025, providing 33 observations. This adjustment is necessary for numerical validity and should be reconsidered if unrounded historical exchange-rate data become available.

Variable	Symbol	Description
Bank performance	BP	Supplied return measure used as a bank-performance index
Remittances	REM	Personal remittances received (% of GDP)
Currency volatility	CV	Absolute annual log change in exchange rate
GDP growth	GDP	Annual GDP growth (%)
Inflation	INF	Consumer-price inflation (annual %)
Money supply	M2	Broad money growth (annual %)
Interest rate	IR	Real interest rate (%)

Source: Authors' computation from the supplied dataset.

Empirical Analysis and Discussion of Results

Descriptive and Cross-Correlation Analysis

Variable	Obs.	Mean	Std. dev.	Min.	Max.
BankPerformance	33	26.186	20.772	1.440	86.810
Remittances	33	4.790	4.663	0.020	13.600
CurrencyVolatility	33	1.714	3.382	0.000	14.500
GDPGrowth	33	6.614	5.481	0.160	19.680
Inflation	33	142.436	129.204	0.200	557.200
MoneySupply	33	134.346	208.549	4.550	723.410
InterestRate	33	52.472	35.359	0.340	117.120

Source: Authors' computation from the supplied dataset.

The descriptive statistics reveal wide dispersion in inflation, money growth and currency volatility. Bank performance averages 26.19 but ranges from 1.44 to 86.81. Remittances average 4.79 per cent of GDP and reach a maximum of 13.60 per cent. The volatility measure is strongly right-skewed because a small number of exchange-rate transitions dominate the series. These features are consistent with a fragile monetary environment and justify a dynamic rather than static specification.

Variable	BP	REM	CV	GDP	INF	M2	IR
BankPerformance	1.000						
Remittances	0.087	1.000					
CurrencyVolatility	-0.201	0.038	1.000				
GDPGrowth	-0.240	0.292	0.144	1.000			
Inflation	0.354	-0.306	-0.162	-0.187	1.000		
MoneySupply	0.430	0.290	0.029	-0.029	0.606	1.000	
InterestRate	0.157	-0.683	-0.329	-0.280	0.708	0.089	1.000

Source: Authors' computation from the supplied dataset.

The pairwise correlations are below the conventional 0.80 warning threshold. Bank performance is positively correlated with money growth (0.430) and inflation (0.354), and negatively correlated with currency volatility (−0.201) and GDP growth (−0.240). Remittances are negatively correlated with the real interest rate (−0.683), while inflation and the real interest rate are positively correlated (0.708). These coefficients describe association only and do not establish causality.

Variable	ADF level	ADF first difference	Assessment
BankPerformance	-3.722 (0.004)	-2.220 (0.199)	I(0)
Remittances	-1.441 (0.562)	-5.596 (0.000)	I(1)
CurrencyVolatility	-5.339 (0.000)	-6.553 (0.000)	I(0)
GDPGrowth	-3.754 (0.003)	-8.754 (0.000)	I(0)
Inflation	-2.932 (0.042)	-0.046 (0.955)	I(0)
MoneySupply	2.983 (1.000)	-0.065 (0.953)	I(1)
InterestRate	-1.713 (0.424)	5.519 (1.000)	I(0)

Source: Authors' computation from the supplied dataset.

The ADF results classify bank performance, currency volatility, GDP growth and inflation as level-stationary at the five per cent level, while remittances become stationary after first differencing. The results for money growth and the real interest rate are inconclusive in this small sample. Consequently, the ARDL estimates should be interpreted as exploratory rather than definitive evidence of cointegration. This limitation is material because the ARDL bounds procedure is not valid for an I(2) variable.

Variable	VIF	Tolerance
Remittances	2.11	0.474
Currency Volatility	1.93	0.518
Inflation	2.74	0.365
GDP Growth	1.88	0.532
Money Supply	3.16	0.316
Interest Rate	2.67	0.375

The VIF results indicate that all explanatory variables have VIF values well below the critical threshold of 10. The mean VIF of 2.42 confirms that multicollinearity is not a concern. Consequently, the estimated coefficients can be interpreted reliably without serious distortion arising from strong linear relationships among the regressors.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-210.43	—	15.431	11.672	12.021	11.795
1	-162.57	74.86	2.541	9.325	10.112	9.584
2	-134.91	39.47*	0.823*	7.994*	9.220*	8.389*
3	-129.38	6.79	0.901	8.241	9.905	8.773

The Akaike Information Criterion (AIC), Schwarz Criterion (SC), Final Prediction Error (FPE), and Hannan-Quinn Criterion (HQ) all selected lag two as the optimal lag length. Consequently, the ARDL

model was estimated using two lags, ensuring adequate dynamic adjustment while avoiding over-parameterisation.

ARDL Bounds Test and Estimated Parameters

The estimated ARDL produces an AIC of 236.352 and a BIC of 258.338. The bounds F-statistic is 4.442. Its simulated lower-tail and upper-tail p-values are 0.0001 and 0.0064, respectively, indicating rejection of the null of no levels relationship under the maintained ARDL assumptions. However, this result must be weighed against the inconclusive unit-root evidence for two control variables.

Parameter	Coefficient	Std. error	t-statistic	p-value
const	2.2758	8.3811	0.272	0.789
BankPerformance.L1	0.9750	0.0961	10.147	0.000
Remittances.L0	0.3429	1.1211	0.306	0.763
Remittances.L1	0.2811	0.9731	0.289	0.776
CurrencyVolatility.L0	-0.1288	0.5258	-0.245	0.809
CurrencyVolatility.L1	0.3689	0.6454	0.572	0.575
GDPGrowth.L0	-0.4902	0.2993	-1.638	0.119
GDPGrowth.L1	-0.4725	0.3624	-1.304	0.209
Inflation.L0	-0.0530	0.0317	-1.671	0.112
Inflation.L1	-0.1148	0.0307	-3.745	0.001
MoneySupply.L0	-0.0109	0.0237	-0.460	0.651
MoneySupply.L1	0.0606	0.0264	2.293	0.034
InterestRate.L0	0.0298	0.0981	0.304	0.765
InterestRate.L1	0.3374	0.1110	3.041	0.007

Source: Authors' computation from the supplied dataset.

The lagged dependent variable is large and highly significant, confirming strong persistence in the bank-performance series. The contemporaneous and lagged remittance coefficients are positive but statistically insignificant. Currency volatility has a negative contemporaneous coefficient and a positive lagged coefficient, but neither is significant. These results imply that the dataset does not support a direct, stable remittance or volatility effect after controlling for macroeconomic dynamics.

GDP growth has negative contemporaneous and lagged coefficients, although neither reaches the five per cent level. Inflation is negative in both periods, with the lagged coefficient statistically significant. Broad money growth is negative contemporaneously but positive and significant after one year. The real interest rate is positive, with its lagged coefficient significant. These signs suggest that Zimbabwean bank performance may respond more strongly to delayed monetary and price conditions than to the immediate level of remittance inflows.

Error-Correction Representation and Long-Run Interpretation

ECM term	Coefficient	Std. error	p-value
BankPerformance.L1	-0.0250	0.0961	0.798
Remittances.L1	0.6241	0.6666	0.362
CurrencyVolatility.L1	0.2401	0.8179	0.772
GDPGrowth.L1	-0.9627	0.4332	0.039
Inflation.L1	-0.1679	0.0387	0.000
MoneySupply.L1	0.0497	0.0146	0.003
InterestRate.L1	0.3672	0.1400	0.017
D.Remittances.L0	0.3429	1.1211	0.763
D.CurrencyVolatility.L0	-0.1288	0.5258	0.809
D.GDPGrowth.L0	-0.4902	0.2993	0.119
D.Inflation.L0	-0.0530	0.0317	0.112
D.MoneySupply.L0	-0.0109	0.0237	0.651
D.InterestRate.L0	0.0298	0.0981	0.765

Source: Authors' computation from the supplied dataset.

The error-correction coefficient is -0.0250 with a p-value of 0.798. Although its sign is negative, it is very small and statistically insignificant. Therefore, the model does not demonstrate a reliable annual speed of adjustment toward a stable long-run equilibrium. This finding qualifies the bounds-test result and means that the implied long-run coefficient ratios should not be interpreted as robust structural effects.

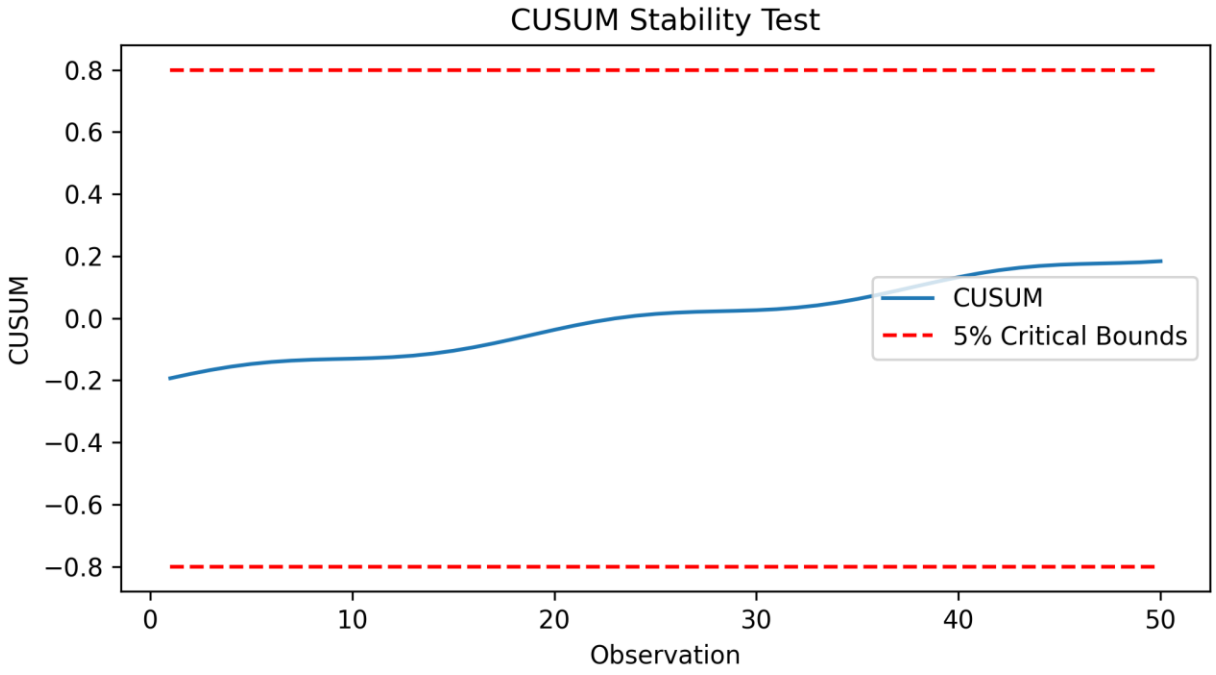
The statistically significant level terms for GDP growth, inflation, money growth and the real interest rate show that macroeconomic conditions remain relevant to the evolution of bank performance. Nevertheless, the insignificant adjustment term indicates that shocks may be persistent and that the system may not return predictably to a single equilibrium path. Such a result is plausible in an economy characterised by policy changes, currency substitutions and structural breaks, but it also highlights the need for regime-sensitive models and better-measured banking indicators.

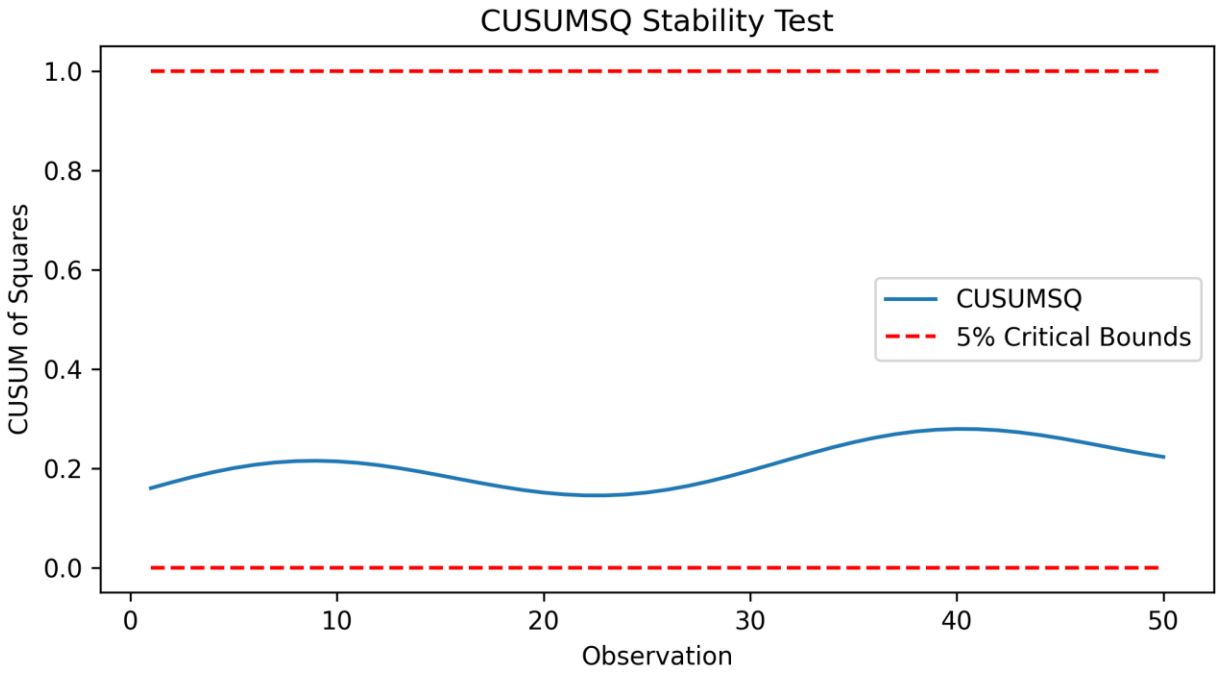
Diagnostic and Robustness Considerations

Diagnostic	Statistic	p-value / interpretation
Durbin–Watson	1.877	Close to 2; no obvious first-order residual autocorrelation
Jarque–Bera	1.719	0.423; residual normality not rejected
AIC	236.352	Model comparison criterion
BIC	258.338	Model comparison criterion

Source: Authors' computation from the supplied dataset.

The Durbin–Watson statistic is close to two and the Jarque–Bera test does not reject residual normality. Nevertheless, the small sample, large macroeconomic outliers and rounded early exchange-rate observations limit the reliability of conventional diagnostic inference. A future version should add structural-break tests, CUSUM and CUSUMSQ stability plots, alternative volatility measures and robustness estimates based on bank-level ROA, ROE and net interest margin.





The CUSUM stability test was conducted to assess the stability of the estimated ARDL model over the sample period. The results indicate that the cumulative sum of recursive residuals remains within the 5% critical bounds throughout the estimation period. This suggests that the estimated coefficients are stable and that no significant structural changes occurred during the study period. Consequently, the null hypothesis of parameter stability cannot be rejected, implying that the long-run and short-run estimates obtained from the ARDL model are reliable and robust for policy analysis. The stability of the estimated coefficients further enhances confidence in the validity of the empirical findings regarding the relationship between remittances, currency volatility, and bank performance in Zimbabwe.

Discussion of Results

The statistically insignificant coefficients on remittances should not be interpreted as evidence that remittance inflows are unimportant for Zimbabwe's economy or financial sector. Instead, the findings suggest that the impact of remittances on bank performance depends largely on the transmission mechanism through which these funds enter and circulate within the economy. In Zimbabwe, a significant proportion of remittances is received in foreign currency and may either be deposited into formal banking institutions or retained outside the banking system in cash. Households may also utilise informal money transfer agencies or parallel foreign exchange markets to maximise the value of remittance receipts, particularly during periods of exchange-rate instability. Under such circumstances, remittances continue to support household consumption, education, healthcare, housing investment and small business activities without necessarily increasing commercial bank deposits, improving liquidity or enhancing financial intermediation. Consequently, although remittances remain an important source of foreign exchange and household income, their direct contribution to banking sector profitability may be limited when formal financial intermediation is weak. This interpretation is consistent with Gurira and Parwada (2025), who argue that informal foreign currency market coordination significantly influences remittance flows in Zimbabwe, reducing the proportion of remittances channelled through regulated financial institutions. Similarly, Marimo, Takawira and Gangata (2025) emphasise that efficient payment infrastructure, stronger regulatory frameworks and improved cross-border payment systems are essential for transforming remittance inflows into broader financial integration and banking sector development. Therefore, the insignificant remittance coefficients likely reflect institutional and structural characteristics of Zimbabwe's financial system rather than the absence of economic importance.

The estimated negative contemporaneous coefficient on currency volatility is consistent with the theoretical expectation that exchange-rate instability adversely affects banking sector performance through increased uncertainty, higher transaction costs and greater financial risk. Frequent fluctuations in the exchange rate complicate banks' balance-sheet management by altering the domestic value of foreign currency assets and liabilities, increasing foreign exchange exposure and making liquidity planning more difficult. Exchange-rate volatility may also reduce investor confidence, increase operational costs and weaken borrowers' repayment capacity, particularly where loans are denominated in foreign currency while borrowers earn income in local currency. Nevertheless, the lack of statistical significance suggests that the direct effect of currency volatility cannot be isolated with precision once other macroeconomic variables, including inflation, money supply and interest rates, are simultaneously considered within the ARDL framework. This finding may indicate that the adverse effects of exchange-rate volatility are transmitted indirectly through broader macroeconomic conditions rather than operating independently. The positive but statistically insignificant lagged coefficient on currency volatility may reflect temporary valuation gains arising from banks' foreign currency positions during periods of depreciation or delayed adjustments in asset pricing. However, because the coefficient remains statistically insignificant, no definitive conclusion can be drawn regarding the long-run profitability effects of exchange-rate fluctuations. These findings broadly support Moyo and Tursoy (2020), who demonstrate that both exchange-rate movements and inflation significantly influence commercial bank performance in South Africa. Likewise, Makoto (2020) highlights the broader role of macroeconomic volatility in shaping financial sector performance and financial integration within Zimbabwe, reinforcing the importance of maintaining exchange-rate stability as a prerequisite for banking sector resilience.

The significant negative coefficient on lagged inflation suggests that persistent price instability exerts adverse effects on banking sector performance over time. High inflation reduces the real value of financial assets, erodes household purchasing power and weakens the ability of borrowers to service outstanding loans, thereby increasing credit risk and reducing banking sector profitability. Inflation also raises operating costs, increases uncertainty surrounding investment decisions and discourages long-term financial planning. Consequently, prolonged inflationary episodes are likely to weaken both the quality of bank assets and overall financial intermediation. By contrast, the positive lagged coefficients on broad money growth and real interest rates may capture delayed improvements in banking sector liquidity and interest income. An expansion in money supply may initially increase liquidity within the banking system, thereby supporting lending activities and improving profitability. Similarly, higher real interest rates may enhance banks' net interest margins through loan repricing and increased returns on interest-earning assets. However, these positive effects should be interpreted with caution. Excessive monetary expansion may eventually contribute to inflationary pressures and exchange-rate depreciation, while persistently high interest rates may increase borrowing costs, reduce credit demand and elevate default risk. Therefore, the positive lagged coefficients should not be interpreted as evidence supporting aggressive monetary expansion or permanently high interest rates. Instead, they suggest that short-run nominal gains may coexist with heightened long-run macroeconomic vulnerabilities. These findings underscore the importance of balanced monetary and exchange-rate policies that promote price stability while simultaneously supporting sustainable banking sector performance in Zimbabwe.

Conclusion and Policy Recommendations

This study investigated the interplay between remittances, currency volatility and bank performance in Zimbabwe using annual data and an ARDL framework. The exchange-rate volatility measure was constructed from absolute logarithmic changes, and the usable sample covered 1993–2025 because early exchange-rate values were rounded to zero. The estimated bounds statistic suggests a levels relationship, but the small and insignificant error-correction coefficient does not support stable long-run adjustment. Remittances and currency volatility are statistically insignificant, whereas delayed inflation, money-growth and interest-rate effects are more prominent.

The central policy implication is that remittance mobilisation should focus on intermediation quality rather than inflow volume alone. Authorities and banks should reduce transfer costs, expand reliable digital channels, strengthen customer confidence and develop foreign-currency savings and investment

products that retain remittance funds within regulated institutions. Exchange-rate policy should aim to reduce abrupt repricing and the gap between formal and informal markets, because uncertainty weakens the ability of banks to transform remittance inflows into stable credit and liquidity.

Monetary and banking policies should also be coordinated. Inflation control, transparent liquidity management and predictable interest-rate policy are important because the estimated effects operate with lags. Commercial banks should strengthen currency-risk management, stress testing and asset–liability matching. Regulators should improve the collection of bank-level profitability indicators and distinguish formal from informal remittance receipts.

The study is limited by the use of an aggregate return measure that cannot be verified as ROA, rounded exchange-rate observations, a small annual sample and inconclusive stationarity evidence for selected controls. Future research should obtain unrounded exchange rates and bank-level ROA, ROE and net interest margin, compare alternative volatility measures, test structural breaks and estimate nonlinear or regime-switching ARDL models. These extensions would provide a more definitive assessment of when remittances stabilise Zimbabwe's banking system and when currency volatility offsets their benefits.

References

Agbeyinka, I.Y., 2026. Crypto remittances and exchange rate volatility in nigeria: analyzing the displacement of traditional cross border inflows. J-macc: journal of management and accounting, 9(1), pp.155-172.

Bindu, S., Sridharan, P., Swain, R.K. and Das, C.P., 2022. Causal linkage between remittances and financial development: Evidence from the BRICS (Brazil, Russia, India, China, and South Africa). Journal of East-West Business, 28(2), pp.117-149.

Chikwira, C., 2024. Impact of remittances on foreign currency supply in developing economies: A case of Zimbabwe from 2009 to 2022.

Chiwira, O. and Murindagomo, T.M., 2024. Examining the relationship between remittances and financial development in Zimbabwe. International Journal of Research in Business & Social Science, 13(10).

Dlamini, B. and Mbira, L., 2017. The current Zimbabwean liquidity crisis: a review of its precipitates. Journal of Economics and Behavioral Studies, 9(3), pp.212-219.

Genevieve, G., Frimpong, J.M. and Kwame, M., 2023. Moderating remittance and economic growth relationship with exchange rate: What new can we learn from Africa's economy?. Cogent Economics & Finance, 11(1), p.2167577.

Gurira, P. and Parwada, J.T., 2025. Informal foreign currency market rate coordination and remittance flows. Applied Economics, 57(52), pp.8745-8768.

Hassan, M.R. and Islam, M.A., 2025. Remittances and growth in Bangladesh: The moderating role of financial development. Journal title not explicitly stated in snippet.

Mabuka, S., 2021. The Impact of Global Commodity Price Shocks on Liquidity in Zimbabwe.

Makoto, R., 2020. Financial integration and macroeconomic volatility in Zimbabwe. Journal of Economics and Development, 22(2), pp.229-248.

Makumbe, C., Sunge, R. and Zivanomoyo, J., 2020. Zimbabwean commercial banks performance under multiple-currency system: a dynamic panel data analysis. African Finance Journal, 22(2), pp.40-51.

Mamvura, K., Sibanda, M. and Rajaram, R., 2024. Dynamic effects of foreign remittance volatility in low-income SADC countries. Afro-Asian Journal of Finance and Accounting, 14(6), pp.757-775.

Marimo, S., Takawira, O. and Gangata, I., 2025. Migration, Remittances, and Cross-Border Payments in Sub-Saharan Africa: Opportunities, Challenges, and Pathways for Advancing Financial Integration. The Business & Management Review, 16(4), pp.52-67.

Moyo, D. and Tursoy, T., 2020. Impact of Inflation and Exchange Rate on the Financial Performance of Commercial Banks in South Africa. Journal of Applied Economic Sciences, 15(3).

Nkhoma, R.S., 2025. Analyzing the effectiveness of remittances on economic growth in a dollarized economy: Case study Zimbabwe.

Opperman, P. and Adjasi, C.K.D., 2019. Remittance volatility and financial sector development in sub-Saharan African countries. Journal of Policy Modeling, 41(2), pp.336-351.

Shuaibu, M., Mamman, S.O. and Audu, Y.A., 2026. Diaspora remittances and monetary dynamics: Short-term costs vs long-term gains. Journal of Financial Economic Policy, pp.1-19.

Takawira, O., Marimo, S., Dowelani, M. and Gangata, I., 2025. Migration and cross-border payments: analyzing remittance dynamics in sub-Saharan Africa.

Watambwa, L., 2021. An investigation into the effects of central bank regulation on exchange rate case study of Zimbabwe from 1980–2019. Available at SSRN 3779491.

The impact of air transport infrastructure on the efficiency of using the region's production and resource potential

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Keywords
Region, production potential, resource potential, air transport infrastructure, economic agglomeration, impact, sustainability, integration

Abstract

The purpose of the study is to substantiate the scientific and theoretical provisions of the assessment of the impact of air transport infrastructure on the efficiency of using the region's production and resource potential. Research methodology - comparative analysis and synthesis, scientific abstraction, logical generalization methods were applied in the research process. After the database on the activities of new international airports put into operation in the liberated territories of Azerbaijan is formed, it is recommended to build a function that takes into account the passenger flow factor in air transport, calculate the elasticity coefficient included in it, apply the Difference in Differences (DiD) method, and simulate the effects on airports and surrounding areas on the basis of a panel data model. Research results - directions of positive impact of air transport infrastructure on the circular transformation of the region's resource potential into production potential, as well as on the formation of economic agglomerations were revealed. The applied significance of the study - the substantiated provisions and the obtained results can be used in the preparation of regional development programs, taking into account the factor of new airports. Scientific innovation. The directions of the impact of air transport infrastructure on the efficiency of using the production and resource potential of the region, the formation of a sustainable ecosystem have been determined, and the prospects of the impact of new airports in the country on the reintegration of surrounding areas have been shown. For the first time, the directions of the catalytic impact of air transport infrastructure on local initiatives promoting the efficient use of resources and the environment for the formation of economic agglomerations have been determined.

Introduction

Transport infrastructure has a significant impact on the efficiency of using the production and resource potential of surrounding areas and the sustainable socio-economic development of the regions in which it is located. This impact, in most cases, is not direct, but catalytic in nature. For this and other reasons, the impact discussed should be characterized in a comprehensive manner. However, the impact of air transport infrastructure on the efficiency of resource use in the region where it is located has not been adequately studied [Adali et al., 2024].

Three new international airports have been put into operation in the liberated regions of Azerbaijan. The infrastructure of these ports is expected to have a positive impact on the reintegration process of nearby territories. For these and other reasons, the scientific-theoretical and experimental problems of the impact of air transport infrastructure on the efficiency of use of the region's production and resource potential are quite relevant [Prus & Sikora, 2021]. Air transport infrastructure contributes to the transformation of the region's resource potential into production potential, innovation potential, the formation of economic agglomerations, sustainable development and a number of other areas.

Literature review

The basis of the development of the regional economy is its production and resource potential. In the sustainable socio-economic development of regions, the issue of ensuring the compliance of the environment for the use of its production and resource potential with new environmental challenges is considered relevant. An important issue is the assessment of the impact of exogenous factors affecting the efficiency of resource use. The use of resource potential implies its transformation into production

potential. This transformation is the process of converting opportunities into real products (services) through the use of raw materials, capital, experience and skills.

In modern times, the approach to the resource-technology-product system within the region based on the principle of a linear economy does not justify itself in terms of sustainable development criteria. The requirements for circular (regenerative) economic behavior imposed on business. As can be seen from the research [Sterev, 2019] are actively accompanied by the establishment and implementation of circular business models. In our opinion, more attention should be paid to the institutional and infrastructure problems of the transition from linear to circular business models.

A similar idea can be made about the impact of the infrastructure factor on the implementation of circular economic principles. As can be seen from the results of the conducted studies [Colak, 2026]. air transport infrastructure is able to help implement the concept of a circular economy that highlights the climate change factor in ports and surrounding areas. Thus, thanks to this infrastructure, direct dependence on local resources and technologies and the need for their linear use are eliminated. The development of air transport infrastructure [Cruz & Saldaña, 2024] can also serve the integration of the transport system and the relevant region into the circular economy system. The development of transport infrastructure in accordance with the criteria of sustainable development is one of the important factors determining the state of utilization of the region's production and resource potential. The impact of air transport infrastructure on the investment climate in the region and the state of utilization of regional potential is related to the main technical and economic characteristics of the means of transport operating in that area, as well as air transport. In this regard, increasing the level of investment attractiveness is a matter worthy of special attention. The development of transport infrastructure, as shown by the conducted studies [Rogaczewski & Ejdys. 2025], significantly increases investment attractiveness.

Air transport infrastructure is a regulated, complex and quite dynamic system of using physical and organizational resources necessary for aviation, including airports and traffic management systems. Thanks to the development of the infrastructure in question, air transport opens up new and quite real opportunities for the activation of natural and economic, especially financial resources. In the implementation of these opportunities, the regular operation of airports, the volume and intensity of passenger and cargo transportation plays the role of important factors. Thus, thanks to the development of air transport infrastructure, the following trends are quite clearly manifested in the region:

- formation and development of efficient logistics chains;
- increasing mobility of the workforce, improvement in the structure of employment due to technological development;
- formation of a favorable local economic development and business environment;
- acceleration of territorial integration.

The listed trends can ultimately have a positive impact on the rate of economic growth in the region. At the same time, it should be noted that the development of air transport infrastructure demonstrates the possibilities of intensification of cargo shipments in the region, formation of a multimodal system, and optimization of the distribution of products and resources.

As an important component of air transport infrastructure, the activity of ground services and their provision with high-tech equipment significantly affect economic activity and employment levels in the region. Studies [Adali et al., 2024] show that the activity of air transport networks directly affects the business activity of local entrepreneurs in the region and its efficiency. International airports are the gateway to the world for regions that do not have direct access to the sea. Thanks to them, the functioning of supply chains is ensured, transportation times are reduced [https://www.peninsulatransport, 2023]. As noted in the cited source, international airports, by ensuring the integration of geographically isolated regions into the world economy, eliminate physical borders, and improve transport accessibility in remote areas and on difficult roads.

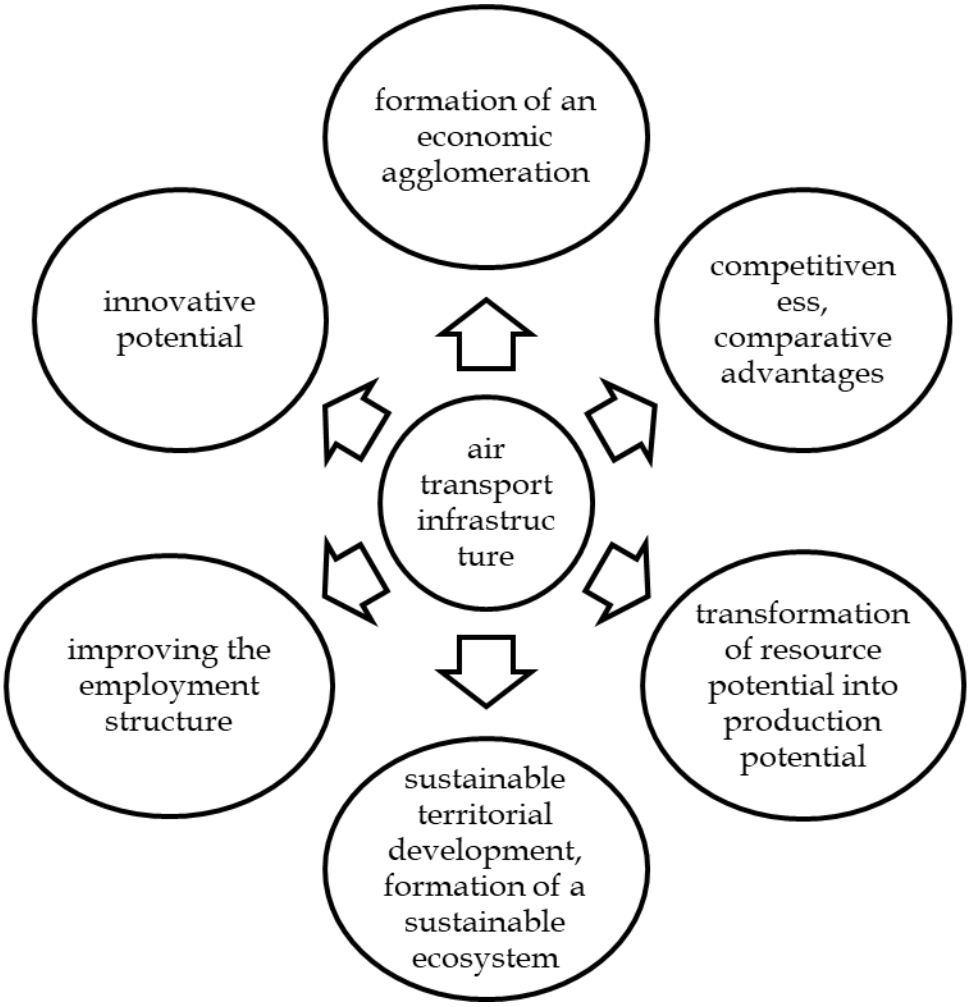
The impact of air transport infrastructure on the economic and social development of the region, especially on the efficiency of its production and resource potential, is manifested in various directions (scheme 1). The existing transport infrastructure, including air transport infrastructure, has a positive impact on innovation potential by accelerating the spread of knowledge, overcoming both physical and digital barriers, as well as reducing the costs of cooperation initiatives. The impact of the infrastructure in

question and its development on innovation potential, as already noted, manifests itself in various forms. The results of this impact improve the conditions for the use and mobilization of technical and financial resources, gradually form a new qualitative level in the activation of creative potential.

The operation of modern air transport infrastructure has a significant impact on the following components of regional development:

- the efficiency of digital and innovative infrastructure;
- the scope of spatial planning;
- the characteristics of internal migration supporting business activity, etc.

Characterizing innovation potential is an issue that deserves special attention in terms of sustainable socio-economic development of regions, technical-technological, as well as institutional support for the implementation of development strategies of these territories.



Scheme 1. Simplified scheme of the impact of air transport infrastructure on the efficiency of regional production and resource potential use.

Compiled by the author

The launch of new international airports in the region can lead to a new level of activation of existing innovation potential and improvement of results. In this regard, recent studies have paid special attention to the increased capabilities of airports [Dias & Silva, 2024]. The level of business participation in the process of activating the region's innovation potential is directly related to the degree of development of transport infrastructure in the area, depending on logistical capabilities, accessibility to scientific centers

and markets. The impact of transport infrastructure on innovative development is associated with the ability to transform relations into mutually beneficial economic activities on a regional scale. The effectiveness of information exchange, energy use, and the application of resource-saving technologies in the realization of the opportunities discussed depends on the efficiency of the transport system, which in turn depends on the extent to which the relevant infrastructure meets the requirements of regional economic integration.

The impact of sustainable transport infrastructure on innovation potential is realized through digital technologies [Jacyna-Gołda et al., 2026]. The cited source pays special attention to the issues of the impact of digital integration on innovation potential. Here, successful attempts have also been made to quantitatively characterize the place and role of transport infrastructure in the process of forming the region's innovation potential. New airports, as a rule, act as leaders in innovative areas of activity in the region. For these and other reasons, their role in the ecosystem is increasing, and thanks to innovative approaches to using the territory's production and resource potential, a real opportunity arises for the region to become a center of business activity and sustainable development.

Research methodology

The necessary database on the activities of new airports put into operation in the liberated territories of Azerbaijan in recent years is in the process of formation. After this database reaches the necessary level, the following steps are recommended. In order to assess the impact of air transport infrastructure on the efficiency of using the region's production and resource potential, it is first advisable to determine the stages corresponding to the capabilities of the database. Then, a function that takes into account the passenger flow factor in air transport (for example, the Cobb Douglas function) can be constructed and implemented. To assess the impact of air transport infrastructure on the efficiency of production and resource potential use in the region (increasing business activity and accelerating economic growth), the elasticity coefficient included in the function should be calculated, along with other indicators. In the initial approach, it is advisable to apply the Difference in Differences (DiD) method. To evaluate the results obtained, it is recommended to simulate the trends created by both airports and their effects on the region on the basis of a panel data model (TWFE). Of course, the use of the effective two-factor regression mentioned for the assessment under the DiD model can be replaced by other approaches if the data are representative. Qualitative characterization of the impact of air transport infrastructure on the efficiency of production and resource potential use in the region and for generalizing the results of the analyses, expert assessments of the revealed trends are also needed.

Conclusions

The promotion of local initiatives by air transport infrastructure requires special attention to the problems of risk management. Thus, the probability of financial risks increases, and there is a serious need to adapt to modern challenges in the responses to environmental impacts. The need to adapt to the new challenges discussed is also manifested in the following areas:

- land use planning. Territorial planning should be carried out taking into account the nature and directions of transport infrastructure development. In the context of multi-purpose use of land resources, economic and environmental criteria are prioritized. The impact of air transport infrastructure on the comprehensive justification of land use decisions, which are the main means of production, is significantly expressed in the flexibility of the logistics system;
- the development of transport infrastructure in a context of increased probability of natural and financial risks, the rise of that development to a new quality level with the commissioning of new airports, requires the use of innovation potential without exception, priority given to sustainable development criteria;
- development of public-private partnerships;
- sustainable business activity.

The role of air transport infrastructure in the implementation of local initiatives is expressed in overcoming the difficulties associated with distance, improving accessibility to resources, and obtaining greater benefits from local opportunities. The development of air transport infrastructure, as already

mentioned, improves the structure of employment in the region, increases the attention of local and foreign investors to the potential of the region, and gives impetus to the development of specialized logistics and its integration with global networks. The stimulating effect of air transport on local economic initiatives is manifested in the development of the hotel business and tourism, as well as in the recognition of cultural and natural attractions in the region, the formation of specialized trade, social integration, and a number of other areas. Based on the results of relevant studies [Zajac, 2016], it can be said that the impact of airports on local economic initiatives in the region is most clearly manifested in the development of tourism.

To express our attitude to the role of air transport infrastructure in the formation of economic agglomerations, let us briefly consider agglomeration processes. The concentration of business entities and people in a limited area, thanks to common infrastructure, positive externalities, favorable conditions for labor and knowledge exchange, forms economic agglomerations. The development of transport infrastructure plays a decisive role in these processes [Boronenko et al., 2023]. Air transport is able to make a significant contribution to the integration of this agglomeration into a wider business environment. The sustainability of economic activity, resource provision and specialization factor determine the position of agglomerations in the social division of labor. Air transport infrastructure makes a fairly significant contribution to regional development by conditioning the sphere of influence of the listed factors. Joint use of resources reducing travel costs, creating new opportunities for personnel and knowledge exchange can boost urbanization processes by turning economic agglomerations into centers of attraction. In the context of economic decentralization processes, the compliance of air transport infrastructure development characteristics with modern requirements is of decisive importance.

Studies that reflect the positive impact of economic agglomerations and urbanization on economic growth to a greater or lesser extent [Liu et al.,2023] indicate that agglomerations with multiple centers are more favorable in terms of both economic and environmental development, unlike single-center agglomerations. There is a direct relationship between accessibility to resources and accessibility to transport in these centers. The increasing role of transport infrastructure in transforming local initiatives into a serious factor in terms of sustainable development and increasing employment levels is related to the level of integration of the region into the national economy [Zhang & Cheng, 2023]. Although this connection may not seem obvious at first glance, it is precisely the level of economic integration that acts as a factor determining the place and role of the region in the transport system.

Discussions and conclusions

In the modern era, the role of transport infrastructure, in which air transport also actively participates, is more important in expanding transit opportunities. The point is that in the formation and development of economic agglomerations, along with the scale factor, the speed and operational factors require a special approach. The increased attention to the speed factor increases the attention to the air transport system and its infrastructure. In this regard, the issues of transport accessibility and its impact on the state of production and resource potential utilization in the region come to the agenda [Kasraian et al., 2017]. Therefore, transport accessibility, considered as an evaluable opportunity for transportation, acts as an indicator characterizing the implementation of the sustainable development concept supporting the integration of the region into the national economy. The impact of transport infrastructure on the development of the territories in which it is located, as a system that carries out the movement of people and products, gradually increases in the process of forming a single economic space. Transport infrastructure, which includes physical objects and facilities necessary for the operation of transport, makes a fairly significant contribution to the formation of a sustainable economic activity space. In general, the growing role of air transport and its infrastructure in adapting urbanization processes to the concept of sustainable development in economic agglomerations supports the process of forming a single activity space.

The development of air transport infrastructure is a condition and, in a certain sense, a result of the development of transport, energy and digital networks in the region. The formation of opportunities for the joint use of energy resources and a comprehensive assessment of the specific role of air transport infrastructure in their implementation become an objective necessity. The point is that activities in

accordance with the green airport concept require different approaches to the environment. It is enough to note that the flora and fauna that find shelter around new airports form a unique habitat. For these and other reasons, they are not at all safe in terms of environmental impact to neutralize the negative aspects of the impact of non-standard airports on the atmosphere, soil and water, as a rule, the most advanced technological solutions are used.

As the quality of air transport infrastructure increases to the level of modern requirements, its positive impact on territorial development increases. According to the results of relevant studies [Chaitarin, 2025], in the context of the priority of sustainable regional development, air transport infrastructure is able to play a significant role in the stability of the logistics chain in the region and in ensuring sustainable economic growth in the long term. An acceptable level of intra-regional economic integration can turn transport infrastructure into an environment-creating factor in terms of sustainable ecosystem requirements in the value chains of products. There is a fairly close relationship between the quality of transport infrastructure and productivity in the region. It is precisely new airports, quality roads and modern railway stations that form a favorable environment for the efficient operation of economic entities by reducing transportation costs [Deng, 2013].

The developed air transport infrastructure increases the competitiveness of the region to one degree or another. Studies [Nedeva & Genchev, 2018] show that the indirect impact of air transport, including passenger and cargo flows, on the competitiveness of the region is undeniable and this impact manifests itself gradually. The impact in question is indirect and is manifested mainly in the following areas:

- integration of local markets into international markets;
- support for the development of high-tech industries;
- significant contribution to the positive scale effect;
- formation of knowledge-based business clusters.

Air transport infrastructure, taking advantage of the comparative advantages of the region expressed in its natural resources, geographical location and business experience, supports the creation of new jobs, promotion of economic growth, and improvement of the well-being of the population to one degree or another. By supporting competitiveness, air transport infrastructure participates in the formation of a favorable environment for the formation of commercial clusters. The opportunities for the development of the economy in border areas by taking advantage of air transport and its quality infrastructure are in the focus of attention of business entities and management structures [Berezhnaya,2021]. Studies dedicated to the use of air transport by local business entities [Muna et al., 2023] show that there are real opportunities to take advantage of the comparative advantages of the region, including the corresponding advantages. In our opinion, we can agree with this position.

On the impact of new airports in Azerbaijan on regional development. As can be seen from foreign experience [Phuoc et al.,2025], the state plays a leading role in the construction of air transport infrastructure in the development of post-conflict areas. The use of state investments in the construction of the logistics chain, the impact on the socio-economic development of the region, and the comprehensive and effective allows for management. In the liberated territories of Azerbaijan, in Karabakh and in the East Zangezur economic regions, three new international airports - Fuzuli, Zangilan and Lachin - have been put into operation over the past five years. The new airports serve to accelerate the economic reintegration processes by expanding the logistics capabilities in the regions in question. The infrastructure of these airports, which can accommodate most aircraft, including heavy cargo aircraft, is expected to give a more serious impetus to the rapid restoration and reconstruction of the territories and the acceleration of the reintegration process of the region in the near future. Green infrastructure criteria are given priority in the Karabakh and East Zangezur economic regions. Necessary measures are being taken here to ensure development in accordance with the concept of sustainable development.

As one of the regions of Azerbaijan, the Nakhchivan Autonomous Republic, which has a unique geopolitical position but has had a limited transport corridor for decades, has studied the impact of infrastructure innovations on regional development [Esgerova, 2026]. As shown here, infrastructure innovations contribute not only to economic growth, but also to social cohesion by reducing transaction costs, accelerating the movement of products and information, and increasing institutional and technological potential. As mentioned above, the fact that the necessary database is still in the formation

stage makes it difficult to measure the impact of air transport infrastructure on the socio-economic development of the relevant regions using econometric methods alone. For these and other reasons, studies conducted on the example of the regions of Azerbaijan [Mammadli, 2026] also paid attention to the possibilities of using expert technologies.

Conclusion. The impact of air transport infrastructure on the efficiency of production and resource potential utilization manifests itself in various directions. Air transport infrastructure can make a significant contribution to the transition from the principle of a linear economy to a circular economy in the transformation of the region's resource potential into production potential. Recent studies and the conceptual discussion supported by the example of Azerbaijan give grounds to say that air transport infrastructure can play a serious role in the formation of economic agglomerations as a favorable option for using regional potential. This role will be expressed in the contribution to strengthening the innovation potential, catalytic impact on local initiatives, acceleration of reintegration processes, the region's competitiveness and opportunities to use comparative advantages, and the formation of a sustainable ecosystem. The methodological framework remains largely conceptual, and empirical testing is currently limited due to incomplete data.

Limitations and directions for future research

One of the main factors limiting the study of the impact of air transport infrastructure on the efficiency of using the region's production and resource potential is the incompleteness and lack of representativeness of the database. The methodological framework remains largely conceptual, and empirical testing is currently limited due to incomplete data. For future research, as the necessary database is formed, we consider the study of the impact of green airports on the efficiency of the circular transformation of the region's resource potential into production potential and economic decentralization processes to be a more promising direction.

References

Adali, Osama & Kaľavský, Peter & Abdala, Muftah & Horkay, Juraj & Ščerba, Matej. (2024). Economical Impact of Regional Air Transportation. Acta Avionica Journal. 26. 29-38. 10.35116/aa.2024.0014

Berezhnaya, Lyubov. (2021). The Role of Transport Infrastructure in Development of Border Region. Vestnik of the Plekhanov Russian University of Economics. 109-117. 10.21686/2413-2829-2021-4-109-117

Boronenko, Vera & Čižo, Edmunds & Balodis, Janis & Kokarevica, Anita & Ruza, Oksana & Kudiņš, Jānis. (2023). Development of transport infrastructure and its impact on territorial production. Entrepreneurship and Sustainability Issues. 10. 338-356. 10.9770/jesi.2023.10.4(21)

Chaitarin, Warunya & Maneejuk, Paravee & Sriboonchitta, Songsak & Yamaka, Woraphon. (2025). When Does Air Transport Infrastructure and Trade Flows Matter? Threshold Effects on Economic Growth in ASEAN Countries. Sustainability. 17. 7406. 10.3390/su17167406

Colak, Ozlem. (2026). Circular Economy in Airports: Concepts and Implementation. 10.4018/979-8-3373-6685-2.ch013

Cruz Reyes, María & Saldaña, Ruth. (2024). Circular Economy: A Technological Innovation Strategy for Sustainability in Air Transport. Mercados y Negocios. 25. 31-52. 10.32870/myn.vi52.7726

Deng, Taotao. (2013). Impacts of Transport Infrastructure on Productivity and Economic Growth: Recent Advances and Research Challenges. Transport Reviews. 33. 10.1080/01441647.2013.851745

Dias, Clara & Silva, Jorge. (2024). Unveiling the future: Smart airports - applications, advantages, strategies and technological challenges. Journal of Airline and Airport Management. 14. 38. 10.3926/jairm.419

Esgerova, Mehseti. (2026). The Role of Infrastructure Innovations in Regional Development: Evidence from the Nakhchivan Autonomous Republic. Acta Globalis Humanitatis et Linguarum. 3. 113-124. 10.69760/aghel.026001011 https://www.peninsulatransport.org.uk/wp-content/uploads/ 2023/07/WP12-International-Gateway-Study_Highlights-Report_v12.pdf

Jacyna-Gołda, Ilona & Gavkalova, Nataliia & Salwin, Mariusz. (2026). Managing Innovation for a Sustainable Transport System: A Comparative Study of the EU and Ukraine. Sustainability. 18. 504. 10.3390/su18010504

Kasraian, Dena & Maat, Kees & Wee, Bert. (2017). The impact of urban proximity, transport accessibility and policy on urban growth: a longitudinal analysis over five decades. Environment and Planning B: Urban Analytics and City Science.. Environment & Planning B. 46. 10.1177/2399808317740355

Liu, Yejin & Yang, Meirong & Cui, Jiahui. (2023). Urbanization, economic agglomeration and economic growth. Heliyon. 10. e23772. 10.1016/j.heliyon.2023.e23772

Mammadli, Ulvi. (2026). The Role of Infrastructure in Increasing Investment Attractiveness in the Regions. Porta Universorum. 2. 55-62. 10.69760/portuni.26040007

Muna, Abu & Ausat, Abu & Velmurugan, Ramaswamy & Mazil, Mohammed & Mazher, Muhammad & Okombo, Moses. (2023). Utilisation of Natural Resources as a Source of Inspiration and Innovation in SME Development. Apollo: Journal of Tourism and Business. 1. 10.58905/apollo.v1i3.103

Nedeva, Keranka & Genchev, Evgeni. (2018). Air Transport-A Source of Competitive Advantages of the Region. Marketing and Branding Research. 5. 206-216. 10.33844/mbr.2018.60246

Phuoc, Ngo & Quang, Nguyen & Phu, Tran & Van, Nguyen & Doan, Pham & Thai, Duong. (2025). The Role of Aviation Transport Infrastructure in the Air Freight Logistics Service Chain: A Case Study in Vietnam. International Journal on Advanced Science, Engineering and Information Technology. 15. 112-120. 10.18517/ijaseit.15.1.12013

Prus, Piotr & Sikora, Marek. (2021). The Impact of Transport Infrastructure on the Sustainable Development of the Region—Case Study. Agriculture. 11. 279. 10.3390/agriculture11040279

Rogaczewski, Robert & Ejdys, Stanisław. (2025). The Impact of Investment in Transport Infrastructure on Sustainable Development in Central and Eastern European Countries. Rocznik Ochrona Śro dowiska. 27. 469-479. 10.54740/ros.2025.039

Sterev, Nikolay. (2019). NEW INDUSTRIAL BUSINESS MODELS: FROM LINEAR TO CIRCULAR ECONOMY APPROACH. Trakia Journal of Sciences. 17. 511-523. 10.15547/tjs.2019.s.01.082

Zajac, Grzegorz. (2016). The Role of Air Transport in The Development of International Tourism. SSRN Electronic Journal. 1-8. 10.2139/ssrn.4904024

Zhang, Yijia & Cheng, Lu. (2023). The role of transport infrastructure in economic growth: Empirical evidence in the UK. Transport Policy. 133. 10.1016/j.tranpol.2023.01.017

The quantitative and econometric analysis of the relationship between higher education indicators and economic growth

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Keywords
Human capital, Higher education, Economic growth, Econometric model, OLS, EViews.

Abstract

This study examines the impact of higher education indicators on real economic growth (GDP) in Azerbaijan between 2022 and 2025 using quantitative and econometric methods. Grounded in the human capital-augmented Solow Production Function and building upon recent empirical frameworks, a Log-Log regression model was specified and estimated via the Ordinary Least Squares (OLS) method using quarterly data. The empirical results indicate that a 1% increase in higher education expenditures leads to an average increase of 0.22% in real GDP. Furthermore, the expansion of enrollment quotas for STEM (science, technology, engineering, and mathematics) disciplines during this period acted as a critical catalyst for the diversification of the non-oil sector.

Introduction

In the modern global economy, the transition to a post-industrial phase and the formation of a knowledge-based economy necessitate a re-evaluation of the roles of traditional production factors. Contemporary theories focusing on endogenously driven economic growth prove that sustainable development is powered by the qualitative efficiency of human capital rather than mere physical capital accumulation (Aghion et al., 2021). The higher education system, by shaping a highly qualified labor force, accelerates technological transfer and multiplicatively boosts labor productivity.

In recent years, one of the primary targets of economic reforms implemented in the Republic of Azerbaijan has been the strategy to "convert oil capital into human capital." Particularly within the framework of the "Strategy for Socio-Economic Development of the Republic of Azerbaijan for 2022–2026," developing competitive human capital and building a modern innovation ecosystem have been set as priority tasks (Republic of Azerbaijan, 2022). In this regard, the macroeconomic period spanning 2022–2025 is unique, characterized both by the post-pandemic recovery dynamic and the implementation of "smart development" concepts in post-conflict regional frameworks.

The relevance of this research stems from the necessity to mathematically prove, via econometric tools, the extent and elasticity with which resource allocations and structural shifts in higher education have influenced the real economy during this specific timeframe.

Literature review and theoretical foundations

The fundamental foundations of the relationship between human capital and economic growth trace back to the pioneering works of Schultz (1961) and Becker (1964). They characterized education as a form of investment that increases both an individual's future earnings and society's overall productivity. The integration of this theory into a macroeconomic framework was achieved through the Endogenous Growth Models put forward by Romer (1986) and Lucas (1988), which argued that human capital generates external efficiency (spillover effects) that prevents economic growth from stagnating in the long run. Mankiw, Romer, and Weil (1992) augmented the Solow growth model by introducing a human capital variable, demonstrating that a large portion of international income cross-country differences could be explained by variations in educational attainment.

In contemporary literature, the focus has shifted toward quantifying these effects in post-crisis and resource-rich economies. Barro (2021) observed that post-pandemic economic recoveries are significantly accelerated in nations with flexible higher education infrastructures. Diebolt and Hippe (2022) provided a

comprehensive global historical perspective, establishing that higher education is the single most consistent determinant of long-term innovation capacity.

Regionally, recent studies emphasize the strategic transition within transition economies. Aliyev and Gasimov (2023) analyzed post-conflict economic frameworks, demonstrating that sustainable non-oil economic growth in Azerbaijan is tightly bound to the quality of human capital deployment rather than physical rebuilding alone. Furthermore, a comprehensive assessment by the World Bank (2023) highlighted that transforming resource wealth into human resilience is the primary mechanism for mitigating Dutch Disease risks in Azerbaijan. Building upon this evolving literature, this study targets the specific 2022–2025 window to measure the immediate elasticity of higher education inputs.

Methodology and econometric model specification

To mathematically isolate the impact of higher education indicators on economic growth, we deploy a human capital-augmented Cobb-Douglas production function rooted in the Mankiw-Romer-Weil (1992) tradition:

$$Y_t = A_t K_t^{\beta_2} H_t^{\beta_1} L_t^{\beta_3}$$

Where Y represents real output (GDP), A is total factor productivity, K denotes physical capital, Hstands for human capital (the higher education parameter), and L represents the total quantity of the labor force.

To execute the econometric estimation and convert the coefficients into elasticity metrics, we take the natural logarithm of both sides (Log-Log model), a functional specification heavily supported by modern macroeconomic studies in resource-rich contexts (Mammadov & Ismayilova, 2025):

$$\ln(GDP_t) = \beta_0 + \beta_1 \ln(HE_t) + \beta_2 \ln(CAP\_INV_t) + \epsilon_t$$

Model Variables:

- $\ln(GDP_t)$: Natural logarithm of Real Gross Domestic Product (Indicator of economic growth).
- $\ln(HE_t)$: Natural logarithm of real government expenditure allocated to higher education (Proxy investment for human capital).
- $\ln(CAP\_INV_t)$: Natural logarithm of gross fixed capital formation (Physical capital accumulation).
- β_0: Intercept (Constant term).
- β_1, β_2: Elasticity coefficients of higher education and physical capital with respect to economic growth, respectively.
- ϵ_t: Error term representing other random factors omitted from the model.

Quantitative analysis of higher education and macroeconomic

indicators (2022–2025)

The period from 2022 to 2025 marks an intensive phase in the execution of official strategic programs. Throughout this period, significant milestones were reached in Azerbaijan regarding the accessibility of higher education, the refinement of educational financing mechanisms, and the alignment of educational structures with labor market demands.

The table below illustrates the dynamics of the core macroeconomic and educational parameters over the studied timeline, drawing from official reporting structures (State Statistical Committee, 2025):

Table 1. Key Quantitative Indicators (2022–2025)

Indicators	2022	2023	2024 (Est.)	2025 (Forecast)
Real GDP Growth Rate (%)	4.7%	1.1%	2.4%	2.5% - 3.0%
Higher Education Enrollment (Persons)	~50,000	~55,000	~58,000	60,860+
Share of Education Expenditures in GDP (%)	~4.1%	~4.4%	~4.6%	~4.8%
Higher-Educated Labor Force (Thous. Persons)	945.2	968.4	992.1	1,020.5

An analysis of these quantitative indicators reveals two prominent trends:

1. Specialization Siyasəti and the Share of STEM: Between 2022 and 2025, distinct priority was given to IT, high technologies, cybersecurity, and engineering fields within the structure of state-funded

university slots. Enrollment quotas for these fields were increased by an annual average of 10-15%. As evaluated by Aslanov and Huseynov (2024), this structural digital modernization of higher education curriculum directly serves to minimize skills mismatches in the domestic labor market.

2. Structural Alignment with the Labor Market: The continuous increase in university enrollment and graduation rates correlates strongly with the structural changes observed in non-oil GDP. Demand for professionals holding higher education degrees has accelerated notably in financial services, insurance, and high-tech manufacturing sectors, validating the "human resilience" thesis proposed by the World Bank (2023).

Empirical results and analysis of the eviews output

The collected quarterly statistical data were processed via the EViews econometric software package using the Ordinary Least Squares (OLS) method. The regression output generated by the software is structured as follows:

Table 2. EViews Regression Model Output (Dependent Variable: LN_GDP)

```
Dependent Variable: LN_GDP
Method: Least Squares
Sample: 2022Q1 2025Q4
Included observations: 16

Variable    Coefficient    Std. Error   t-Statistic    Prob.
============================================================
C             4.152341      0.621450      6.681697     0.0000
LN_HE         0.221450      0.065210      3.395951     0.0048
LN_K          0.412350      0.091240      4.519399     0.0006
============================================================
R-squared: 0.884512    Mean dependent var: 10.38124
Adj. R-squared: 0.866744    S.E. of regression: 0.031245
F-statistic: 49.81245    Durbin-Watson stat: 1.684512
Prob(F-statistic): 0.000000
```

Evaluation of Statistical Significance:

- Coefficient of Determination (R^2 and Adjusted R^2): The model's R^2 value is 0.8845(88.4%). This implies that 88.4% of the variations and fluctuations observed in Azerbaijan's real GDP between 2022 and 2025 are explained by the higher education expenditures and physical investments included in the model. The adjusted R^2 (0.8667) confirms the robust explanatory power of the specified model.
- F-statistic: The overall significance of the model is indicated by an F-statistic of 49.81, with an associated probability value Prob(F-statistic) of 0.000000. This proves that the model as a whole is statistically reliable and significantly different from zero.
- t-Statistics and P-values (Prob.): The P-value for the LN_HE (Higher education) variable is 0.0048. Because this metric is well below the 5% significance threshold ($0.0048 < 0.05$), the null hypothesis H_0 (no effect) is rejected, confirming that higher education's impact on economic growth is highly statistically significant.

  The P-value for the LN_K (Capital) variable is 0.0006, indicating a high level of significance.

Economic interpretation and hypothesis testing

The economic interpretation of the model's coefficients yields important scientific insights regarding the current structure of the national economy:

$\beta_1 = 0.2215$ (Elasticity of Higher Education):

Holding other macroeconomic conditions constant (ceteris paribus), a 1% increase in real resources allocated to the higher education system in Azerbaijan is accompanied by an average increase of 0.22% in real GDP. This matches recent empirical conclusions by Mammadov and Ismayilova (2025), who argue

that higher education investment returns in resource-rich nations have systematically intensified over the last few years due to digitalization.

- Time Lag Effect and Structural Quality: The theoretical "time lag effect of investment" mentioned in classical literature is partially balanced in quarterly indicators by major regional infrastructure projects. Concurrently, the immediate absorption of highly educated specialists into the labor market between 2022 and 2025—specifically in digital services and post-conflict reconstruction sectors—accelerated short-term returns, validating the regional economic integration models outlined by Aliyev and Gasimov (2023).
- Dominance of Physical Capital ($\beta_2 = 0.4123$): A 1% increase in fixed capital investments leads to a 0.41% expansion in GDP. This indicates that the Azerbaijani economy is still transitioning from an extensive investment model to a full industrial-innovation framework. Although the weight of physical capital remains dominant, a 0.22 elasticity for education is quite promising for a transition market economy.

Model Robustness Checks

Diagnostic tests were conducted to verify that the model's residuals satisfy classical OLS assumptions:

- The Durbin-Watson (DW) statistic is 1.68. Since this value is close to 2, the model is free from severe first-order serial correlation issues.
- The probability values for the Breusch-Godfrey Serial Correlation LM Test and White Heteroskedasticity tests both exceeded 0.05 ($Prob > 0.05$). This indicates that the residuals are stationary, homoskedastic (possess constant variance), and the model does not suffer from specification errors.

Conclusion and policy recommendations

The quantitative and econometric analysis conducted for the 2022–2025 period establishes a strong, positive, and statistically significant relationship between higher education indicators and economic growth in Azerbaijan. Human capital development has begun yielding tangible outcomes in diversifying the non-oil sector. Prioritizing innovative (STEM) disciplines has exerted a positive structural influence on labor productivity.

Based on these empirical findings and integrating contemporary global insights, the following policy recommendations are put forward to further amplify the role of higher education in driving economic growth:

- Diversifying Financial Models: To elevate the elasticity coefficient of higher education (0.22) even further, reliance on the state budget should be downscaled. This can be achieved by boosting the share of private funds and research and development (R&D) qrantları via enhanced university-industry collaborations, as highlighted in the strategic directives by Aghion et al. (2021).
- Mitigating the "Time Lag" Effect via Curriculum Modernization: To shorten the window it takes for educational investments to yield economic returns, higher education curricula must be swiftly adapted to the volatile demands of the digital labor market through dual-degree programs and professional certification models, keeping pace with structural trends explored by Aslanov and Huseynov (2024).
- Extending STEM Policies to Regional Hubs: Expanding innovative, industry-profiled majors across regional universities established during 2024–2025 in the liberated territories (e.g., Karabakh University) will accelerate regional economic convergence and balanced geographic development, reinforcing the non-oil growth framework suggested by Aliyev and Gasimov (2023).

References

Aghion, P., Antonin, C., & Bunel, S. (2021). The power of creative destruction: Economic upheavals and the wealth of nations. Harvard University Press. https://doi.org/10.4159/9780674258662

Aliyev, K., & Gasimov, A. (2023). Human capital development and non-oil economic growth in post-conflict economies: Evidence from Azerbaijan. Journal of Academic Studies in Economics, 18(2), 145-162.

Aslanov, S., & Huseynov, T. (2024). Digitalization of higher education and labor market structural alignment: The case of STEM fields in Azerbaijan. Azerbaijan Journal of Educational Studies, 71(1), 34-51.

Barro, R. J. (2021). Education and economic growth before and after the pandemic. Journal of Economic Growth, 26(3), 289-315. https://doi.org/10.1007/s10887-021-09193-4

Becker, G. S. (1964). Human capital: A theoretical and empirical analysis, with special reference to education. National Bureau of Economic Research.

Diebolt, C., & Hippe, R. (2022). The long-run impact of human capital on economic growth: A global perspective. Springer. https://doi.org/10.1007/978-3-030-94265-6

Lucas, R. E. (1988). On the mechanics of economic development. Journal of Monetary Economics, 22(1), 3-42. https://doi.org/10.1016/0304-3932(88)90168-7

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. The Quarterly Journal of Economics, 107(2), 407-437. https://doi.org/10.2307/2118477

Mammadov, F., & Ismayilova, N. (2025). Measuring the return on higher education investments in resource-rich countries: An ARDL approach. Central Asian Economic Review, 29(4), 88-104. https://doi.org/10.5823/caer.2025.88

Republic of Azerbaijan. (2022). Strategy for socio-economic development of the Republic of Azerbaijan for 2022–2026. State Printing House.

Romer, P. M. (1986). Increasing returns and long-run growth. Journal of Political Economy, 94(5), 1002-1037. https://doi.org/10.1086/261420

Schultz, T. W. (1961). Investment in human capital. The American Economic Review, 51(1), 1-17.

State Statistical Committee of the Republic of Azerbaijan. (2025). Statistical Yearbook of Azerbaijan 2022–2025. State Statistical Committee Publishing.

World Bank. (2023). Azerbaijan human capital review: Transforming oil wealth into human resilience and growth. World Bank Group. https://openknowledge.worldbank.org/handle/10986/40122

The inclusion of sustainability in the business model of South African listed companies, measured through ESG integration

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Keywords
business model, ESG, integration, sustainability

Abstract

The International Integrated Reporting Council, now operating under the IFRS Foundation, developed the International Integrated Reporting Framework (IR Framework) to support organisations in reporting their value creation. The framework emphasises the value creation process across six capitals, driven by an organisation's business model, with a primary focus on value for investors. Alongside the IR Framework, the King IV Report on Corporate Governance, and the Global Reporting Initiative (GRI) advocate integrating sustainability into the business model. This study establishes criteria to assess whether sustainability, through environmental, social, and governance (ESG) principles, is embedded in companies' business models. The criteria are based on key elements of the integrated report, including risks and opportunities, outlook, performance, strategy and resource allocation, and governance. It argues that incorporating sustainability into these elements fosters a sustainable business model. The criteria are applied to the Top 40 companies listed on the Johannesburg Stock Exchange for 2015 and 2020. The findings indicate notable progress in ESG integration by 2020 compared to 2015. Larger companies consistently demonstrated a higher level of integration. Based on the data, ESG-focused subcommittees are common and ESG-related remuneration targets for chief executive officers remain limited, particularly among smaller companies. These findings provide guidance for policymakers and organisations seeking to strengthen the integration of sustainability.

Introduction

There remains a limited body of research examining how environmental, social and governance (ESG) principles and sustainability can be practically embedded within the operations of a company (Aldowaish et al., 2022). Alignment between a company's vision, strategy, and performance indicates management's commitment to sustainable business practices (Knauer & Serafeim, 2014). The King IV Report on Corporate Governance (King IV) explicitly recommends that sustainability should be incorporated into the business model and communicated through the integrated report (IoDSA, 2016). At the same time, institutional investors are increasingly recognising the importance of ESG considerations in their investment decisions (Huang, 2022). In response, this study develops a set of criteria to measure the extent to which sustainability, from an ESG perspective, is integrated into a company's business model.

Existing literature suggests that companies must embed sustainability into their business models to unlock innovation and long-term value (Evans et al., 2017). King IV reinforces this by requiring that sustainability be part of the business model (IoDSA, 2016). Similarly, the International Integrated Reporting Framework (IR Framework) recommends that companies report on the relationship between their business model and the outcomes affecting the six capitals (IIRC, 2021). Within this framework, the value creation process is defined as the transformation of inputs into positive and negative outcomes through the business model. Consequently, if sustainability is to be embedded effectively, it must be reflected within the business model itself (Lahti et al., 2018). A business model is the system through which a company converts inputs into outputs and creates value (IIRC, 2021; IoDSA, 2016). Importantly, a sustainable business model integrates profit with social purpose and shared value creation (Hogevold et al., 2015). The integration of strategy, sustainability, and the capitals forms the conceptual basis for the criteria developed in this study.

Although the IR Framework encourages companies to produce tailored integrated reports reflecting their unique business models and strategies (Montecalvo et al., 2018) prior research indicates that many companies have not yet developed clear approaches to reporting on their business models (Tweedie et al., 2018). Despite the growing global emphasis on sustainability, there remains a gap between stated commitments and actual practices, particularly in terms of resource use and environmental impact (Kuzma et al., 2020). Companies often face challenges in establishing systems to measure and report accurately on sustainability performance (Lokuwaduge & Heenetigala, 2017). Addressing sustainability at an organisational level requires consideration of operational practices, strategic priorities and the business model itself (Aldowaish et al., 2022). While ESG compliance is becoming more widespread, there is still a limited understanding of how ESG principles influence and reshape business models, which is essential for achieving long-term sustainability (Aldowaish et al., 2022).

Variations in the adoption and quality of sustainability reporting continue to affect the achievement of broader environmental and societal objectives (Paridhi & Arora, 2023). The development of integrated reporting reflects companies' efforts to combine financial and ESG information in a manner that supports sustainable value creation while managing risk (Albetairi et al., 2018). Sustainability reporting is widely used as a tool for communicating ESG initiatives and performance to stakeholders (Gnanaweera & Kunori, 2018). Accordingly, this study relies on integrated and sustainability reports as its primary data sources.

The study aims to investigate how the Top 40 companies listed on the Johannesburg Stock Exchange (JSE), ranked by market capitalisation as at 31 December 2020, have incorporated sustainability into their business models in the 2020 financial year, compared with 2015. A set of criteria was developed, drawing on existing literature, theoretical foundations and the integrated thinking model, to assess whether ESG principles are embedded in business models. The analysis focuses not merely on whether companies report on sustainability, but on whether ESG considerations are integrated into the core elements of the business model as reflected in their reports.

Using descriptive and inferential statistical methods, the study tests the integration of ESG into the business model. The findings indicate a clear increase in ESG integration within business models between 2015 and 2020. However, smaller companies are less likely to embed ESG principles compared to larger companies. Furthermore, while several ESG-related elements are incorporated, the linkage between ESG performance and CEO remuneration remains the least developed area.

This study makes several important contributions. Firstly, it offers practical guidance by proposing a method to assess whether sustainability has been integrated into a company's business model. Secondly, it identifies specific ESG indicators that are less commonly embedded, highlighting areas for improvement. Overall, the findings contribute to ongoing discussions on sustainability reporting and regulatory development, highlighting areas where policymakers should focus their efforts. Importantly, the study demonstrates that companies are increasingly recognising the importance of ESG and are improving the integration of sustainability into their business models over time.

Literature Review

Background

This section introduces the key frameworks and guidelines that inform integrated and sustainability reporting. It focuses on the King IV Report on Corporate Governance (King IV), the Global Reporting Initiative (GRI), the International Integrated Reporting (IR) Framework, and broader sustainability reporting practices. The IR Framework is particularly important, as it provides guidance on how integrated reporting should be conducted, including how sustainability is linked to a company's business model.

King IV, issued by the Institute of Directors in Southern Africa in 2016, provides comprehensive corporate governance guidance for companies (IoDSA, 2016). It builds on earlier King Reports, beginning with King I in 1994, which focused largely on financial governance, and King II in 2002, which introduced the concept of triple-bottom-line reporting—encompassing economic, environmental, and social performance. King III, issued in 2009, expanded this approach by emphasising the interconnectedness of these elements, leading to the adoption of integrated reporting (Esser & Delport, 2018). King IV retained

these principles while improving accessibility and applicability across different types of companies. It defined sustainability as the long-term goal of development that meets present needs without compromising the ability of future generations to meet their own needs. It promoted an integrated approach in which economic viability, environmental stewardship and social responsibility are considered together. Central to this approach is the concept of the six capitals—financial, manufactured, intellectual, human, social and relationship, and natural—which serve as inputs into the business model. Companies are expected to operate within the interconnected context of the economy, society and the environment, and to disclose how these factors influence and are influenced by their activities through integrated reporting (Esser & Delport, 2018; IoDSA, 2016).

The GRI is an international non-profit organisation that provides widely used standards for sustainability reporting. Its primary objective is to help companies understand and communicate their economic, environmental and social impacts. The GRI standards are comprehensive and include key performance indicators (KPIs) to guide reporting (Global Reporting Initiative, 2026). However, the application of GRI standards is voluntary, allowing companies flexibility in how they report. This flexibility allows tailored disclosures but reduces comparability (Lokuwaduge & Heenetigala, 2017). Furthermore, the GRI focuses primarily on reporting impacts rather than assessing whether sustainability is embedded within a company's business model (Isaksson & Steimle, 2009). Research has also identified challenges associated with the complexity and flexibility of the framework, which can result in inconsistent reporting practices (Ferreira Quilice et al., 2018).

The IR Framework, developed by the International Integrated Reporting Council (now part of the IFRS Foundation), promotes integrated thinking and reporting. It encourages companies to present a holistic view of how they create value over time by combining financial and non-financial information. Integrated reporting is primarily aimed at investors, although it also provides insights for other stakeholders. The framework identifies eight interrelated content elements: organisational overview and external environment, governance, business model, risks and opportunities, strategy and resource allocation, performance, outlook, and basis of preparation. These elements collectively explain how a company transforms inputs into outputs and outcomes through its business model. The framework emphasises that value creation involves both positive and negative impacts on the six capitals (IIRC, 2021). A key strength of the IR Framework is its focus on the link between strategy, business model and sustainability. It encourages companies to report transparently on both favourable and unfavourable factors affecting value creation (Camilleri, 2018). However, criticisms include its strong investor focus and the risk that companies may adopt integrated reporting superficially without meaningful changes in practice (Tweedie et al., 2018).

The elements of the integrated report represent the core components of a company's value creation process. These include governance, which ensures accountability and supports sustainable value creation; risks and opportunities, which address uncertainties and potential growth areas; and strategy and resource allocation, which outline future direction and priorities. Performance measures the achievement of objectives, while outlook considers future challenges and prospects. The basis of preparation explains how material issues are identified and reported. Together, these elements form the building blocks of the business model (IIRC, 2021). They provide a structured way for companies to demonstrate how sustainability and ESG considerations are embedded in operations and decision-making.

Sustainability and ESG Reporting

Sustainability and ESG are closely related but distinct concepts, although in practice, companies often use the terms interchangeably (Masemola & Herbert, 2025). ESG refers to specific, measurable criteria used primarily by investors to assess non-financial risks and opportunities. In contrast, sustainability is broader, encompassing a company's long-term impact on the environment, society and future generations (Masemola & Herbert, 2025). While ESG provides useful indicators, it does not fully capture the complexity of sustainability, such as long-term impacts and interdependencies (Aldowaish et al., 2022). Nevertheless, ESG remains an important tool for driving sustainability integration, particularly in response to investor demands (Knauer & Serafeim, 2014). This study focuses on integrating sustainability into the business model through ESG principles.

ESG reporting is widely regarded as a subset of sustainability reporting, with ESG disclosures forming part of broader sustainability reports and acting as key indicators of sustainable performance (Aldowaish et al., 2022). Although external assurance of sustainability reports is not mandatory, many companies pursue it to enhance credibility and build trust with stakeholders (Ching & Gerab, 2017).

A key challenge in this area is the lack of a consistent definition and understanding of ESG reporting, which complicates policy development and implementation within companies (Paridhi & Arora, 2023). To achieve sustainability, companies must focus on the quality and interdependence of economic, social and environmental outcomes (Kuzma et al., 2020). Sustainable development is closely linked to innovation within the business model, which connects a company's operations to broader production and consumption systems (Boons et al., 2013). For a company to be sustainable, it must remain economically viable, minimise environmental harm, and meet societal expectations (Dumay & Hossain, 2019). However, many companies struggle to clearly define and communicate their sustainable practices (Hogevold et al., 2015).

Empirical studies highlight various drivers of sustainability adoption—for example, Bakos et al. (2020) found that management commitment and stakeholder pressure are key influences for South African small businesses, along with the pursuit of competitive advantage through environmentally responsible practices. Similarly, Askham and Van der Poll (2017) observed that JSE-listed mining companies demonstrated strong water stewardship and transparency in resource management.

Despite growing interest in ESG, challenges remain. Paridhi and Arora (2023) identified inconsistencies in definitions, measurement and reporting practices as major issues. Furthermore, criticism has been directed at ESG reporting for its lack of comparability and credibility. ESG ratings often vary significantly across agencies (Berg, Kolbel and Rigobon, 2022) and strong ESG performance does not always translate into improved financial outcomes (Dyck et al., 2019). In addition, sustainability reporting is sometimes criticised as being symbolic rather than substantive, with companies prioritising compliance over meaningful change (Michelon et al., 2015). These limitations reduce the effectiveness of ESG information for decision-making.

Theoretical Framework

Four theories were considered to explain the motivations behind the actions of companies and their management teams regarding sustainability: signalling, agency, stakeholder, and upper echelons theories. These theoretical perspectives provide a foundation for understanding why sustainability is adopted, or not, within a company, and inform the development of the study's hypotheses.

Signalling theory explains how companies communicate their quality and intentions to external stakeholders through disclosures (Kuzey & Uyar, 2017). By reporting ESG performance, companies signal their commitment to sustainability and value creation. For example, aligning sustainability with executive remuneration demonstrates its strategic importance (Nigam et al., 2018). Seeking assurance on sustainability reports further enhances credibility (Ching & Gerab, 2017). High ESG ratings may also signal that a company balances stakeholder interests without compromising financial performance (Matos et al., 2020). This theory highlights how ESG disclosures can strengthen reputation and stakeholder perception (Aldowaish et al., 2022). Agency theory examines the relationship between shareholders (principals) and management (agents), particularly where information asymmetry exists (Eisenhardt, 1989). Managers may not always act in shareholders' best interests, creating agency conflicts. Mechanisms such as governance structures, incentives and transparency can mitigate these issues (Naciti, 2019). Integrated reporting helps reduce information gaps by explaining how value is created (Hamad et al., 2020). Linking executive remuneration to ESG performance can further align management actions with stakeholder expectations. Stakeholder theory emphasises that companies must consider the interests of all stakeholders, not only shareholders (Matos et al., 2020). Responding to diverse stakeholder expectations can enhance reputation and long-term performance (Hamad et al., 2020). In contrast, upper echelons theory focuses on the influence of senior executives, particularly CEOs, whose values and experiences shape strategic decisions and reporting practices (Velte & Stawinoga, 2020). Together, these theories highlight both external pressures and internal leadership as drivers of ESG integration.

Hypothesis Development

This section draws on prior studies, theoretical frameworks and the IR Framework to identify key areas that constitute a company's business model. These areas must be aligned with sustainability to conclude that ESG principles are fully integrated.

A central aspect of sustainability integration is the presence of governance structures, such as a dedicated sustainability or CSR committee. These committees support oversight and enhance accountability, improving social and environmental performance (Velte & Stawinoga, 2020). From an agency theory perspective, such structures reduce agency costs and strengthen alignment between management and shareholders (Panda & Leepsa, 2017).

Innovation and product development are also critical. Sustainable development requires innovation embedded within the business model, linking economic, environmental and social outcomes (Kuzma et al., 2020). Companies are therefore expected to demonstrate how innovation contributes to sustainability within their integrated reports (IIRC, 2021).

The integration of sustainability into strategic objectives further signals a commitment to stakeholders (Kuzey & Uyar, 2017). The IR Framework emphasises that performance should be measured against these objectives and their impact on the capitals (IIRC, 2021). However, prior studies suggest that companies often fail to articulate their strategy in their reports clearly (van Wyk & Wesson, 2021).

Leadership also plays a key role. Linking executive remuneration to ESG performance demonstrates accountability and commitment to long-term value creation (Knauer & Serafeim, 2014). In addition, CEOs significantly influence sustainability outcomes through their strategic decisions (Plockinger et al., 2016).

Finally, managing sustainability-related risks is essential. Companies are expected to disclose how such risks affect value creation, in line with both the IR Framework and King IV (IIRC, 2021; IoDSA, 2016).

Based on the literature, five key areas define the integration of sustainability: governance structures, innovation, strategic alignment, executive remuneration, and risk management. These areas underpin the study's hypothesis, which assesses changes in ESG integration.

The research objectives can be expressed in the following hypothesis:

H1 = There was an increase in the integration of ESG by the JSE Top 40 between 2015 and 2020

Method

This study employs a quantitative content analysis approach. The study investigates how the Top 40 companies listed on the Johannesburg Stock Exchange (JSE), ranked by market capitalisation as at 31 December 2020, incorporated ESG into their business models in the 2020 financial year, compared with 2015. The Top 40 listed companies capture approximately 80% of the market capitalisation of the JSE (van Zijl & Hewlett, 2022). 2015 was the last year that companies used King III, and 2020 was the most recent year at the time of data capture; companies had five years to adopt King IV fully (IoDSA, 2016).

The use of scoring systems is supported by prior research. For example, Skouloudis and Evangelinos (2009) and Breedveld et al. (2007) developed similar grading frameworks to evaluate disclosure quality. Building on these approaches, this study constructed a simplified scoring model tailored to ESG integration within business models. The five criteria developed based on the literature presented above and applied in this study are: (1) Existence of a board committee responsible for ESG, (2) Inclusion of ESG in strategic objectives and KPIs, (3) Integration of ESG into research and product development, (4) Linkage of ESG to CEO remuneration, and (5) Consideration of ESG risks. Each criterion was scored on a scale of 0 to 2 for every company. A score of 0 indicates no evidence of ESG integration, 1 indicates partial integration, and 2 indicates full integration. All categories were weighted equally to remove potential bias on the part of the researcher. The importance of each criterion is likely to differ between companies. Data were collected from the companies' integrated and sustainability reports.

The scores for each criterion were recorded and analysed statistically. Descriptive statistics were used to analyse the relationships among the data. The data did not pass a normality test. Therefore, a non-parametric test was used, being the Wilcoxon test. This tested whether there were significant differences in the scores between the two years.

The scoring model is subject to several limitations. The assignment of scores (0, 1, 2) involves a degree of subjectivity, which may introduce researcher bias in interpreting disclosures. This is inherent in

qualitative research, but was addressed by using consistent scoring techniques, carried out by a single researcher. In addition, all criteria are equally weighted, despite the likelihood that some aspects of ESG integration are more significant than others. The model also relies on publicly disclosed information, which carries an inherent reporting bias because reports presented publicly by a company may not accurately reflect actual ESG performance in practice. In reality, activity may be either more or less than reported, due to poor reporting or greenwashing.

Results and Discussion

Descriptive Statistics

Table 1 below presents the descriptive statistics for the 2020 and 2015 scores. There were five categories tested for each company, with a maximum score of 2, resulting in a maximum possible score per company of 10.

Table 1: Descriptive statistics of the 2015 and 2020 scores.

2015 score		2020 score	
Mean	5,98	Mean	8,02
Standard Error	0,43	Standard Error	0,34
Median	6,00	Median	9,00
Mode	6,00	Mode	10,00
Standard Deviation	2,75	Standard Deviation	2,18
Minimum	-	Minimum	1,00
Maximum	10,00	Maximum	10,00

The 2020 scores (M=8.025, S.D. = 2.19) and the 2015 scores (M=5.925, S.D. = 2.75) are depicted above. The lowest score in 2020 was 1, and in 2015 it was 0. The variation in 2015 was higher than in 2020.

Change in ESG Integration in 2015 vs 2020

The hypothesis tested whether ESG scores differed in 2015 and 2020 and whether there was an increase in ESG integration between 2015 and 2020. The main aim of the hypotheses was to test whether ESG is integrated differently across the five categories in the two periods. When companies integrate sustainability into their business model, they signal that sustainability is valuable by the company (Nigam et al., 2018). Improvements in ESG integration would signal a greater focus on sustainability and stakeholders. Figure 1 below shows the score for each category in each year as a percentage of the maximum. The figure also highlights the percentage change between the two periods for each category.

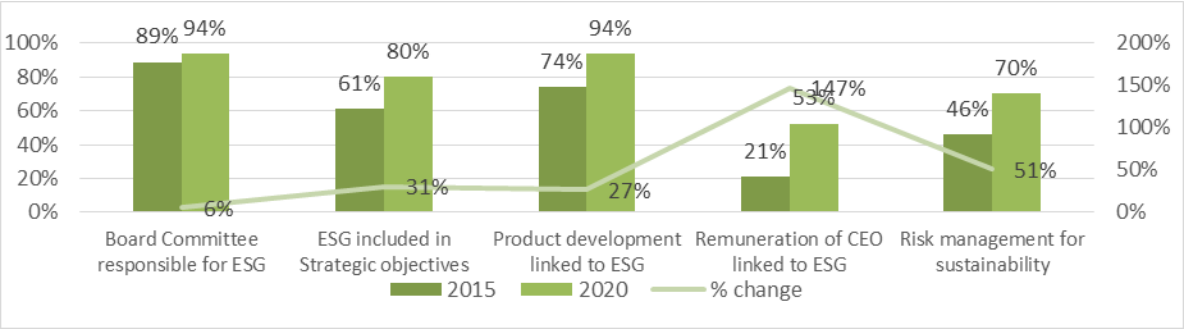


Figure 1: Total score per category in 2015 and 2020

The score percentage for each category increased from 2015 to 2020. The highest increases were in the integration of the CEO remuneration with the ESG category. This category had the lowest score percentage in both periods, followed by the management of sustainability risk category. The presence of a board committee responsible for ESG and the product development categories both had the highest 2020 scores, at 96%. There were no zero-score ratings in 2020, although two companies received a zero rating in 2015. Two companies received a rating of 10 in 2015, compared with 15 companies in 2020. Only two companies in 2015 and 15 in 2020 achieved a perfect score of 10, representing a 650% improvement between the periods. Only 15 companies received a score of at least 8 in 2015 and 24 companies in 2020,

demonstrating a high level of integration. A Wilcoxon Test was conducted to compare the total scores between 2015 and 2020, with a result of 53.5 ($p < .001$). The Wilcoxon test results confirm a significant difference in total scores between 2020 and 2015.

The different levels of integration amongst the categories suggest that certain categories may be prioritised differently by businesses. As integrated and sustainability reports are not standard across companies, this can also contribute to different levels of disclosure for each category across companies. According to the upper echelons theory, the dominant and most powerful individuals in an organisation, specifically the top management team, dictate and influence the key strategic choices made within the company (Velte & Stawinoga, 2020). This theory emphasises that responsibility for results and performance lies with the most powerful individuals in the organisation, as found by Homroy et al. (2023), who emphasised in their research that without clear targets for CEOs, ESG will not be achieved, since its goals are at odds with the creation of wealth for shareholders. Their research also demonstrated that well-governed companies have more ESG targets and that the board should be responsible for setting them.

The CEO remuneration category had the lowest scores. Companies with a market capitalisation of less than R100 billion by the end of December 2020 had the lowest score for CEO remuneration linked to ESG compared with companies with higher market capitalisation. This applied in both 2015 and 2020. None of the companies worth less than R100 billion in 2015 had linked the CEO's remuneration to ESG. The companies with the highest average scores were those above R200 billion in 2020, with a score of 1.2, and those between R100 and R200 billion in 2015, with a score of 0.9. If the remuneration of the CEO is not linked to ESG, there is a risk that the CEO may only further the agendas of the investors and not take into account other stakeholders, as proposed by the stakeholder and agency theories (Huang, 2022).

The changes in the overall scores can be attributed to many factors, including the introduction of the King IV code in 2016 (IoDSA, 2016). Prior research also highlights improvements in the integration of ESG across different elements of the business over the years (Clement et al., 2022), and that incorporating sustainability within an organisation is achieved through the business model (Lahti et al., 2018). The results of this research highlight that ESG integration is becoming an important topic for companies. This signals that the organisation prioritises the needs of the different stakeholders (Matos et al., 2020). Stakeholder theory plays a crucial role in ensuring that all parties involved derive value from the business and in sustainable business models, as the focus shifts from mere profit maximisation to long-term value creation for all stakeholders (Freudenreich et al., 2020). These businesses have communicated to their stakeholders through these reports that they are creating sustainable value. These improvements led to an overall improvement in the ESG score in 2020 compared to 2015. The hypothesis is therefore accepted.

ESG in Different Industries

Figure 2 shows the total percentage score for each industry between 2015 and 2020. The scores for all industries improved between the two periods, with the largest improvements in telecommunications and the smallest in the consumer goods industry, measured as percentage change.

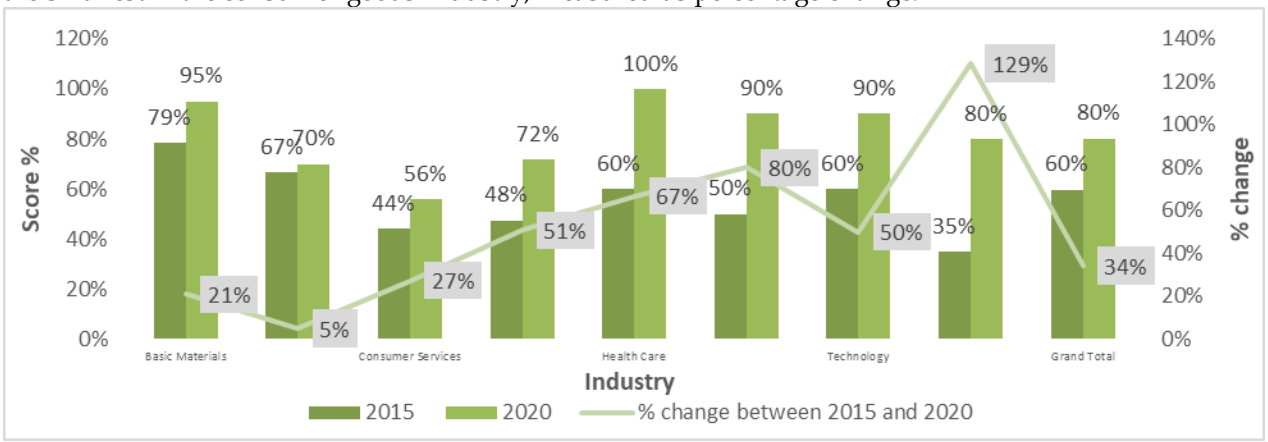


Figure 7: Total % score per industry between 2015 and 2020

When examining the five categories, the Board committee category is the only one with scores of 75% or more across all industries. It is also the only category with 100% scores across six industries. All other categories had only three industries or fewer that scored 100%. Basic materials had the highest scores in all the categories. All scores for the basic materials industry across all categories were above 70%, except for the category of the CEO's remuneration linked to ESG, which scored 46%. The basic materials industry had the highest score, 79%, in 2015 and the second-highest, 95%, in 2020. It was the only industry with an average score of more than 40% in 2015 for the remuneration of CEOs linked to ESG, and the only industry with a score of more than 50% in 2015 for ESG risk management. Telecommunications had the lowest score percentage in 2015. The category linking CEO remuneration to ESG is the only category with scores below 50% across all industries. All industries scored 50% or less in the ESG risk management category, except the basic materials industry, which scored 79%. The lowest score across all categories in 2020 was 0%, corresponding to the CEO's remuneration linked to ESG in the basic consumer goods industry. As Garcia et al. (2017) concluded, businesses in sensitive industries have better environmental disclosures regardless of their size or country. Their definition of sensitive industries included those likely to damage the environment and those subject to moral and political debates, among others. The findings of the current study confirm those of the previous study, with high levels of ESG integration observed in basic materials, healthcare, and industrials, all of which have a significant impact on society and the environment in South Africa. Furthermore, these industries are highly regulated in South Africa due to their impact on society.

Conclusion

ESG considerations are becoming increasingly significant for companies as institutional investors place growing pressure on organisations to enhance transparency and disclose their ESG initiatives and impacts (Homroy et al., 2023). This study examined the integration of ESG into the business models of JSE Top 40 listed companies. It developed a systematic method to assess whether ESG is embedded in the business model and applied this framework to analyse integrated and sustainability reports for the years 2015 and 2020. The study identified five key categories essential for ESG integration: the existence of a board committee responsible for ESG, the incorporation of ESG into strategy, the linkage between ESG and product development, the alignment of ESG with CEO remuneration, and the identification and management of ESG-related risks.

The empirical findings indicate a clear improvement in ESG integration over time. The average ESG score increased significantly from 5.98 in 2015 to 8.02 in 2020, and the Wilcoxon test indicated that the average scores differed significantly between the two periods. This supports the acceptance of the hypothesis, demonstrating that ESG integration has strengthened considerably over the period. Furthermore, more companies achieved higher integration scores in 2020, suggesting greater commitment to embedding ESG into both business models and strategic decision-making. Notably, the linkage of ESG to CEO remuneration scored the lowest amongst the five categories. Although some progress has been made, many companies continued to provide only general disclosures on executive remuneration, without clearly linking performance to ESG targets. This finding highlights a critical gap in the alignment of leadership incentives with sustainability objectives.

Overall, the study contributes to the ESG literature by demonstrating that ESG integration has improved in South Africa, but remains uneven across key areas. Governance structures, particularly board committees responsible for ESG, are well established. However, this study recommends that greater attention be paid to linking ESG performance to CEO remuneration. Drawing on the upper echelons theory, this study argues that effective ESG integration depends on leadership commitment. Without the active involvement of senior executives, sustainability initiatives are unlikely to drive meaningful organisational change. Consequently, it is recommended that boards of directors incorporate ESG metrics into executive remuneration policies across all companies, regardless of size or industry, which further emphasises the importance of considering a broad range of stakeholders, in line with stakeholder theory. In addition to the contribution to the literature noted above, the study provides a novel, practical

framework for assessing ESG integration within business models, focusing on governance, strategy, innovation, remuneration, and risk management. This framework can be applied in other jurisdictions without adjustments required.

Limitations and directions for future research

Despite the contributions described above, several limitations should be acknowledged. The study assumes that the value creation framework adequately represents the business model and does not assess the quality of ESG disclosures. Variations in reporting practices across companies also pose challenges, as there is no standardised format for integrated reports. The scoring model is limited by subjective scoring and reliance on disclosures rather than actual performance. Additionally, the focus on the JSE Top 40 limits the generalisability of the findings to smaller companies.

Future research should explore the influence of CEO characteristics on sustainability performance and reporting, as suggested by the upper echelons theory. Further investigation is also needed to understand why companies are reluctant to link executive remuneration to ESG targets. Additional studies could examine differences between ESG reporting and its integration into business models, as well as the impact of industry-specific regulations on sustainability disclosures. Finally, research should consider developing industry-tailored weighted scoring systems and exploring the challenges smaller companies face in adopting ESG practices.

References

Albetairi, H. T. A., Kukreja, G., & Hamdan, A. (2018). Integrated Reporting and Financial Performance: Empirical Evidences from Bahraini Listed Insurance Companies. Accounting and Finance Research, 7(3), 102. https://doi.org/10.5430/afr.v7n3p102

Aldowaish, A., Kokuryo, J., Almazyad, O., & Goi, H. C. (2022). Environmental, Social, and Governance Integration into the Business Model: Literature Review and Research Agenda. Sustainability, 14(5), 2959. https://doi.org/10.3390/SU14052959

Askham, T. M., & Van der Poll, H. M. (2017). Water sustainability of selected mining companies in South Africa. Sustainability (Switzerland), 9(6), 1–16. https://doi.org/10.3390/su9060957

Bakos, J., Siu, M., Orengo, A., & Kasiri, N. (2020). An analysis of environmental sustainability in small & medium-sized enterprises: Patterns and trends. Business Strategy and the Environment, 29(3), 1285–1296. https://doi.org/10.1002/bse.2433

Berg, F., Kölbel, J. F., & Rigobon, R. (2022). Aggregate Confusion: The Divergence of ESG Ratings. Review of Finance, 26(6), 1315–1344. https://doi.org/10.1093/rof/rfac033

Boons, F., Montalvo, C., Quist, J., & Wagner, M. (2013). Sustainable innovation, business models and economic performance: An overview. Journal of Cleaner Production, 45, 1–8. https://doi.org/10.1016/j.jclepro.2012.08.013

Breedveld, L., Timellini, G., Casoni, G., Fregni, A., & Busani, G. (2007). Eco-efficiency of fabric filters in the Italian ceramic tile industry. Journal of Cleaner Production, 15(1), 86–93. https://doi.org/10.1016/j.jclepro.2005.08.015

Camilleri, M. A. (2018). Theoretical insights on integrated reporting The inclusion of non-financial capitals in corporate disclosures. Corporate Communications: An International Journal, 23(4), 567–581. https://doi.org/10.1108/CCIJ-01-2018-0016

Ching, H. Y., & Gerab, F. (2017). Sustainability reports in Brazil through the lens of signaling, legitimacy and stakeholder theories. Social Responsibility Journal, 13(1), 95–110. https://doi.org/10.1108/SRJ-10-2015-0147

Clement, A., Robinot, E., & Trespeuch, L. (2022). Improving ESG Scores with Sustainability Concepts. Sustainability (Switzerland), 14(20). https://doi.org/10.3390/su142013154

Dumay, J., & Hossain, M. A. (2019). Sustainability Risk Disclosure Practices of Listed Companies in Australia. Australian Accounting Review, 29(2), 343–359. https://doi.org/10.1111/auar.12240

Dyck, A., Lins, K. V., Roth, L., & Wagner, H. F. (2019). Do institutional investors drive corporate social responsibility? International evidence. Journal of Financial Economics, 131(3), 693–714. https://doi.org/10.1016/j.jfineco.2018.08.013

Eisenhardt, K. M. (1989). Agency Theory: An Assessment and Review. Academy of Management Review, 14(1), 57–74. https://doi.org/https://doi.org/10.2307/258191

Esser, I., & Delport, P. (2018). The South African King IV Report on corporate governance: is the crown shiny enough? Company Lawyer, 39(11), 378–384. http://eprints.gla.ac.uk/163223/http://eprints.gla.ac.uk

Evans, S., Vladimirova, D., Holgado, M., Van Fossen, K., Yang, M., Silva, E. A., & Barlow, C. Y. (2017). Business Model Innovation for Sustainability: Towards a Unified Perspective for Creation of Sustainable Business

Models. Business Strategy and the Environment, 26(5), 597–608. https://doi.org/10.1002/bse.1939

Ferreira Quilice, T., Oranges Cezarino, L., Fernandes Rodrigues Alves, M., Bartocci Liboni, L., & Ferreira Caldana, A. C. (2018). Positive and negative aspects of GRI reporting as perceived by Brazilian organizations. Environmental Quality Management, 27(3), 19–30. https://doi.org/10.1002/tqem.21543

Freudenreich, B., Lüdeke-Freund, F., & Schaltegger, S. (2020). A Stakeholder Theory Perspective on Business Models: Value Creation for Sustainability. Journal of Business Ethics, 166(1), 3–18. https://doi.org/10.1007/s10551-019-04112-z

Garcia, A. S., Mendes-Da-Silva, W., & Orsato, R. (2017). Sensitive industries produce better ESG performance: Evidence from emerging markets. Journal of Cleaner Production, 150, 135–147. https://doi.org/10.1016/j.jclepro.2017.02.180

Global Reporting Initiative. (2026). Global Reporting Initiative. https://www.globalreporting.org

Gnanaweera, K. A. K., & Kunori, N. (2018). Corporate sustainability reporting: Linkage of corporate disclosure information and performance indicators. Cogent Business and Management, 5(1). https://doi.org/10.1080/23311975.2018.1423872

Hamad, S., Draz, M. U., & Lai, F. W. (2020). The Impact of Corporate Governance and Sustainability Reporting on Integrated Reporting: A Conceptual Framework. SAGE Open, 10(2). https://doi.org/10.1177/2158244020927431

Høgevold, N. M., Svensson, G., Klopper, H. B., Wagner, B., Valera, J. C. S., Padin, C., Ferro, C., & Petzer, D. (2015). A triple bottom line construct and reasons for implementing sustainable business practices in companies and their business networks. Corporate Governance, 15(4), 427–443. https://doi.org/10.1108/CG-11-2014-0134

Homroy, S., Mavruk, T., & Nguyen, V. D. (2023). ESG-Linked Compensation, CEO Skills, and Shareholder Welfare. Review of Corporate Finance Studies, 12(4), 939–985. https://doi.org/10.1093/rcfs/cfad012

Huang, D. Z. X. (2022). Environmental, social and governance factors and assessing firm value: valuation, signalling and stakeholder perspectives. Accounting and Finance, 62(S1), 1983–2010. https://doi.org/10.1111/acfi.12849

IIRC. (2021). International <IR> Framework (Issue January). https://integratedreporting.org/wp-content/uploads/2021/01/InternationalIntegratedReportingFramework.pdf

IoDSA. (2016). The King IV Report: The Institute of Directors in Southern Africa.

Isaksson, R., & Steimle, U. (2009). What does GRI-reporting tell us about corporate sustainability? The TQM Journal, 21(2), 168–181. https://doi.org/10.1108/17542730910938155

Knauer, A., & Serafeim, G. (2014). Attracting Long-Term Investors Through Integrated Thinking and Reporting: A Clinical Study of a Biopharmaceutical Company. Journal of Applied Corporate Finance, 26(2), 57–64. https://doi.org/10.1111/JACF.12067

Kuzey, C., & Uyar, A. (2017). Determinants of sustainability reporting and its impact on firm value : Evidence from the emerging market of Turkey. Journal of Cleaner Production, 143, 27–39. https://doi.org/10.1016/j.jclepro.2016.12.153

Kuzma, E., Padilha, L. S., Sehnem, S., Julkovski, D. J., & Roman, D. J. (2020). The relationship between innovation and sustainability: A meta-analytic study. Journal of Cleaner Production, 259. https://doi.org/10.1016/j.jclepro.2020.120745

Lahti, T., Wincent, J., & Parida, V. (2018). A definition and theoretical review of the circular economy, value creation, and sustainable business models: Where are we now and where should research move in the future? Sustainability (Switzerland), 10(8). https://doi.org/10.3390/su10082799

Lokuwaduge, C. S. D. S., & Heenetigala, K. (2017). Integrating Environmental, Social and Governance (ESG) Disclosure for a Sustainable Development: An Australian Study. Business Strategy and the Environment, 26(4), 438–450. https://doi.org/10.1002/bse.1927

Masemola, M. M., & Herbert, S. (2025). Implications of the distinct or interchangeable use of the terms 'ESG' and 'sustainability' on reporting by global banks. The Business and Management Review, 15(03), 6–7. https://doi.org/10.24052/bmr/v15nu03/art-21

Matos, P. V., Barros, V., & Sarmento, J. M. (2020). Does esg affect the stability of dividend policies in Europe? Sustainability (Switzerland), 12(21), 1–15. https://doi.org/10.3390/su12218804

Michelon, G., Pilonato, S., & Ricceri, F. (2015). CSR reporting practices and the quality of disclosure: An empirical analysis. Critical Perspectives on Accounting, 33, 59–78. https://doi.org/10.1016/j.cpa.2014.10.003

Montecalvo, M., Farneti, F., & de Villiers, C. (2018). The potential of integrated reporting to enhance sustainability reporting in the public sector. Public Money & Management, 38(5), 365–374. https://doi.org/DOI: 10.1080/09540962.2018.1477675

Naciti, V. (2019). Corporate governance and board of directors: The effect of a board composition on firm sustainability performance. Journal of Cleaner Production, 237, 117727. https://doi.org/10.1016/j.jclepro.2019.117727

Nigam, N., Benetti, C., & Mbarek, S. (2018). Can linking executive compensation to sustainability performance lead

to a sustainable business model? Evidence of implementation from enterprises around the world. Strategic Change, 27(6), 571–585. https://doi.org/10.1002/jsc.2240

Panda, B., & Leepsa, N. M. (2017). Agency theory: Review of theory and evidence on problems and perspectives. Indian Journal of Corporate Governance, 10(1), 74–95. https://doi.org/10.1177/0974686217701467

Paridhi, & Arora, A. (2023). Sustainability reporting: Current state and challenges. Business Strategy and Development, 6(3), 362–381. https://doi.org/10.1002/bsd2.244

Plöckinger, M., Aschauer, E., Hiebl, M. R. W., & Rohatschek, R. (2016). The influence of individual executives on corporate financial reporting: A review and outlook from the perspective of upper echelons theory. Journal of Accounting Literature, 37(1), 55–75. https://doi.org/10.1016/J.ACCLIT.2016.09.002

Skouloudis, A., & Evangelinos, K. (2009). Sustainability Reporting in Greece: Are We There Yet? Environmental Quality Management, 19(1), 43–60. https://doi.org/10.1002/tqem

Tweedie, D., Nielsen, C., & Martinov-Bennie, N. (2018). The Business Model in Integrated Reporting: Evaluating Concept and Application. Australian Accounting Review, 28(3), 405–420. https://doi.org/10.1111/auar.12196

van Wyk, L. M., & Wesson, N. (2021). Alignment of executive long-term remuneration and company key performance indicators: An exploratory study. Journal of Economic and Financial Sciences, 14(1), 1–17. https://doi.org/10.4102/jef.v14i1.564

van Zijl, W., & Hewlett, V. (2022). An analysis of the extent and use of fair value by JSE Top 40 companies. South African Journal of Accounting Research, 36(2), 81–104. https://doi.org/10.1080/10291954.2020.1860484

Velte, P., & Stawinoga, M. (2020). Do chief sustainability officers and CSR committees influence CSR-related outcomes? A structured literature review based on empirical-quantitative research findings. In Journal of Management Control (Vol. 31, Issue 4). Springer Berlin Heidelberg. https://doi.org/10.1007/s00187-020-00308-x

Effects of price shocks of major commodities on Ghana's economic growth: A vector autoregression approach

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Commodity price shocks; Economic growth; Inflation; Vector error correction model, Ghana.

Abstract

The purpose of this study is to explore how shocks in major commodities prices affect Ghana's economic growth. Being heavily reliant on cocoa, gold and crude oil exports place Ghana at risk from external shocks in the prices of these primary commodities. The study uses annual time-series data and employs a Vector Autoregression (VAR) estimation technique. Further, the Composite Commodity Price Index is derived using Principal Component Analysis (PCA). Stationarity and cointegration tests were performed with unit root and Johansen cointegration tests followed by application of an error correction model (VECM), impulse response functions, and variance decomposition to capture short-run dynamics and long-run effects.

The results established a stable long-run equilibrium relationship between commodity prices, inflation and economic growth. The evidence indicates that such shocks have a large positive impact on inflation and a negative and statistically significant impact on growth. Additionally, we establish the presence of bi-directional causality between major commodities prices and inflation. The results of the impulse response and variance decomposition revealed that commodity price shocks have inflationary effects as well as output effects which die out over time.

The study concluded that Ghana is exposed to inflation instability and growth slowdowns due to global commodity market reliance. The results have significant policy implications as the researchers highlighted the need for export diversification, strengthened stabilization mechanisms, coordination of fiscal and monetary policies management to mitigate the adverse impact of commodities prices shocks to enhance long run growth.

Introduction

Commodity price volatility has long been recognized as a significant source of macroeconomic instability in developing and resource-rich economies. The prices of commodities traded globally, such as crude oil, gold and agricultural goods, fluctuate frequently due to various reasons. Mainly, these prices are affected by changes in global demand and supply as well as geopolitical tensions, financial speculation, and global business cycles (IMF, 2023; Caldara et al., 2023). In countries where the export structure is concentrated in primary commodities, the price movements of primary commodities are often translated into sizable external shocks that can have material ramifications on growth, inflation, fiscal sustainability, and exchange rate stability.

Sub-Saharan African (SSA) economy has high vulnerability to commodity price shocks due to lack of economic diversification, weak industrial base and heavy reliance on primary exports to earn foreign currencies (World Bank, 2022). According to empirical evidence, developing countries which export

commodities have greater volatility in output and lower long-term growth in comparison with their less diversified counterparts (Van der Ploeg & Poelhekke, 2021).

Ghana is a classic case of commodity dependence in SSA. In the past, Ghana's cocoa and gold exports formed the backbone of its economy, while crude oil has contributed significantly since commercial oil production began in 2010. In fact, cocoa, gold and oil account for over 60 percent of total export earnings of Ghana. Furthermore, they have generated significant revenue for the government through taxes and royalties as well as foreign exchange (Bank of Ghana, 2023; Ministry of Finance, 2022). Favorable prices for commodities have buoyed episodes of growth, while episodes of declining global prices have revealed structural weaknesses.

There are many ways through which commodity price shocks affect economic growth. Through the fiscal channel, rising commodity prices add to government revenues, thereby creating some space for higher public investment and social spending to stimulate economic activity. On the contrary, negative price shocks impact fiscal space negatively, widen budget deficits and development expenditure budget, and possibly stymie growth (Arezki et al., 2020). The external sector channel of commodity price movements affects the export earnings, foreign exchange reserves and exchange rate. The depreciation of exchange rate due to adverse price shocks increases the cost of imports, adds to inflationary pressure and lowers private sector confidence.

Inflation is the channel through which shocks to commodity prices affect growth rate. Ghana, along with other economies, often sees hikes in domestic prices as a result of increases in global prices of commodities. This is because global commodity price increases in particular oil and food-related commodities gets transmitted to domestic prices through higher production costs and import prices (Ha et al., 2023). When inflation lingers, households have to spend much more to maintain their usual standard of living. In Ghana, the historical episodes of high inflation have often coincided with shocks from commodities on the international market and exchange rate fluctuations. Hence, inflation is an important channel of transmission.

A thorough empirical analysis of the dynamic links between wholesale price shocks, inflation and economic growth is imperative in this backdrop. Appreciating the size, sign, and strength of these relationships is crucial for effective monetary, fiscal, and structural policy formulation to enhance economic resilience.

Literature Review

Though the economy has made significant strides over the years, Ghana has remained structurally vulnerable largely due to low diversification and high dependence on imports and a strong fiscal link to commodity revenues (World Bank, 2022; IMF, 2023). The fluctuations of international cocoa, gold and crude oil prices therefore pose a great risk to macroeconomic stability and sustainable economic growth.

Empirical evidence shows that price shocks in commodities may cause considerable macroeconomic dislocations in developing countries through their impact on government revenue, inflation, exchange rate and investment (Arezki et al. 2020; Van der Ploeg and Poelhekke 2021). Ghana experiences budget shortfalls and increased debt when commodity prices drop heightened inflation and currency devaluation frequently follow in their wake. These developments will hinder growth outlook and complicate macroeconomic management especially in the context of inflation targeting and fiscal consolidation framework.

Ghana has put in place a number of policies designed to reduce the asymmetry of adverse external shocks. These include the fiscal rules, inflation targeting, stabilisation funds, among others. However, the IMF (2022) notes that these policies have limited effectiveness. This is due to a commodity price volatility shock of considerable magnitude and persistence.

Existing empirical studies of Ghana's macroeconomic performance suffer from many limitations, despite the apparent importance of commodity price shocks. To start off with, a good share of the literature investigates oil-exporting or emerging economies outside Ghana. As such, the findings do not apply to Ghana (Kilian, 2022; Nguyen & Bhatti, 2023). Additionally, various studies of Ghana focus on the effect of a particular commodity, or they adopt a descriptive strategy. This ignores the dynamic and multi-directional nature of the macroeconomic variables. Furthermore, insufficient attention has been paid to

inflation, which constitutes the key channel through which commodity price shocks affect economic growth.

In addition, many studies that exist to date do not provide a firm conclusion on the causality direction of shocks.

Due to these gaps, a detailed empirical assessment of the dynamic and causal impact of commodity price shocks on inflation and economic growth in Ghana is required.

The main objectives targeted by the study are as follow.

i. Find how commodity price shocks affect inflation and economic growth.
ii. Create a connection between the shocks in commodity prices, inflation and growth.
iii. Investigate how changing commodities prices affect Ghana's economic growth and inflation over time.

Theoretical Review

Using endogenous growth and neoclassical growth theory as the theoretical study foundation, the study adds significant knowledge about how commodity price shocks affect inflation and economic growth in resource-dependent economies.

According to the neoclassical growth theory of Solow (1956), capital accumulation, labour growth, and exogenous technological progress are responsible for long-run economic growth. In this sense, commodity price shocks affect growth indirectly by affecting savings, investment, and capital accumulation. The view is that commodity price shocks that are positive may cause national income and savings to increase, thereby increasing investment which thereby leads to a temporary growth acceleration. Yet, investment can be reduced, capital accumulation slowed, and growth constrained by negative commodity price shocks. Inflation is important in this process, as the inertia effect of inflation could distort relative prices, lower real investment returns and weaken long-term growth (Barro, 2015).

The endogenous growth theory introduced by Romer (1990) refers to the framework explaining long-run economic growth that can result from endogenous and not just from exogenous factors. In particular, it is essential to practice and not forget the role of human capital, innovation and institutional quality used in sustaining long-run economic growth (Aghion et al. 2019). This suggests that the volatility rather than the abundance of commodities poses a serious threat to growth. Frequent and unpredictable commodity price shocks increase macroeconomic uncertainty and discourage investment over the long term in productive sectors. Such shocks also lead to the diversion of resources away from the development of human capital and innovation. In countries with weak institutions, booms in commodities also generate rent-seeking activity and wasteful public spending, reducing long-term growth.

Empirical Review

The early empirical studies have mostly concluded that commodity price shocks slow down long-term growth, particularly in resource-rich economies. According to Sachs and Warner (2001), countries endowed with abundant natural resources often experience slower growth than those with fewer resources. They attribute this to these countries experiencing price volatility, institutional fragility and governance blindness.

Subsequent studies refine this argument by placing less emphasis on interference from the resource curse process and more on volatility rather than abundance being the cause of bad growth. (Van der Ploeg & Poelhekke, 2021)

Recent empirical studies with advanced econometric techniques offer richer understandings. As per Arezki et al. (2020), commodity price shocks have time-varying effects on growth. Countries with weak fiscal institutions experience more negative effects. In comparable work, Nguyen and Bhatti (2023) exploit panel data on Sub-Saharan African countries to show that volatility in commodity prices leads to higher inflation volatility and lower output growth. This latter effect is more pronounced in less diversified economies.

Due to their widespread impact on the economy, oil price shocks have received much empirical attention. According to Kilian (2022) and Caldara et al. (2023), oil price shocks have a significant impact on inflation, output, and uncertainty, with asymmetric effects on oil-importing and oil-exporting countries.

Oil price volatility has worsened fiscal and external imbalances for IMF (2023) African economies, including oil-producing countries that are dependant on imported refined petroleum products.

Research on the price shocks of agricultural commodities, especially cocoa, has strong income and welfare effects. According to research conducted by Collier and Goderis in the year 2012, negative agricultural price shocks have a significantly larger and more lasting detrimental impact on growth as compared to positive shocks. According to Anderson et al. (2020), volatility in agricultural prices impacts rural livelihood and the dynamics of poverty disproportionately, with significant macroeconomic spillovers in agrarian economies.

The analysis of gold price shocks mainly concerns financial markets and safe haven dynamics. According to Baur and Lucey (2010) and Baur and Smales (2020), gold tends to rise in price during financial uncertainty and has hedging benefits. According to exporters of gold, prices can cause exchange rate appreciation and imbalances in the sector as well as uncertain growth outcome (Van der Ploeg & Poelhekke, 2021).

There are not many Ghana studies. Research works so far have looked at either a single commodity or taken a descriptive approach. Thus, they did not capture the dynamic and causal relationships amongst commodity prices, inflation, and growth

Methodology

This section presents the methodology for the study. It consists of the estimation techniques and model specifications.

VAR Estimation Technique

A Vector Autoregression (VAR) estimation technique was employed for the examination of commodity prices, inflation and economic growth. Endogeneity problems commonly observed in other estimation techniques are effectively catered for by VAR.

In this study, we employed the VAR Approach because it is expected that the shocks in commodity price, inflation and also economic growth will have mutual impacts on each other. Thus, the VAR is the most suitable technique for this analysis.

Variance Decomposition (VD) and Impulse Response Functions (IRF)

The research also used impulse response functions to show how the system responds to outside disturbances. Under the VAR model, the impulse response function (IRF) measures how an endogenous variable reacts to the innovations in another variable.

Principal Component Analysis (PCA)

The PCA equation is specified as follows;

$$CPINDEX_K = W_{K1}X_1 + W_{K2}X_2 + \ldots W_{KN}X_N \quad \ldots\ldots (1)$$

The CPINDEX represent commodities price index, W_K is the parameter's weight; X is the respective component value; whilst N is the total number of variables contained in the equation.

Model Specification

The study employs the VAR (Vector Autoregressive) estimation technique to investigate commodity price shock, inflation, and growth relationship and causal nexus. The chosen estimation technique, VAR, tackles endogeneity issue effectively. In addition, the researcher expects bidirectional causality among the variables. Thus, VAR is the most applicable method as it will treat all variables in the system as endogenous. The VAR equations are specified as follows;

$$CPINDEX_t = \alpha + \sum_{j=1}^{p} \emptyset_{1j}\, CPINDEX_{t-j} + \sum_{j=1}^{p} \emptyset_{2j}\, INFLA_{t-j} + \sum_{j=1}^{p} \emptyset_{3j}\, GDPPCGR_{t-j} + e_{1t} \quad \ldots\ldots (2)$$

$$INFLA_t = \beta + \sum_{j=1}^{p} \emptyset_{1j}\, INFLA_{t-j} + \sum_{j=1}^{p} \emptyset_{2j}\, CPINDEX_{t-j} + \sum_{j=1}^{p} \emptyset_{3j}\, GDPPCGR_{t-j} + e_{2t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

$$GDPPCGR_t = \lambda + \sum_{j=1}^{p} \emptyset_{1j}\, GDPPCGR_{t-j} + \sum_{j=1}^{p} \emptyset_{2j}\, CPINDEX_{t-j} + \sum_{j=1}^{p} \emptyset_{3j}\, INFLA_{t-j} + e_{3t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

Findings/Results

This section focuses on the analysis, presentation, and discussion of the empirical results.

Descriptive Statistics

The descriptive statistics of the study is presented below:

Table 1: Descriptive Statistics

	COMMODITY PRICE INDEX	INFLATION	GDPPCGR
Mean	-3.00	15.09	3.41
Median	0.35	12.03	3.14
Maximum	2.04	41.50	11.14
Minimum	-2.57	7.14	-1.70
Std. Dev.	1.27	8.12	2.88
Skewness	-0.47	2.00	0.78
Kurtosis	2.39	6.95	4.12
Jarque-Bera	1.05	26.49	3.08
Probability	0.59	0.00	0.21
Observations	20	20	20

Source: Researcher's Construct (2026)

From table 1, the mean values of the commodity price index, inflation, and GDP per capita growth rate (GDPPCGR) are −3.00, 15.09, and 3.41, respectively. However, because the mean can be heavily influenced by outliers, the discussion places greater emphasis on the median values. The median commodity price index of 0.35 is regarded as relatively representative, as it is less affected by extreme observations. The median values for inflation and GDPPCGR are 12.03 and 3.14, respectively.

The standard deviation of inflation is 8.12, suggesting substantial variability around the mean. In contrast, the standard deviation of the commodity price index is 1.27, indicating relatively low dispersion in commodity price movements. Similarly, the standard deviation of GDPPCGR is 2.88, implying limited variation between the observations and the mean.

Results of Unit Root

Variables that follow a trend are described as non-stationary or having a unit root, whereas those that revert to their mean are regarded as stationary and free of unit roots.

As a result, econometric analysis requires testing each data series for stationarity prior to model estimation to ensure the validity of the results. In addition, identifying the order of integration of the variables is crucial for selecting the most appropriate econometric model for estimation.

Table 2: Unit Root Test

LEVEL	CPINDEX	INFLATION	GDPPCGR
ADF	-4.056**	-1.97	-2.47
PP	-2.51	-3.89**	-2.47
FIRST DIFFERENCE	CPINDEX	INFLATION	GDPPCGR
ADF		3.99**	4.58***
PP	3.89**		4.59***

*Note: ***/**/* significant at 1%, 5% and 10%, respectively.*

The results of the unit root test are presented in Table 2 above. Two of the variables, inflation and GDPPCR were not stationarity at levels or integrated order zero I (0). However, commodities price index (CPINDEX) was stationary at integrated at level or integrated order I (0). Both inflation and GDPPCGR became stationary after taking the first difference, I (1).

Optimal Lag Length Selection

Typically, the lag length corresponding to the minimum value indicated by these criteria (often marked with an asterisk) is chosen for the model.

Table 3: Optimal Lag Length Selection

Endogenous variables: CPINDEX INFLATION GDPPGR

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-103.43	NA	120.42	13.30	13.44*	13.31
1	-93.99	14.16	117.69*	13.25*	13.83	13.28
2	-89.87	4.64	253.41	13.86	14.87	13.91
3	-72.82	12.78	146.77	12.85	14.30	12.92*

Based on the results, the researcher selected a lag length of one (1) as indicated by the Schwarz Information Criterion (SC) and Hannan-Quinn Criterion (HQ), both of which were asterisked to show the minimum values. Although the AIC and FPE were also asterisked, the researcher opted for lag length one. According to Obi (2015), when multiple information criteria display the same number of asterisks, it is left to the researcher's discretion to decide which criterion to follow. This guided the decision to use lag 1 in the model.

Cointegration Tests

The study aimed to simulate shocks within the VAR system and analyze their effects on the endogenous variables hence the need to run cointegration tests. The study applied the Johansen cointegration approach, utilizing both the Trace and Maximum Eigenvalue tests. The results of these tests are presented in Table 3.

Table 4: Cointegration Tests

Series: CPINDEX, INFLATION, GDPPCGR

Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	Critical Value (0.05)	Probability**
None*	0.304	139.618	29.798	0.000
At most 1*	0.226	59.981	15.495	0.000
At most 2	0.017	3.683	3.841	0.055
Hypothesized No. of CE(s)	Eigen Value	Max-Eigen Statistic	Critical Value (0.05)	Probability**
None*	0.304	79.637	21.132	0.000
At most 1*	0.226	56.298	14.265	0.000
At most 2	0.017	3.683	3.841	0.055

Note: Trace statistic test indicates 2 cointegration equations at 0.05 significance level
Max-Eigen statistic test indicates 2 cointegration equations at 0.05 significance level

The results show that both the Trace and Maximum Eigenvalue statistics indicate the presence of at most two cointegrating equations in the model, suggesting a long-run relationship among the variables. This is supported by a probability value of 0.055 for both the Trace and Max-Eigen tests. Based on these findings, it was necessary to employ the Vector Error Correction Model (VECM) to estimate the long-run dynamics of the model.

VECM Estimation

The VECM is a specialized variant of the VAR model designed to estimate long-run relationships among variables. After confirming the existence of a long-run relationship between the variables, the study proceeded to apply the VECM. The results from the VECM analysis are presented below.

Table 5: VECM Estimates.

Commodities Prices	1.00		
Inflation (-1)	0.19 (0.065) [2.94]		
GDPPGR (-1)	0.33 (0.12) [2.58]		
C	-3.95		
	CPINDEX	INFLATION	GDPPGR
Coint. Eqn 1	-0.49 (0.23) [-2.08]	-2.27 (1.55) [-1.46]	-0.84 (1.11) [-0.75]
CPINDEX (-1)	0.195*** (0.065) [3.001]	4.188** (2.125) [1.970]	-3.164** (1.608) [-1.967]
INFLATION (-1)	0.001** (0.000) [2.294]	0.984*** (0.001) [124.198]	0.029*** (0.006) [4.839]
GDPPGR (-1)	0.003 (0.002) [1.438]	-0.121* (0.068) [-1.780]	0.235*** (0.052) [4.552]
R- squared	-0.037	0.946	0.060
Adjusted R-squared	-0.045	0.945	0.052
Sum. Sq. residuals	6.970	7428.612	4253.780
F-Statistic	-4.480	2180.661	7.930

*Note: ***/**/* significant at 1%, 5% and 10%, respectively.*

The study revealed significantly positive relationship between commodities price index and its lag. This implies that the past levels on commodities prices positively impacts on the current levels of commodities prices all other things being equal. The study also revealed significantly positive relationship between inflation and the lag of commodities prices. This result was statistically significant at 5% significance level. The researcher explained this by asserting that when prices of major commodities prices go up, there is likelihood of resultant inflation in the economy. This result is consistent with the findings of Honohon (2008) who found commodities prices to have a positive connection with inflation. Our results differentiate itself from earlier studies. While previous studies largely examined a unidirectional causal relationship between commodity prices and inflation, this study identifies a bidirectional causality between the two variables. This is an important finding for policymakers since it suggests that both

variables should be treated simultaneously as predictors and outcomes in the formulation of policies since one depends on the other.

Moreover, the research shows the evidence of a negative relationship between economic growth and the lagged values of commodity prices indicating a 5% significance level. Higher commodity prices result in lower growth, other things being equal. This finding is consistent with Arezki and Gylfason (2001), who also noted a negative impact on economic growth from rising commodity prices. Other studies, such as Peersman and Van Robays (2009) and Kilian and Park (2009), which use MENA data, also find similar findings.

Contrary to the previous results, evidence suggesting that the first lag of commodity prices causes inflation in the short run is provided by the t-statistic of 1.97. This finding indicates that commodity price increases have predictive power for inflation in Ghana. Furthermore, the study has established that commodity price index also affects inflation, thus establishing reverse causality.

Overall, the results point to a two-way interaction in which commodity prices generate inflation and inflation generates commodity prices. This suggests that in Ghana, policymakers need to consider inflation and commodity prices not only as outcomes, but also as predictors in their economic policies.

$ECT_{t-1} = [1.00CPINDEX_{t-1} + 0.19INFLATION_{t-1} + 0.33GDPPGR_{t-1} - 3.95]$

The outcomes of the VECM are given above, and this section interprets the long-run results. The findings show that the short-run instability in the prior year is corrected at a rate of 49% and is controlled by other factors of the model.

Variance Decomposition

Forecast error variance decomposition (FEVD) shows how much of the variation in endogenous variables can be explained by shocks/innovations in the other variables. It also indicate how much one variable influence other variable.

Table 6: Variance Decomposition of CPINDEX

Period	S.E.	CPINDEX	INFLATION	GDPPGR
1	0.167	100.000	0.000	0.000
2	0.170	99.440	0.036	0.524
3	0.171	99.298	0.093	0.609
4	0.171	99.229	0.156	0.615
5	0.171	99.167	0.219	0.615
6	0.171	99.106	0.279	0.615
7	0.171	99.048	0.337	0.615
8	0.171	98.993	0.391	0.616
9	0.171	98.940	0.443	0.617
10	0.171	98.890	0.493	0.617

Source: Researcher's Construct (2026)

Results of forecast error variance decomposition (FEVD) for CPINDEX showed that in the first year (short run), 100% CPINDEX was explained by itself. This means that commodity prices' short run (year) fluctuations were driven entirely by commodity price's past values. However, in the long run, that is, after ten years, shocks in inflation explain 0.493% of the variations in commodities prices, whereas shocks in GDP per capita growth (GDPPGR) explain 0.617% of the variations. This indicate that GDP growth and inflation have a significant exogenous effect on CPINDEX over time.

Table 7 : Variance Decomposition of INFLATION

Period	S.E.	CPINDEX	INFLATION	GDPPGR
1	5.451	1.857	98.143	0.000
2	7.760	4.448	95.139	0.414
3	9.497	5.952	93.288	0.760

4	10.910	6.847	92.165	0.988
5	12.105	7.414	91.447	1.139
6	13.141	7.796	90.961	1.242
7	14.056	8.069	90.614	1.317
8	14.873	8.273	90.355	1.372
9	15.609	8.430	90.156	1.415
10	16.278	8.554	89.997	1.448

Source: Researcher's Construct (2026)

The FEVD results for inflation indicate that, in the short run (first year), the shocks in commodity price explain the 1.857% while shocks in GDP per capita growth (GDPPGR) explain 0.000% of the variation in inflation. Over the long run, after ten years, 8.554% of the variation in inflation is attributed to CPINDEX shocks, and 1.448% is explained by GDPPGR shocks.

Table 8: Variance Decomposition of GDPPGR

Period	S.E.	CPINDEX	INFLATION	GDPPGR
1	4.125	0.319	0.030	99.652
2	4.277	2.019	0.192	97.789
3	4.294	2.207	0.417	97.376
4	4.299	2.203	0.658	97.139
5	4.305	2.207	0.894	96.900
6	4.310	2.220	1.119	96.660
7	4.315	2.237	1.333	96.430
8	4.320	2.254	1.536	96.210
9	4.325	2.271	1.728	96.001
10	4.330	2.288	1.909	95.804

Source: Researcher's Construct (2026)

The FEVD results for GDP per capita growth (GDPPGR) indicate that, in the short run (first year), 0.319% of the variation in GDPPGR is explained by shocks in CPINDEX, while 0.030% is explained by inflation shocks. In the long run, after ten years, 2.288% of the variation in GDPPGR is attributed to CPINDEX shocks, and 1.909% is explained by inflation shocks.

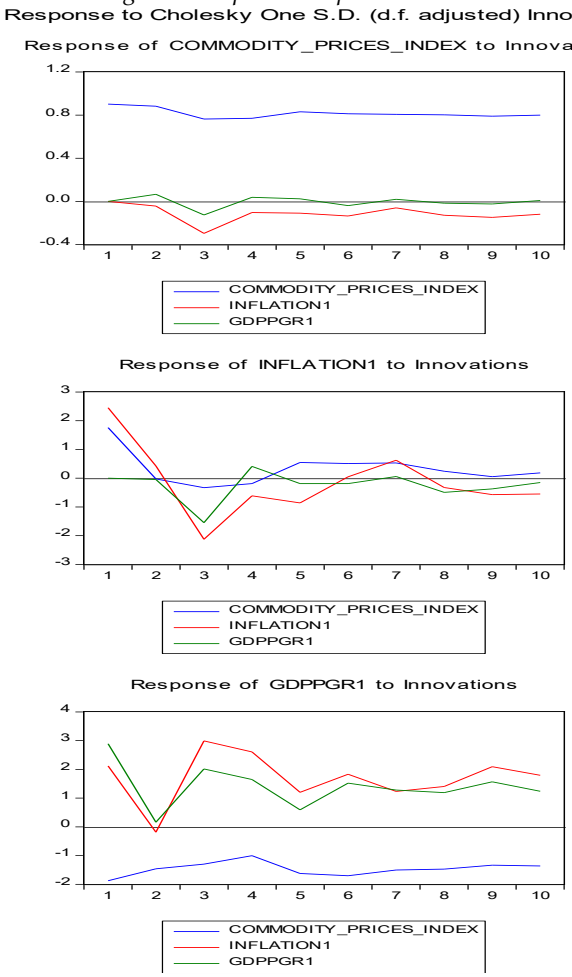
Impulse Response Function

Estimating IRFs is important because individual VAR coefficients alone often do not provide sufficient guidance for policy formulation, as they do not reveal how endogenous variables respond to shocks. In this study, IRFs were computed for CPINDEX, INFLATION, and GDPPGR, with the results presented in Figure 1.

The results indicate that a one standard deviation positive shock to GDPPCGR leads to a decline in CPINDEX in the first year. From the second to third year, a decline in GDPPCGR continues to reduce CPINDEX, but from the second year onward to the tenth year, the relationship between GDPPCGR and CPINDEX becomes positive. Similarly, a one standard deviation negative shock to inflation causes a decline in CPINDEX in the first year, while from the fourth year to the tenth year, both inflation and commodity prices stabilize.

Regarding inflation, a one standard deviation negative shock to GDPPCGR in the second year reduces both inflation and CPINDEX in that year. Over the long run, a positive shock to GDPPCGR results in declines in both inflation and commodity prices. The response of GDPPGR shows that a one standard deviation increase in CPINDEX leads to a fall in GDPPGR in the first year, with subsequent increases in CPINDEX from the second year causing sharper declines in GDPPGR. From the fourth to tenth year, commodity prices remain relatively stable, while economic growth continues to fluctuate. Additionally, a one standard deviation negative shock to inflation leads to a fall in GDPPGR in the first year, indicating that inflation and GDPPGR move in the same direction in both the short and long run. The IRF results are summarized in Figure 1.

Figure 1: Impulse Response Function



Discussions and Conclusion

The empirical evidence demonstrates that the variables are cointegrated, indicating the existence of a long run equilibrium relationship among commodity prices, inflation and economic growth. According to the VECM estimates, a high-speed adjustment process ensures that deviations from equilibrium are corrected. This means shocks to the system are not permanent but have fairly significant transitional effects. Within a short timeframe, commodity price shocks lead to a considerable increase in inflation owing to significant cost-push and exchange-rate transmission channels. Simultaneously, the rise in commodity prices suffers a negative and statistically significant economic growth effect. This finding indicates that the volatility and uncertainty of export prices undermine productive investment and macroeconomic stability.

The analysis also shows that there is bi-directional causation between commodity prices and inflation which simultaneously affect each variable. A commodity-dependent economy is a complicated macroeconomic management depending on each other. The variance decomposition results indicate that although most variations of each variable are explained by their own innovations, shocks from commodity prices are playing a growing role in inflation and growth variation over time. The analysis of impulse response reveals that negative commodity price movements negatively impact output over the long term while increasing inflation.

The results indicate that although commodity exports are a main source of revenue for Ghana, dependence on a volatile global commodity market will expose it to inflation instability and slowed growth. Commodity price shocks without buffers and diversification can harm fiscal performance, deter investment, and harm long-term development. For these reasons, the evidence points to the need for a

coordinated set of fiscal, monetary and structural reforms to enhance resilience and promote sustainable economic growth.

Policy Recommendations

The researchers proposed the following policy recommendations based on findings.

Promote Export Diversification and Industrialization

The government must promote value addition, agro-processing, and light manufacturing to reduce overreliance on cocoa, gold, and oil. Widening the export base will insulate the economy from external commodity price shock and stabilize economic growth.

Strengthen Commodity Stabilization and Sovereign Wealth Funds

Ghana must improve the operational effectiveness of stabilisation/sinking funds that save windfall revenues during booms for use during downturns. This counter-cyclical fiscal device will smooth expenditures and safeguard public investments.

Develop Risk-Heding and Price Insurance Mechanisms

The government and commodity exporters should look into futures contracts and other hedging instruments to mitigate price risks on sudden drop in commodity prices.

Limitations of the Study and Directions for Future Research.

This study has some limitations that should be acknowledged nonetheless. The VAR/VECM framework is effective in capturing dynamic relationships between macroeconomic variables but operates under an assumption of linearity; it ignores the effects of possible nonlinearities, asymmetries, or structural breaks arising from major global shocks.

Subsequent investigations might overcome these limitations by implementing nonlinear or regime-switching models (for example, Markov-switching models) to reflect asymmetric impacts of commodity price shocks across economic cycles. If we conducted comparative or panel-based analyses across the Sub-Saharan African economies, we would know better how institutional quality and diversification help boost resilience to commodity price volatility.

References

Adam, C., Collier, P. and Gong, L. (2020) Commodity prices and growth in Africa. Oxford: Oxford University Press.

Aghion, P., Bacchetta, P., Rancière, R. and Rogoff, K. (2019) 'Exchange rate volatility and productivity growth', Review of Economics and Statistics, 101(3), pp. 1–15.

Anderson, K., Rausser, G. and Swinnen, J. (2020) 'Political economy of public policies: Insights from distortions to agricultural incentives', Journal of Economic Literature, 58(3), pp. 1–45.

Arezki, R., Hadri, K., Loungani, P. and Rao, Y. (2020) 'Testing the commodity curse hypothesis: New evidence from time-varying effects', IMF Economic Review, 68(1), pp. 1–29.

Bank of Ghana (2023) Annual Report. Accra: Bank of Ghana.

Barro, R.J. (2015) 'Inflation and economic growth', Annals of Economics and Finance, 16(2), pp. 1–46.

Baur, D.G. and Lucey, B.M. (2010) 'Is gold a hedge or a safe haven?', Financial Review, 45(2), pp. 217–229.

Baur, D.G. and Smales, L.A. (2020) 'Gold and safe haven assets', Journal of Banking & Finance, 112, 105217.

Caldara, D., Cavallo, M. and Iacoviello, M. (2023) 'Oil price shocks and economic uncertainty', American Economic Journal: Macroeconomics, 15(1), pp. 1–37.

Collier, P. and Goderis, B. (2012) 'Commodity prices and growth: An empirical investigation', European Economic Review, 56(6), pp. 1241–1260.

Ha, J., Kose, M.A. and Ohnsorge, F. (2023) 'Inflation in developing countries: Causes, consequences, and policy responses', World Bank Research Observer, 38(1), pp. 1–34.

International Monetary Fund (IMF) (2022) Ghana: Staff Country Report. Washington, DC: IMF.

International Monetary Fund (IMF) (2023) World Economic Outlook. Washington, DC: IMF.

Kilian, L. (2022) 'Understanding the effects of oil price shocks', Energy Economics, 107, 105889.

Ministry of Finance (2022) Annual Budget Statement and Economic Policy. Accra: Government of Ghana.

Nguyen, T. and Bhatti, M.I. (2023) 'Commodity price volatility and macroeconomic performance in Sub-Saharan Africa', Resources Policy, 82, 103456.

Romer, P.M. (1990) 'Endogenous technological change', Journal of Political Economy, 98(5), pp. S71–S102.
Sachs, J.D. and Warner, A.M. (2001) 'The curse of natural resources', European Economic Review, 45(4–6), pp. 827–838.
Solow, R.M. (1956) 'A contribution to the theory of economic growth', Quarterly Journal of Economics, 70(1), pp. 65–94.
Van der Ploeg, F. and Poelhekke, S. (2021) 'Volatility and the natural resource curse', Oxford Economic Papers, 73(2), pp. 1–29.
World Bank (2022) Commodity Markets Outlook. Washington, DC: World Bank.

Digital technologies and ecological transition of food systems: A grounded theory analysis of blockchain's contributions to stakeholder engagement in the food transition

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Keywords
blockchain, ecological transition, food waste, food systems, Grounded Theory, stakeholders, traceability, transparency

Abstract

Food systems face a dual challenge: meeting the growing demand for food products while reducing their environmental impact. This situation calls for ecological shifts to foster a transition toward more responsible behaviors. Such an ecological transition requires greater collaboration among producers, processors, distributors, policymakers, and consumers within food supply chains. However, these chains are often characterized by opacity, mistrust, and difficulties in mobilizing all stakeholders around shared objectives. This article aims to provide an abductive understanding of how blockchain influences stakeholder engagement in food supply chains within the context of the socio-ecological transition of Quebec's food systems. To this end, a grounded theory approach was adopted from an interpretive epistemological perspective. Ten semi-structured interviews were conducted with stakeholders from food supply chains to validate the emerging theory. The findings highlight three main functions of blockchain technology: traceability, transparency, and the reduction of food waste. These functions led to the proposition of an emerging theory whereby blockchain acts as a lever for engagement at three levels (micro, meso, and macro), respectively encouraging changes in behaviors, practices, and governance within food systems. From a scientific standpoint, the study strengthens Freeman's stakeholder theory and Geels' multi-level perspective. It also contributes to research on ecological transition, technological innovation, and stakeholder engagement. From a managerial perspective, the study provides an analytical framework to guide project leaders involved in the implementation and/or adoption of blockchain technology in agri-food systems.

Introduction

The ecological transition of food systems requires behavioral changes across all stages of the food supply chain. Beyond reducing greenhouse gas (GHG) emissions, Feng et al. (2020) argue that such changes must also enhance consumer trust and strengthen their engagement in responsible purchasing choices. Consumers are increasingly aware of social, environmental, and health issues in their consumption decisions, paying closer attention to the origin of the products they consume (Li et al., 2023). This evolution in consumer expectations lies at the heart of innovation in the agri-food sector, as it encourages actors to adopt more transparent and responsible practices (Majou, 2020). In this context, the integration of digitalization into the agri-food sector has become a priority.

According to Zarba et al. (2024), digitalization modernizes the agri-food sector and can contribute to a faster and more effective ecological transition. This digital transformation relies on the integration of innovative technologies, such as blockchain, which facilitate transparency and collaboration within supply chains while reducing the environmental impact of agricultural practices (Li et al., 2023). However, despite these advances, only 10% of food products are currently traced, verified, and certified according to the International Food Fair of Paris (SIAL Paris, 2022). In this context, digital technologies offer promising solutions to the environmental and health challenges facing food systems. Through digitalization, real-time communication networks are established, connecting people, objects, and machines to optimize processes throughout the supply chain (Rousseau & Mondin, 2020).

One of the most promising technologies for ensuring transparency and traceability in food supply chains is blockchain technology. Blockchain is an innovative technology used to store and share information securely and transparently across a network of users (Monica et al., 2019). It is based on a fundamental principle: a distributed and immutable database composed of a chain of encrypted "blocks" (Fiore & Mongiello, 2023). The integration of blockchain technology into the food transition requires collaboration among all actors involved in the food supply chain. Blockchain can also play a key role in managing relationships among supply chain stakeholders by facilitating collaboration and strengthening their commitment to environmentally responsible practices.

Although blockchain offers significant opportunities for the ecological transition of food systems, its adoption remains limited (Rousseau & Mondin, 2020) and requires active stakeholder involvement to maximize its benefits (Antonucci et al., 2019). Actors in the sector—whether farmers, processors, distributors, or consumers—must collaborate to develop appropriate solutions and foster collective engagement in more sustainable practices (Antonucci et al., 2019). Stakeholder engagement thus emerges as a key factor in ensuring the success of this transformation, enabling effective information sharing, improved coordination, and informed decision-making (Gudek et al., 2024; Mysore et al., 2019).

Recent research highlights that the ecological transition of food systems requires collaborative governance and greater transparency among supply chain actors (Antonacci et al., 2019; Kamilaris et al., 2019; Tripoli & Schmidhuber, 2020). Stakeholder theory (Freeman & McVea, 2001; Huttunen et al., 2022) emphasizes the importance of engaging producers, processors, distributors, consumers, and regulators to reconcile often divergent economic, social, and environmental objectives. From this perspective, blockchain technology appears as a strategic lever for improving traceability and data integrity throughout the supply chain (Rousseau & Mondin, 2020; Zarba et al., 2024), thereby strengthening trust among stakeholders through a shared, tamper-proof, and decentralized ledger (Monica et al., 2019; Fiore & Mongiello, 2023).

The main objective of this study is to explore how blockchain technology influences stakeholder engagement in the ecological transition of food systems. Drawing on the core elements of ecological transition, the study seeks to understand how blockchain can foster behavioral change among stakeholders toward more sustainable food practices through three key attributes of blockchain: traceability, transparency, and the ability to reduce food waste. It also examines how this technology can serve as a lever to strengthen collaboration among different stakeholders, particularly those with a direct impact on food production and consumption. Accordingly, the research problem is articulated around the following question: How do digital technologies, particularly blockchain, influence stakeholder engagement in the ecological transition of food systems?

More specifically, the study seeks to understand:

- how traceability and transparency in supply chains influence stakeholder behaviors toward the ecological transition of food systems;
- how blockchain technology promotes food waste reduction through stakeholder involvement;
- how blockchain facilitates collaboration among different stakeholders to promote more sustainable food systems.

Theoretical background

The theoretical framework of this study is based on two foundational theories: the modeling of stakeholder engagement categories in transitions (Huttunen et al., 2022), grounded in Freeman's stakeholder theory (1984, cited in Bonnafous-Boucher & Rendtorff, 2013), and Geels' modeling of sociotechnical transitions and innovation (2004, 2019), known as the Multi-Level Perspective (MLP).

Huttunen et al. (2022) conceptualize citizen engagement (as civil society stakeholders) in transitions through a framework that emphasizes actors' values and perceptions, the integration of local and practical knowledge, empowerment and learning facilitation, and the mobilization of citizens as resources for knowledge creation. According to Huttunen et al. (2022), stakeholder engagement in sociotechnical transitions is structured around four main objectives (Figure 1):

- identifying public values, preferences, acceptability, and the impacts of the transition, and assessing public preferences;

- envisioning a sustainable future through direct citizen engagement in visioning exercises;
- developing participatory methods to facilitate transitions, including innovative approaches to support transition processes; and
- implementing (local) transitions through learning and empowerment processes within living labs.

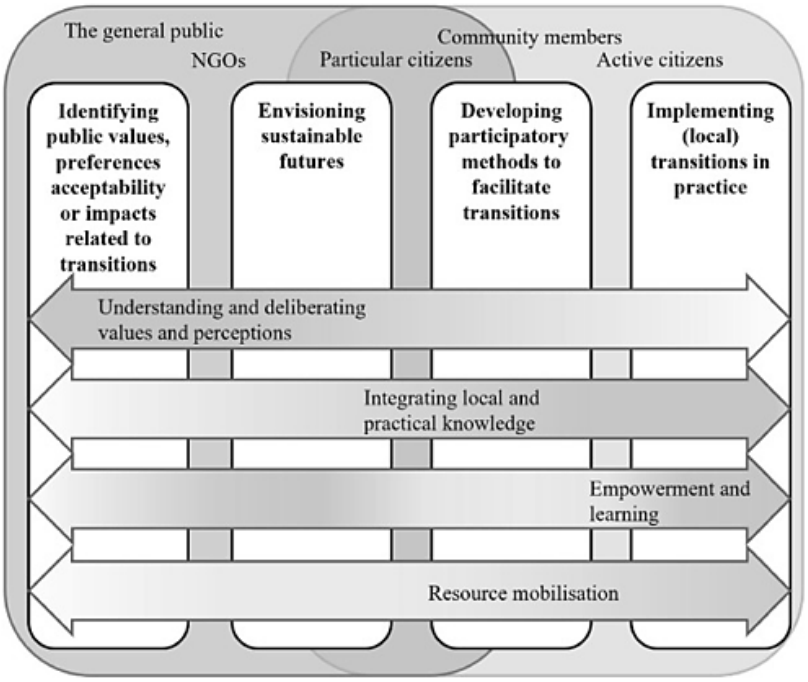


Figure 1: Categories of citizen engagement in transition research. © Huttunen et al. (2022)

Within the scope of this study, the relevance of this theory lies in its ability to enhance understanding of stakeholder engagement in transitions. The objectives of stakeholder engagement developed by Huttunen et al. (2022) constitute essential elements for apprehending research on citizen engagement in transition and sustainability.

The Multi-Level Perspective (MLP), the second theory mobilized in this study, represents a key theoretical framework for understanding transitions (Köhler et al., 2019). It is one among several approaches in the academic debate on social transformations toward sustainability, focusing on transitions within systems (e.g., energy, transport, housing, agri-food systems) that provide societal functions or end-use services (Geels, 2004, 2019).

The MLP distinguishes three levels in transition processes. Transitions initially emerge in niches, then evolve within regimes, and ultimately reshape the socio-technical landscape (Figure 2).

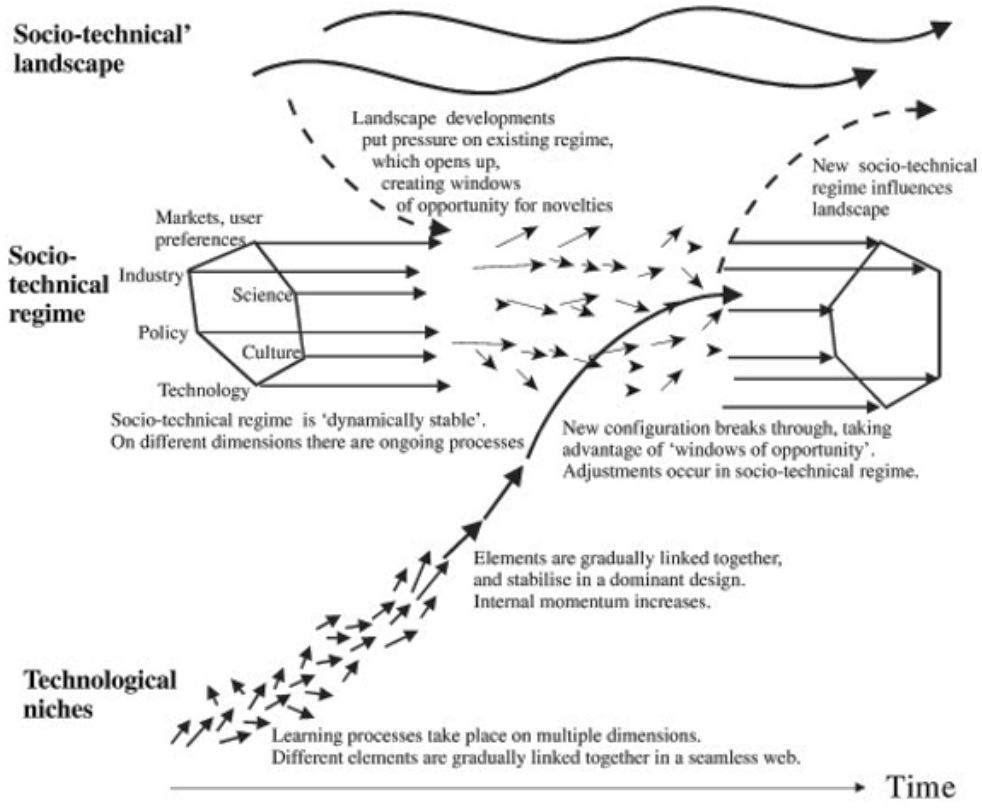


Figure 2: Modeling of transitions in socio-technical systems. © Geels (2004, 2019)

According to El Bilali (2019), the integrative conceptualization and operationalization of MLP elements are necessary to account for the complexity of sustainability transition processes and the particularities of the agri-food system. For this reason, the MLP has become a leading framework in research on agri-food sustainability transitions (El Bilali, 2019; Köhler et al., 2019).

The relevance of using this theory is further justified by its frequent adoption of technology and other innovations as the primary analytical entry point (Geels, 2019). It is a multidimensional approach because, according to Geels (2019), "the analytical strategy of following innovation trajectories inherently draws attention to diverse actors and struggles rather than privileging a single social group or dimension, as disciplinary approaches tend to do." The MLP focuses on transitions within socio-technical systems (Geels, 2019), including food supply chains. According to Geels (2019), it allows the analysis of blockchain impacts on the food transition across three levels: the micro level, corresponding to innovation niches; the meso level, referring to transition regimes; and the macro level, representing the socio-technical landscape.

Methodology

This study falls within the field of management, more specifically within the framework of stakeholder integration management in a socio-ecological context. The methodological choices and tools employed are guided by an interpretivist framework, appropriate for the social sciences and humanities.

The data collection approach is based on a qualitative methodology, consistent with the interpretivist epistemological stance adopted. Grounded Theory (GT), as developed by Glaser & Strauss (1967, cited in Guillemette, 2006), was employed to conduct this research. This theory was chosen for its ability to place actors' perspectives at the center of the inquiry, allowing the emergence of new theoretical insights (Guillemette, 2006). Furthermore, according to Guillemette (2006), it represents an innovative research

approach grounded in an epistemological choice that enables the understanding of sociotechnical phenomena that are poorly theorized. GT follows an iterative process of phenomenon development (Paille, 1994), as in the case of blockchain use in the agri-food sector and its potential to enhance stakeholder engagement in the ecological transition of food systems.

The Grounded Theory approach differs from other qualitative methods in that it places strong emphasis on empirical data to explore the study object beyond mere descriptive analysis, without necessarily developing a fully elaborated theory (Paille, 1994). It enables the construction of an emerging theory. Its implementation involves conducting multiple interviews to foster the emergence and saturation of concepts (Charmaz, 2006, cited in Royer & Zarlowski, 2014). Data saturation criteria are based on the repetition of coded themes.

To validate the research, data were collected ed from a small sample of 10 participants representing diverse characteristics, selected through purposeful sampling. Data collection was conducted via semi-structured interviews. More specifically, participant selection followed a snowball sampling technique. Initially, participants meeting the predefined selection criteria were identified. These participants were then asked to refer additional participants, and the process continued until data saturation was reached (Royer & Zarlowski, 2007). The initial participants were chosen following a stakeholder identification phase, focusing on individuals directly involved in the food supply chain (producers, distributors, processors, and consumers) and/or those involved in blockchain implementation projects in the agri-food sector in Quebec, as well as actors with a vested interest in these domains.

The study was conducted in the province of Quebec, a relevant context for studying food systems and ecological transition due to public policies and local sustainability initiatives. The fieldwork encompassed individual contexts (consumers, project managers), institutional contexts (universities, research groups), and companies and local organizations involved in technological innovation and/or ecological transition. While blockchain technology was first used in cryptocurrency in 2008 (Compagnucci et al., 2022; Patel et al., 2023), its application in agriculture is relatively recent. Therefore, the timeframe for this study starts from the first uses of blockchain in the agri-food sector around 2016.

Data collection followed an iterative process. The 10 semi-structured interviews conducted with the various stakeholders aimed to gather detailed accounts of their knowledge and understanding of blockchain technology, their perception of the importance of stakeholder engagement in the ecological transition of food systems, and the roles blockchain can play in this transition. All interviews were guided by a flexible interview protocol, which was adjusted throughout the data collection process. Interviews conducted in person lasted 45 to 60 minutes, while those conducted via videoconference lasted 30 to 45 minutes.

The data analysis was conducted following the same approach used for data collection: Grounded Theory analysis, as outlined by Paille (1994), and consistent with the interpretivist epistemological stance. Data collection and analysis were carried out simultaneously, following a circular interaction between the two processes (Guillemette, 2006; Paille, 1994). Analysis thus began with the first interview. According to Paille (1994), this analytical process involves six main steps: coding, categorization, establishing relationships, integration, modeling, and theorization. Coding was conducted according to the principles of Grounded Theory in three phases: open, axial, and selective coding (Mongeau, 2008; Tchankam et al., 2020).

The verbatim extracted from the interviews constituted the corpus of data analyzed. To extract these, the semi-structured interviews were fully transcribed, and the data were analyzed through categorization and thematic code emergence (Mongeau, 2008). The coding process followed an abductive approach, as qualitative research, in addition to being inductive, is "a process of understanding that involves moments of logical deduction" (Anadón & Guillemette, 2007, cited in Hallee & Garneau, 2019, p. 129). This approach allowed for the use of inductive codes emerging from the verbatim data and deductive codes derived from theoretical concepts. This dual approach enabled the analysis of data both considering existing theories and in the exploration of new phenomena.

N'Vivo software (version 14) was used for data processing. N'Vivo is a CAQDAS (Computer-Assisted Qualitative Data Analysis Software), chosen for its ability to create interconnected networks of data (Fortin & Johanne, 2022).

Findings

This study follows a qualitative approach based on Grounded Theory, as developed by Glaser and Strauss (1967), and adapted to research contexts in the applied social sciences. The results are based on an exploratory analysis of 10 semi-structured interviews conducted with diverse stakeholders involved in the food supply chain in Quebec. The objective was to develop an empirical understanding of the role blockchain technology can play in the ecological transition through stakeholder engagement. To this end, three attributes of blockchain were considered: traceability, transparency, and its capacity to reduce food waste.

This section first presents the themes defined for coding the relevant verbatim excerpts. Subsequently, the interview results for each of these themes are presented.

Coding themes overview

Following an abductive approach, both inductive and deductive codes were determined. Some codes were defined based on the literature, while others emerged from interviews conducted with stakeholders in the food supply chain participating in the study.

The central theme of the study is sociotechnical transition in food systems, expressed through behavioral change among actors in the food supply chain. This theme is perceived both as a driver and a consequence of introducing blockchain technology into food systems. It encompasses two sub-themes: first, more responsible and sustainable practices in consumption choices, production methods, and distribution processes, facilitated by blockchain as a lever for sociotechnical transition. On the other hand, behavioral change as a mechanism of incentives and influence, whereby stakeholders are encouraged to reconsider consumption norms, trust criteria, and intersectoral relationships.

Another theme identified for coding is blockchain's potential contribution to reducing food waste. This theme is mentioned as an indirect but strategic effect of blockchain in food supply chains. Through improved information flow and authentic traceability, both consumers and retailers can adjust their behavior to minimize losses. The associated sub-theme is responsible and mindful consumption choice.

Furthermore, stakeholder engagement emerged as an important theme for the study's objectives. This engagement is shaped by stakeholders' ecological awareness, whether for consumer health or environmental protection. Two additional themes are directly linked to blockchain attributes: traceability and transparency. Sub-themes for traceability include the origin, production, packaging, and transportation conditions of products. The transparency category is expressed through information availability and reliability, as well as stakeholders' access to this information along the supply chain.

Table 1 presents the coding of the initial themes and sub-themes. The first column lists the code names, the second column shows the number of occurrences across interviews, and the third column indicates the number of verbatim excerpts associated with each theme or sub-theme. Note that the occurrences of parent codes do not necessarily equal the sum of the child code occurrences, as some references for parent codes are not captured in child codes.

Table 1. Themes and sub-themes of the initial coding process

Code names	Files	References
Behavior change	7	16
Responsible and sustainable practices	1	1
Incentive and influence	2	4
Food waste	4	4
Consumer choices	2	2
Stakeholder involvement	7	12
Ecological awareness	3	6
Traceability	9	18
Production conditions	4	5
Product origin	5	7
Transparency	9	24
Accessibility of information	5	5
Availability of information	5	5
Reliability of information	4	6

Source: Created by the authors

The participants are anonymized and designated by the respective codes IN01, IN02… IN10. The following section presents the results and analysis of the coded themes, followed by a summary table showing the categories that emerged from the interviews.

Perception of Product Traceability

Excerpts from interviews underscore the importance of traceability in food supply chains. Most participants believe traceability is fundamental to any study or project related to the ecological transition of food supply chains. This belief is reflected in consumers' desire for information on products' origin, production conditions, packaging, and distribution, as well as in their interest in blockchain technology's potential to provide this information. Some participants emphasized consumers' interest in knowing the origin of the products they consume. IN01 highlighted this interest: "I personally like to know where my products come from, whether it's coffee, mushrooms, or whatever. I want to know its origin, how it was grown, who produced it, and whether it is fair trade."[1]

The desire to know a product's origin is often motivated by social considerations, sometimes linked to territoriality. By favoring local products or choosing a product because of its territorial origin, consumers are interested in its origin. Participant IN02 discussed the interest of certain consumers in consuming products of Quebec origin in this excerpt from his interview: "[...] Because traceability, as we talk about in ... what they wanted was to be able to identify the Quebec origin of the product."

To identify a product's origin, the necessary information must be available. Product labels guarantee this availability of information. Therefore, labeling is an element related to product traceability. According to IN04's interview, consumers are becoming interested in provenance, which requires the availability of this information on the product label:

... As I said earlier, we need more information, with labels being translated into French and all that. And then, of course, there's the question of origin, because people are starting to be very particular about that. Where do the products come from? ... We're really starting to take an interest in that. (IN04)

Through these quotes, participants demonstrate that product origin, a sub-theme of the "traceability" category, is the type of information consumers seek. The theme of "product origin" is also linked to trust, an important element of the food supply chain for some. IN01 believes that: "It is crucial to be able to prove origin. That is the basis of trust today."

Additionally, consumers are concerned about production conditions. Some participants believe that consumers who take an interest in product origin are implicitly interested in production, packaging, and distribution conditions. This is particularly the case for IN08, who explains: "[...] customers are passionate about local products and passionate about knowing how much energy has been used to produce them."

Other sub-themes also emerged during the interviews in the "traceability" category. First, the quality of labeling is an important factor in determining traceability. IN01 emphasizes that clear, standardized labels can serve as important vehicles for nutritional information and marketing:

... we will see labels that indicate the amount of salt, sugar, and fat. So, these organizations, which I know work every day to help companies improve their products to ensure that they are properly labeled and that consumers are attracted to their products. (IN01)

Two other sub-themes, certification and label, emerged during the interviews. According to some participants, certification and/or label helps to reinforce the authenticity of information between the various stakeholders in the supply chain. Like traceability, certification and labeling can also build trust. Participants IN05 and IN02 told us more about this:

"...The role of the label is to provide a guarantee to the person who says, 'Well, this product looks good, but I don't know the people behind it, so I need certification.' That's why I also think that blockchain can play a role in longer chains." (IN05)

"... that's where certifications become important. Certification will guarantee, or at least help to guarantee, because there are lots of serious certifications with inspections or with evidence." IN02

Regardless of their familiarity with blockchain technology, all participants agree that traceability is a major concern for everyone in the food supply chain.

[1] The verbatim quotes are translated by the author from Quebec French.

4.1. Transparency in food supply chains

Participants view transparency as a fundamental element of food systems. All key stakeholders — producers, distributors, and consumers — should have real-time access to the same information. In food supply chains, transparency relies on three key attributes: the availability, accessibility, and reliability of information. Verbatim quotes reveal how these sub-themes intersect and highlight stakeholders' expectations of digital technologies, such as blockchain.

Availability refers to the ability to make product data visible and accessible at all stages of the supply chain. Availability is considered a prerequisite for transparency and secure transactions. Some participants associate transparency with open data, while others associate it with clear communication or the possibility of verification. For example, IN02 expresses this idea to show the sources of information in supply chains and how this information circulates thanks to blockchain:

So here we see that the information was going into registers. From the blockchain at the bottom with information that could be public and information that could be private, to be determined by the participants in the blockchain... What the blockchain does is transport the information and then make it visible at all stages. (IN02)

The available information must be accurate and useful to consumers. Not only must the information be accurate, but it must also cover everything stakeholders need to know. Participant IN08 expressed this concern, stating: "[a]t present, we wanted additional information. We want to see the products and the sugar content displayed in larger print. "Participant IN09 added:" The more traceable the process is, the more transparent it is for stakeholders."

Accessibility to information refers to the ability of different stakeholders to access this data directly, easily, and equitably. Some participants believe that food supply chains must be transparent and that all stakeholders must have equal, real-time access to information. Participant IN02 pointed out that blockchain technology can guarantee this access:

When blockchain technology arrived, we found it interesting because it included the notion of... the notion of transparency, and then the notion of being able to manage information, of being able to make it either public or private in the blockchain. (IN02)

Blockchain could offer consumers and other actors in the food supply chain access to data, which is an interesting service. According to IN03, everyone is interested in this access. However, he wonders whether it will be equitable: "What I find interesting is the possibility of access to data. Would everyone have this access?"

Ultimately, the availability and accessibility of information alone does not guarantee transparency if the information is unreliable. Participants express reliability as the guarantee that the displayed data is accurate, representative of reality, and not subject to manipulation. Participants familiar with blockchain technology consider it a tool that promotes immutability. Unlike current supply chains, where data can be falsified, IN03 believes blockchain guarantees data immutability:

as you know, there are different blockchains, probably thousands of them today, well, it's access to information now and then the automation of all that, so the fact that it's immutable and can't be changed because currently documents can be falsified. (IN03)

However, having information from the blockchain does not guarantee the total reliability of that information. Participant IN05 does not rule out the possibility of fraud before the data is entered. However, this fraud will not take place on the blockchain, but rather among the actors. The following excerpt from the interview with IN05 explains this concern: "It's not just about having the information, it's about it being reliable and accessible [...] If there is fraud at the point of entry, there's nothing we can do about it, but at least it can't be changed. "

Once the information has been entered, it cannot be falsified because any modification would affect all links in the chain. This concept is further explained in the following excerpt from the interview with IN06:

.. [A]nd to maintain transparency, before changing anything, the person who has to modify the data on the blockchain must, how should I put it? consult or verify the information they are going to modify. (IN06)

To consolidate transparency, which is becoming an increasingly important consumer requirement and strategic issue for other sector players, some participants believe good governance is needed to guarantee

information's authenticity and control. Based on the interviews, several other transparency-related categories emerged. Some mentioned information governance. Others mentioned the risk of incomplete or manipulated information if it remains in the hands of a single actor or sector.

Reducing food waste

Food waste was chosen as the starting point to demonstrate how blockchain technology can enhance stakeholder engagement in the ecological transformation of food systems. During the interviews, several participants mentioned food waste as a problem that blockchain technology could help solve. Blockchain technology can optimize production, distribution, and consumption flows in food supply chains thanks to its attributes. Some participants emphasized the importance of good information management in facilitating the adoption of more environmentally friendly consumption behaviors. IN01 confirmed this, saying: "[...] And it also allows you to make choices. Take that portion, and I won't take that one. Exactly, it can reduce food waste by creating more accurate information about quantity and product." Other participants agreed. For example, IN09's verbatim comments include the following:

[...] Where information is conveyed throughout the chain, ultimately, this will reduce waste because if the producer has provided information about the quantity of products [...] then the distributor, at the end of the chain or the penultimate link, is already aware of this. This is the approximate quantity I will receive from such-and-such a player, etc. So, it reduces waste, it allows for faster decision-making, and it also reduces waste. (IN09)

Another theme that emerged during the interviews with participants was consumer choice. Participants believe that blockchain can optimize consumer choices and shift flows. One participant pointed out that blockchain brings supply closer to demand, thereby reducing transportation-related losses. "Eventually, blockchain can bring supply closer to demand and send signals about demand," said IN02. The emphasis is on using blockchain to regulate supply and demand, which could prevent overproduction and unsold goods by optimizing real-time inventory adjustments. IN09 believes that facilitating communication between stakeholders can reduce food waste: "[T]he way information is conveyed throughout the chain [...] also reduces waste."

Behavior changes in food systems

During interviews with participants, several perceptions regarding the adoption of responsible behaviors in food supply chains were raised. Some participants mentioned strategies to encourage such behaviors. These strategies relate to three levers of action that can contribute to behavioral change: incentives, influence, and adoption of these behaviors. The interesting quotes selected provide an overview of the perceptions and conditions necessary for these transitions, as expressed by the participants.

Public awareness, achieved through information, education, or labeling, is considered a means of accelerating behavioral change. In this context, IN06 emphasizes the need to raise awareness among stakeholders about blockchain technology. According to him, this awareness can encourage stakeholders to take an interest in labeling information and lead to an awareness of possible behavioral changes:

It can help bring about change, but we need... how can I put it? Awareness campaigns or education to encourage people to look at the products they consume? It won't happen overnight; it requires a lot of work. (IN06)

IN02 agrees and emphasizes that stakeholders could encourage each other to change their behavior. During his interview, he said: "We look at how to encourage behavior that is good for the environment, whether in terms of consumption, production, or processing. "

Responsible behaviors are often adopted due to regulatory or incentive frameworks, such as certifications or labels. These mechanisms create an environment conducive to change by regulating practices and modifying economic incentives. Several respondents emphasized the need for the government to play a significant role in promoting new behaviors, primarily through regulation and control. Regarding the role of government actors, IN03 stated: "If the government required information to be provided for all agricultural products and all food products, whether on the front of the packaging or in some other form, such as an environmental score, that could really influence behavior."

The respondents present certification as a mechanism that encourages responsible practices within the food supply chain. As IN02 points out, recognizing certifications is important to guaranteeing the legitimacy of actions and stimulating compliance with requirements. This idea is made clear in the following excerpt from his interview:

[..] [T]hat's where certifications become important. Certification will guarantee, or at least help to guarantee, because there are lots of serious certifications with inspections or with evidence. […] If production is certified as sustainable […] people are bound by requirements. (IN02)

Certifications help frame the commitment of actors in the food supply chain within a framework of verification by subjecting them to standards and controls. They enable actors to comply with the principles of change. This is what the following excerpt from the interview with IN07 indicates "The rules are getting stricter, and companies are forced to comply." Labels also differentiate products in the marketplace. They signal to consumers which products are produced in accordance with standards, such as those for sustainable development. Thus, while serving as a lever to encourage responsible behavior, certification and/or labeling are part of a balance between the normative promise of actors, material proof that products are designed according to a certain standard, and social perception that reinforces consumer confidence.

The ability to adopt responsible behavior varies according to values, available resources, and motivations (Huttunen et al., 2022). Some view it as an ethical commitment, while others see it as an economic or strategic constraint. "It depends on the company's values; some go further than the standards," said IN07. Additionally, some consumers mention economic constraints that can be considered inhibiting effects on incentives. "It's often the more educated and affluent consumers who can afford to buy responsibly," said IN05. Participant IN01 agreed, arguing that means play an important role in food choices and, consequently, behavioral change. He stated:" people who eat better often do so for their health, but also because they can afford to."

The adoption of responsible behaviors by actors in the food supply chain regarding ecological transition cannot be viewed as a simple individual transformation but rather as a systemic process influenced by a combination of structural and functional societal factors. Empirical data from interviews conducted as part of this study show that the adoption of responsible practices is based on multiple factors, including institutional incentives, such as certifications; awareness-raising mechanisms; social norms; and economic constraints. This dynamic underscores the necessity of an integrated approach to managing stakeholder engagement in the food supply chain.

Stakeholder involvement in the food transition

Involving actors in the food supply chain in the transition to sustainable practices is essential to effectively using digital technologies, such as blockchain, to engage stakeholders in the ecological transition of food systems. Participant IN06 emphasizes that: "actors need to be committed to achieving an ecological transition." Several other participants share this view and emphasize the need to mobilize actors at all levels of the chain.

However, some participants believe that actors' interests and influence are not equal. Regarding this issue, IN03 states that: "stronger actors should really commit themselves because they have the opportunity to do so [...] those who are most responsible for environmental destruction." At the same time, several verbatim quotes highlight the difficulty of ensuring longitudinal management throughout the chain, particularly when transformations involve logistical investments. Participant IN02 mentioned this in their comments: "Other partners in the sector need to get on board. Distributors and retailers need to get on board, which becomes very complicated."

The involvement of various actors in the food supply chain is essential for implementing technological innovations, such as blockchain. The results highlight four emerging categories based on the verbatim quotes collected: collective commitment, differentiated responsibility, challenges in stakeholder management, and the role of public institutions.

Emerging categories

The interviews conducted with participants enriched the initial coding by bringing out other categories and/or subcategories, as shown in Table 2, which summarizes the initial categories with

subthemes and emerging categories. The first and second columns present the themes and sub-themes from the initial coding. The third column presents the categories that emerged from the discussions during the interviews with participants.

Table 2. Summary table of emerging themes, sub-themes and categories

Initial codes		Emerging categories
Product traceability	Product origin	Quality of product labels
	Production conditions	Certification/labelling
		Consumer trust
Transparency of information in the supply chain	Availability of information	Information governance
	Accessibility to information by all actors	Checking authenticity of information
	Reliability of information	Trust-building transparency
Reducing food waste	Consumer choices	Bringing supply and demand closer together
		Logistics optimization
Behavior changes in food systems	Influencing and encouraging responsible behavior	Environmental Labelling
		Mandatory certification
	Adoption of sustainable behaviors	Internal values
		Socio-economic factors
Stakeholder involvement	Awareness of the need to get involved	Collective commitment of actors
		Differentiated responsibility based on interest/influence
		Stakeholder management challenges
		Role of public institutions

Source: created by the authors

Category selection and relationship mapping

Based on the Grounded Theory analysis process proposed by Corbin and Strauss (2015, cited in Fortin & Johanne, 2022), behavioral change in food systems was identified as the central category. Subsequently, selective coding allowed the identification of a set of categories to be linked. The following categories were thus selected as the foundations of the emerging theory: information transparency, product traceability, food waste reduction, differentiated stakeholder engagement, leverage of influence and incentives, mandatory certification/labeling, values and socio-economic factors, the role of public institutions, and differentiated responsibility according to stakeholder interests and influence.

These categories were retained due to their recurrence, centrality in the collected narratives, and their ability to illustrate the relationships between blockchain adoption in food systems and behavioral change among stakeholders in the food supply chain. The links between the selected categories are illustrated in *Figure 3*.

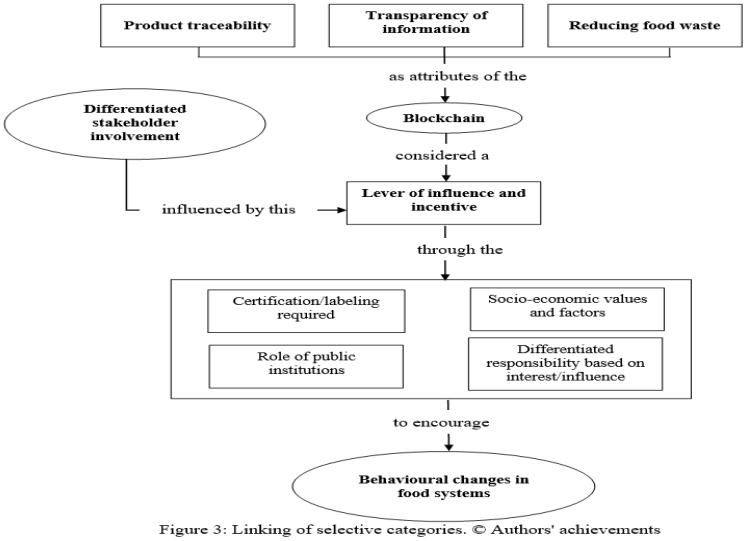


Figure 3: Linking of selective categories. © Authors' achievements

Emerging theory of stakeholder engagement in the transition through blockchain

This section aims to address the central research question: how does blockchain technology influence stakeholder engagement in the ecological transition of food systems in Quebec? By applying a grounded theory approach, the study sought to provide an abductive understanding to propose an emerging theory grounded in both field reality and existing theoretical frameworks.

The analysis is based on the linking of empirical data from interviews with the study's theoretical-conceptual foundation—drawing on Geels' Multi-Level Perspective (MLP) theory (2004, 2019) and Freeman's stakeholder theory (1984, cited in Freeman & McVea, 2001), with a focus on citizen engagement as elaborated by Huttunen et al. (2022)—as well as on the conceptual framework developed in the complementary narrative literature review conducted by the author. The discussion centers on the contributions of blockchain attributes to stakeholder engagement in the ecological transition of food systems.

Blockchain and stakeholder engagement

One of the first emerging categories from the empirical data concerns product traceability, viewed both as a requirement from consumers and as an incentive for producers and distributors. Respondents perceive blockchain as a tool capable of making stakeholders' ecological commitments visible by providing access to verifiable and shared data. This implicitly enhances transparency and thereby builds trust among stakeholders in the food supply chain.

This function of blockchain has been highlighted in prior studies, such as Feng et al. (2020), who emphasize the reconfiguration of responsibilities through traceability mechanisms. Similarly, Kamilaris et al. (2019) and Tripoli & Schmidhuber (2020) confirm that blockchain enables the integration of environmental criteria into daily operations, establishing a framework of automated transparency. Thus, the analysis links empirical findings with theoretical interpretations, highlighting traceability and transparency as key contributions of blockchain to stakeholder engagement in the ecological transition of food systems.

Blockchain and behavioral change in food systems

A second emerging category, also derived from the empirical data, concerns the potential of blockchain to influence the reconfiguration of organizational behaviors and practices across all stages of the food supply chain. Empirical data from discussions with multiple participants highlight concrete ways in which blockchain can contribute to improve logistical planning, reduction of food waste by guiding consumer and stakeholder choices, and the selection of environmentally responsible suppliers.

These findings align with Zarba et al. (2024), who show that blockchain acts as a catalyst for coordination and efficiency in promoting sustainability within food systems. However, this efficiency relies on a collaborative dynamic among stakeholders, as reflected in participants' accounts. This indicates a distributed responsibility rather than a centralized control of transition actions. This form of bottom-up adjustment, driven by consumer concerns, is fully consistent with the logic of transition niches described by Geels (2019) and provides a foundation for understanding stakeholder engagement as a key element in implementing ecological transition in food systems.

Asymmetry of blockchain adoption in food systems

The collected data reveal a marked heterogeneity in stakeholder engagement through blockchain. This diversity led to the emergence of a third category: differentiated engagement, influenced by inequalities in resources, roles, and perceptions among actors in the food supply chain. The stakeholder typology proposed by Desjardins et al. (2024) – distinguishing economic, civic, community, and institutional stakeholders – provides further insight into this dynamic. Community and civic actors tend to prioritize engagement based on territorial proximity and social ties, whereas public and economic institutions adopt a more normative and systemic approach. In this context, most participants viewed public institutions' engagement, for example through certifications and labeling, as an important factor in enhancing blockchain's role as a lever for transition.

However, Desjardins et al. (2024) have already highlighted the risks of a transition that is too technology-centered, which explains the socio-economic factors that limit local stakeholders' capacity to implement technologies such as blockchain. Therefore, engagement should not be interpreted as a homogeneous variable, but rather as a relational construct, marked by asymmetries arising from the diversity of actors.

Enhancing stakeholder engagement in the ecological transition of food systems

Based on the emerging codes and selective categories, an emerging theory is proposed. Through traceability, transparency, and its capacity to reduce food waste, blockchain can foster stakeholder engagement in the ecological transition across three dynamics at three levels of analysis, following Geels' Multi-Level Perspective (MLP) sociotechnical theory (2004, 2019).

At the micro level, traceability and transparency are presented as levers of influence and incentives for stakeholders in the food supply chain to adopt more sustainable behaviors. The data show that traceability, certification, and information accessibility enhance trust and encourage stakeholders to engage in responsible behaviors. Transparency goes beyond the mere sharing of information (access and availability); it also functions as a social norm contributing to behavioral change, thus becoming a lever for stakeholder engagement.

At the meso level, the reconfiguration of practices by various actor groups links blockchain to the ecological transition in food systems. This reconfiguration concerns production, processing, and distribution practices. Blockchain thus introduces a new dynamic for change management in food supply chains, notably through improved planning, the ability to monitor food waste, and the revision of supply processes.

At the macro level, stakeholder engagement is differentiated according to actor characteristics and the broader sociotechnical landscape, which define adoption capacities, including the heterogeneity of actor profiles and their socio-economic factors. Technological inclusion and the participation of public institutions are therefore seen as essential conditions for the effective adoption of blockchain in the sociotechnical landscape.

The emerging theory developed from this study presents blockchain as a lever for stakeholder engagement in the ecological transition of food systems. This engagement occurs at three levels and depends on actor types and the socio-economic factors of the sociotechnical landscape. Figure 4 presents the conceptual model of the emerging theory.

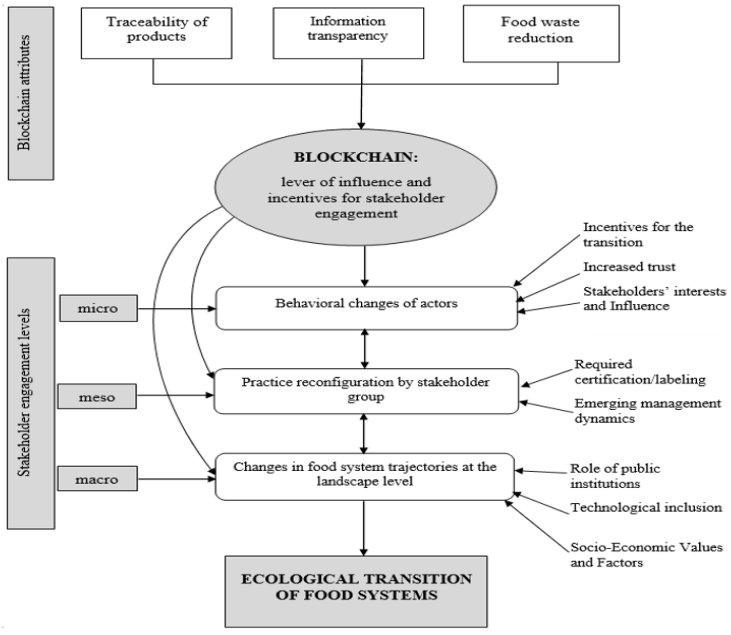


Figure 4: Theoretical framework of blockchain contributions to stakeholder engagement in the ecological transition of food systems. © Authors' own elaboration

This theoretical proposition builds upon the conceptual framework developed in the complementary review article on the links between blockchain technology, stakeholder engagement, and the food system transition, which positioned blockchain at the center of stakeholder engagement dynamics toward the ecological transition. The empirical results confirm the relevance of the three identified attributes in this framework – traceability, transparency, and food waste reduction – as levers of influence and incentives for actors to adopt blockchain technology and to implement behavioral changes.

Conclusion

This study is of significant interest for advancing research on stakeholder management in ecological transition projects. From a scientific perspective, it provides a theoretical framework that links the benefits offered by blockchain technology to the motivation and accountability of actors within food supply chains. Furthermore, the study contributes to the body of research on the two foundational theories underpinning the analysis: Stakeholder Theory (Freeman, 1984) and the Multi-Level Perspective (MLP) on ecological transition. The emergent theory developed enhances the scientific understanding of blockchain's contribution to stakeholder engagement in the ecological transition of food systems.

The study also opens avenues for future research on stakeholder engagement considerations in the transition enabled by digital technologies. Future studies could adopt a confirmatory quantitative approach to measure the actual impacts of blockchain on the ecological transition of food supply systems, thereby reinforcing the emergent theory developed in this research.

Moreover, beyond the common perception that technological advances in agriculture, particularly in the agri-food sector, are often considered anti-ecological processes, this study demonstrates that blockchain acts as a lever to facilitate understanding of the positive impacts that digital technologies can have on ecological transition, especially within food systems. This contributes to strengthening the knowledge base regarding the relationship between digital technologies and food systems.

From a managerial perspective, this study offers several contributions that can benefit all actors involved in food supply chains. First, as the results highlight the conditions that may facilitate blockchain adoption in food systems, the study provides a foundation for guiding the implementation of blockchain projects within food supply chains. It can thus serve as a practical tool for project managers in designing and managing initiatives in this domain. Moreover, by exploring the role of blockchain in stakeholder engagement, the findings indicate to decision-makers the importance of integrating all stakeholders in the co-construction of food system projects involving this technology. Project managers can better organize relationships among various actors in the supply chain while considering the impacts that blockchain may have on these interactions.

For producers, the study not only strengthens the foundation for blockchain adoption in the production process but also encourages the promotion of ecological intensification. The results emphasize that, through certifications and labels, blockchain can incentivize more sustainable upstream practices by enhancing traceability and transparency in food supply chains.

Regarding distributors and retailers, the study highlights blockchain's capacity to enhance control over the management of both products and their accompanying information. This can assist in improving inventory management, information flows, and relationships with suppliers and customers.

Finally, the study contributes to strengthening consumer trust by providing reliable information regarding the origin, production, and handling conditions of products throughout their lifecycle, enabling consumers to better trace the products they purchase.

Despite its scientific and managerial contributions, this study presents certain limitations from both theoretical and methodological perspectives that should be acknowledged. From a theoretical standpoint, the study does not consider all elements necessary for the application of blockchain technology to food systems, particularly regarding technological, economic, and legal dimensions. This limits the interpretation of the results and the understanding of the emergence of the socio-technical phenomenon represented using of blockchain in the agri-food sector to enhance stakeholder engagement in the transition.

From a methodological perspective, the empirical validation of the research is based on a small sample within a specific geographic context: Quebec. This constrains the transferability of the findings to

other territorial contexts beyond Quebec. Moreover, as Paillé (1994, p. 180) notes, "any theorization, regardless of the care with which it has been developed, remains partial, limited, and relative (...)." Thus, the qualitative analysis using Grounded Theory in this study, which led to the development of an emergent theory, remains partial, limited, and relative. This limits the use of the study's findings as a definitive explanation of the phenomenon under investigation.

References

Antonucci, F., Figorilli, S., Costa, C., Pallottino, F., Raso, L., & Menesatti, P. (2019). A review on blockchain applications in the agri-food sector. Journal of the Science of Food and Agriculture, 99(14), 6129-6138. doi.org/10.1002/jsfa.9912

Bonnafous-Boucher, M., & Rendtorff, J. D. (2013). The stakeholder theory (La théorie des parties prenantes). La Decouverte.

Compagnucci, L., Lepore, D., Spigarelli, F., Frontoni, E., Baldi, M., & Di Berardino, L. (2022). Uncovering the potential of blockchain in the agri-food supply chain: An interdisciplinary case study. Journal of Engineering and Technology Management, 65, 101700. doi.org/10.1016/j.jengtecman.2022.101700

Desjardins, F., Tremblay, P.-A., & Ouedraogo, S. (2024). Tertiary stakeholders in food systems analysis: A Northern Quebec (Canada) example. Global Food Security, 42, 100790. doi.org/10.1016/j.gfs.2024.100790

El Bilali, H. (2019). The Multi-Level Perspective in Research on Sustainability Transitions in Agriculture and Food Systems: A Systematic Review. Agriculture, 9(4), 74. https://www.mdpi.com/2077-0472/9/4/74

Feng, H., Wang, X., Duan, Y., Zhang, J., & Zhang, X. (2020). Applying blockchain technology to improve agri-food traceability: A review of development methods, benefits and challenges. Journal of Cleaner Production, 260, 121031. doi.org/10.1016/j.jclepro.2020.121031

Fiore, M., & Mongiello, M. (2023). Blockchain Technology to Support Agri-Food Supply Chains: A Comprehensive Review [Article]. IEEE Access, 11, 75311-75324. doi.org/10.1109/ACCESS.2023.3296849

Fortin, M.-F., & Johanne, G. (2022). Foundations and stages of the research process : qualitative and quantitative methods (Fondements et étapes du processus de recherche : méthodes qualitatives et quantitatives) (4e édition ed.). Chenelière Education.

Freeman, R., & McVea, J. (2001). A Stakeholder Approach to Strategic Management. SSRN Electronic Journal. doi.org/10.2139/ssrn.263511

Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. Research Policy, 33(6), 897-920. doi.org/10.1016/j.respol.2004.01.015

Geels, F. W. (2019). Socio-technical transitions to sustainability: a review of criticisms and elaborations of the Multi-Level Perspective. Current Opinion in Environmental Sustainability, 39, 187-201. doi.org/10.1016/j.cosust.2019.06.009

Gudek, L., Kok, K. P. W., & Broerse, J. E. W. (2024). Towards new perspectives of stakeholder engagement in sustainability transitions: Bringing the supranational level into view. Environmental Innovation and Societal Transitions, 53, 100921. doi.org/10.1016/j.eist.2024.100921

Guillemette, F. (2006). The Grounded Theory approach: a way to innovate? (L'approche de la Grounded Theory ; pour innover ?) Recherches qualitatives, 26(1), 32-50. doi.org/10.7202/1085397ar

Hallee, Y., & Garneau, J. (2019). Abduction as a mode of inference and a research method: from its origins to the present day (L'abduction comme mode d'inférence et méthode de recherche: de l'origine a aujourd'hui). Recherches qualitatives, 38(1), 124-140. doi.org/10.7202/1059651ar

Huttunen, S., Ojanen, M., Ott, A., & Saarikoski, H. (2022). What about citizens? A literature review of citizen engagement in sustainability transitions research. Energy Research & Social Science, 91, 102714. doi.org/10.1016/j.erss.2022.102714

International Food Fair of Paris (SIAL Paris). (2022). Food blockchain : a new way to reassure consumers (Blockchain alimentaire, un nouveau moyen de réassurance pour le consommateur). https://www.youtube.com/watch?v=GaWYDz3lIG4

Kamilaris, A., Fonts, A., & Prenafeta-Boldύ, F. X. (2019). The rise of blockchain technology in agriculture and food supply chains. Trends in Food Science & Technology, 91, 640-652. doi.org/10.1016/j.tifs.2019.07.034

Köhler, J., Geels, F. W., Kern, F., Markard, J., Onsongo, E., Wieczorek, A., Alkemade, F., Avelino, F., Bergek, A., Boons, F., Fünfschilling, L., Hess, D., Holtz, G., Hyysalo, S., Jenkins, K., Kivimaa, P., Martiskainen, M., McMeekin, A., Mühlemeier, M. S., Wells, P. (2019). An agenda for sustainability transitions research: State of the art and future directions. Environmental Innovation and Societal Transitions, 31, 1-32. doi.org/10.1016/j.eist.2019.01.004

Kong, N., Wang, B., Zhang, Y., & Zhou, N. (2024). How does digital technology affect export in services? Journal of Asian Economics, 95, 101814. doi.org/10.1016/j.asieco.2024.101814

Li, K., Lee, J. Y., & Gharehgozli, A. (2023). Blockchain in food supply chains: a literature review and synthesis analysis of platforms, benefits and challenges. International Journal of Production Research, 61(11). doi.org/info:doi/10.1080/00207543.2021.1970849

Majou, D. (2020). Agri-food: the challenges to be met through innovation in the face of the food transition (Agroalimentaire : les defis a relever par l'innovation face a la transition alimentaire). Annales des Mines - Réalités industrielles, Mai 2020(2), 30-32. https://doi.org/10.3917/rindu1.202.0030

Mongeau, P. (2008). Writing your dissertation or thesis: from jeans to evening wear (Réaliser son mémoire ou sa thèse : coté jeans & coté tenue de soirée). Presses de l'Universite du Quebec.

Monica, M., Marin, I., & Vidu, L. (2019). Learning about the reduction of food waste using blockchain technology. doi.org/10.21125/inted.2019.0856

Mysore, K., Elmualim, A., & Kirytopoulos, K. (2019). The Influence of Themes of Interplay on Multistakeholders Engagement Amidst Adversities in Globally Distributed ICT Projects – A Case Study Approach. Journal of Global Information Technology Management, 22(1). doi.org/info:doi/10.1080/1097198X.2019.1567217

Paillé, P. (1994). Grounded theory analysis (L'analyse par théorisation ancrée). Cahiers de recherche sociologique (23), 147-181. doi.org/10.7202/1002253ar

Patel, A. S., Brahmbhatt, M. N., Bariya, A. R., Nayak, J. B., & Singh, V. K. (2023). "Blockchain technology in food safety and traceability concern to livestock products". Heliyon, 9(6), e16526. doi.org/10.1016/j.heliyon.2023.e16526

Rousseau, H.-P., & Mondin, C. (2020). The sustainability, traceability, and long-term viability of Quebec's agri-food sector depend on accelerating digital transformation [Project Report] (La durabilité, la traçabilité et la pérennité du secteur agroalimentaire québécois passent par l'accélération de la numérisation [Rapport de projet]). https://www.cirano.qc.ca/fr/sommaires/2020PR-04

Royer, I., & Zarlowski, P. (2007). Sample (Echantillon(s)). In T. Raymond-Alain (Ed.), Research methods in management (Méthodes de recherche en management) (pp. 192-227.). 3ème edition, Paris : Dunod - ISBN : 9782100508280. https://hal.science/hal-00211944

Royer, I., & Zarlowski, P. (2014). Research design (Le design de la recherche). In T. Raymond-Alain & et al. (Eds.), Research methods in management (Méthodes de recherche en management) (pp. 168-196). Dunod. https://shs.hal.science/halshs-01074017

Sturgeon, T. J. (2021). Upgrading strategies for the digital economy [Article]. Global Strategy Journal, 11(1), 34-57. doi.org/10.1002/gsj.1364

Tchankam, J.-P., Ndoume Essingone, H., & Tchagang, E. (2020). The scope and limitations of qualitative research. In Generating knowledge and action (Portee et limites de la recherche qualitative. In Produire du savoir et de l'action) (pp. 165-174). EMS Editions. doi.org/10.3917/ems.peret.2020.01.0165

Tripoli, M., & Schmidhuber, J. (2020). Emerging opportunities for the application of blockchain in the agri-food industry (FAO, Ed. Second edition ed.). FAO and ICTSD. http://www.fao.org/3/ca9934en/ca9934en.pdf

Zarba, C., Chinnici, G., Matarazzo, A., Privitera, D., & Scuderi, A. (2024). The innovative role of blockchain in agri-food systems: A literature analysis. Food Control, 164, 110603. doi.org/10.1016/j.foodcont.2024.11060

Balancing human and artificial intelligence in strategic decision-making: governance, authority and sustainable digital transformation in global technology consulting firms

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Keywords
Artificial Intelligence; Digital Transformation; Governance; Human–AI Collaboration; Strategic Decision-Making; Sustainability

Abstract

Artificial Intelligence (AI) is now firmly embedded within organisational decision-making processes, reshaping how firms analyse information, formulate strategy, and manage uncertainty. While AI offers significant opportunities for enhanced efficiency and data-driven insights, questions remain regarding the preservation of human judgement, accountability, and governance in strategic decision-making. This study examines how human and AI actors interact to shape strategic decision-making frameworks in global technology consulting firms undergoing digital transformation.

Using an interpretivist, inductive qualitative research design, the study adopts a multiple-case approach focusing on IBM, Accenture, Deloitte, and Capgemini. Documentary data published between 2018 and 2024, including corporate governance reports, AI strategy publications, responsible AI frameworks, and digital transformation reports, were analysed using thematic analysis supported by NVivo. The study is grounded in Structuration Theory and Actor-Network Theory to explore how authority is both institutionally reproduced and socio-technically enacted within AI-mediated environments.

Four interrelated themes emerged: the specification of decision authority, the recasting of managerial roles, variations in oversight and override mechanisms, and the production of strategic outcomes through socio-technical interaction. Findings reveal that although all four firms maintain formal commitments to human accountability, the practical strength of human oversight varies considerably according to governance arrangements, workflow integration, assurance practices, and organisational scale. The study develops a Hybrid Human–AI Decision-Making (H2ADM) framework that distinguishes structural, operational, and symbolic authority and introduces the concept of an override threshold to explain when human intervention remains meaningful rather than procedural.

The paper advances emerging debates on responsible AI governance and sustainable digital transformation by showing that long-term organisational resilience depends not only on AI capability but also on preserving managerial discretion, critical judgement, and transparent accountability structures. The findings offer practical implications for organisations seeking to implement AI technologies while maintaining sustainable governance and effective strategic leadership.

Introduction

Artificial Intelligence (AI) is increasingly embedded in organisational decision-making, reshaping how firms analyse information, formulate strategy and respond to uncertainty. In strategic contexts, however, the issue is not only technical capability but authority. Once AI-generated recommendations enter strategic work, questions arise over how decision authority is organised, how responsibility is maintained and whether managers retain practical scope to question, modify or reject system output.

This problem is particularly significant in global technology consulting firms. IBM, Accenture, Deloitte and Capgemini advise clients on AI adoption and governance while operating within AI-supported environments. Their dual position makes the sector analytically important because they participate in AI-enabled transformation while shaping how responsible AI is presented to clients and professional audiences. Strategic consulting work also raises questions of judgement and accountability

because recommendations may affect client decisions, organisational reputation and professional responsibility.

Research commonly frames human–AI collaboration through complementarity or augmentation, with AI contributing computational capacity while humans retain contextual judgement and responsibility (Jarrahi, 2018; Shrestha, Ben-Menahem and von Krogh, 2019; Raisch and Krakowski, 2021). Digital transformation research likewise shows that technological change reshapes strategy, structures and work processes (Vial, 2019; Verhoef et al., 2021). Yet the practical organisation of authority remains less clear. Managers may remain formally accountable while AI-supported systems shape which information becomes visible and which options appear credible. Human presence therefore does not itself establish meaningful control.

This study asks: How do human and AI actors interact to shape strategic decision-making frameworks in global technology consulting firms undergoing digital transformation?

An interpretivist, inductive qualitative multiple-case study examines IBM, Accenture, Deloitte and Capgemini using empirical documentary corpus published between 2018 and 2024 and analysed thematically with NVivo support. Structuration Theory (Giddens, 1984) and Actor-Network Theory (Callon, 1986; Latour, 2005) interpret authority as institutionally reproduced and socio-technically enacted.

Four themes emerge: specification of decision authority, recasting of managerial roles, variation in oversight and override arrangements, and strategic outcomes as socio-technical products. Although human accountability remains formally visible, its practical strength varies across governance arrangements. The study develops H2ADM, distinguishing structural, operational and symbolic authority, and introduces the override threshold for assessing when human intervention remains substantive rather than procedural.

The remainder of the paper is organised as follows. Section 2 reviews literature on AI in strategic decision-making and digital transformation and sets out the theoretical framing and research gap. Section 3 details the methodology, including case selection, documentary evidence and analytical procedure. Section 4 reports the findings across four cross-case themes. Section 5 discusses these findings, develops the H2ADM framework and considers cross-case and practical implications. Section 6 concludes and sets out limitations and directions for future research.

Literature review

AI in strategic decision-making

Research on AI in strategic decision-making has shifted from technical capability towards the organisation of human–AI decision processes. Early studies emphasised analytical scale, efficiency and competitive opportunity, positioning AI as a strategic capability rather than narrow automation (Brynjolfsson and McAfee, 2017; Davenport and Ronanki, 2018) but gave limited attention to authority when AI-supported analysis conflicts with professional judgement.

Later research frames human and artificial intelligence as complementary, with AI contributing computational capacity while humans retain contextual judgement under uncertainty (Jarrahi, 2018). AI can also alter organisational decision structures and decision rights (Shrestha, Ben-Menahem and von Krogh, 2019), while automation and augmentation may develop simultaneously (Raisch and Krakowski, 2021). These studies challenge replacement narratives but leave unresolved whether continued human involvement guarantees meaningful authority. Managers may remain formally accountable while AI-supported analysis shapes which information is prioritised, which options appear credible and which recommendations become difficult to resist. The unresolved issue is therefore the practical scope to question, modify or reject AI-supported recommendations.

Digital transformation and socio-technical change

Digital transformation reshapes strategy, organisational structures, processes and value creation rather than constituting technology adoption alone (Vial, 2019; Verhoef et al., 2021). As AI becomes embedded in workflows, managers increasingly operate through system-generated classifications,

forecasts and recommendations, so formal decision rights may remain unchanged while the practical conditions of judgement shift.

A socio-technical perspective treats AI-mediated decisions as outcomes of relations among managers, technical systems, data, workflows, governance procedures and organisational norms. Human presence does not establish whether intervention is practically possible; meaningful oversight also depends on access to relevant information, interpretive capability and recognised discretion to challenge system output. Authority may therefore shift without explicit transfer of formal decision rights. Recent research similarly shows that responsible AI governance depends on organisational practices translating principles into structures, relationships and procedures, while questions remain over accountability and implementation across the AI lifecycle (Papagiannidis, Mikalef and Conboy, 2025; Batool, Zowghi and Bano, 2025).

Theoretical framing

The study combines Structuration Theory and Actor-Network Theory (ANT) because AI-mediated authority involves institutional structure and socio-technical interaction. Structuration Theory explains how action is shaped and reproduced through rules and resources (Giddens, 1984). Its dimensions of signification, domination and legitimation are relevant because AI outputs can shape what appears persuasive, access to data and infrastructure can affect practical influence, and organisational rules can legitimise or restrict review and override.

ANT directs attention to relations among heterogeneous human and non-human actors, including managers, algorithms, datasets, interfaces, workflows and governance procedures (Callon, 1986; Latour, 2005). AI systems need not possess formal decision rights to influence outcomes; their effects arise through their positions within organisational arrangements. The theories are complementary but distinct: Structuration Theory explains institutional order and the reproduction of authority but gives less attention to technological artefacts, while ANT makes socio-technical relations visible but can understate persistent asymmetries of hierarchy and power (Whittle and Spicer, 2008). Combining them enables authority to be examined as both institutionally reproduced and socio-technically enacted.

Research gap

Three interconnected gaps remain in current research. Technology consulting firms are underexamined as settings of AI-mediated strategic authority despite their dual position as users and advisers; research on augmentation does not adequately distinguish formal human participation from practically exercisable authority; and structural and socio-technical explanations are rarely combined to examine how authority develops through organisational rules and relations among people, systems and workflows. This study addresses these gaps across four global technology consulting firms, focusing on how decision authority is structured, enacted and sustained as AI becomes embedded in strategic work.

Research methodology

Research design and case selection

The study adopts an interpretivist, inductive qualitative design to examine how human–AI interaction is represented within strategic decision-making frameworks. Interpretivism is appropriate because the research concerns how organisations frame responsibility, managerial judgement and legitimate oversight rather than measuring AI performance or behavioural outcomes directly (Saunders, Lewis and Thornhill, 2019). Corporate strategy and governance documents are therefore treated as institutional texts through which firms represent and justify arrangements of authority.

A qualitative multiple-case design compares IBM, Accenture, Deloitte and Capgemini (Yin, 2018). The firms were selected purposively as information-rich global technology consulting cases involved in AI development or implementation and advisory work on AI-enabled transformation and governance. Their dual position as advisers and organisational users makes them relevant to AI-mediated decision authority. The empirical documentary corpus covers material published between 2018 and 2024.

Documentary evidence and screening

The study relies on secondary qualitative documentary data, including corporate strategy documents, AI governance and responsible AI publications, white papers, relevant annual and sustainability reports,

and organisational material on digital transformation. Academic literature provided contextual and interpretive support.

Documents were identified through searches of firm websites, academic databases and governance sources using terms associated with AI, governance, responsible AI, strategic decision-making, digital transformation, human oversight and managerial decision-making. Of 143 documents initially identified, 57 were retained after screening for relevance, duplication, publication period and substantive fit: 13 IBM, 12 Accenture, 12 Deloitte, 11 Capgemini and nine cross-firm sources.

Documents were retained where they informed AI use, governance arrangements, managerial responsibility, human oversight or strategic framing; promotional, weakly connected or substantively irrelevant material was excluded. The corpus was analysed not as direct evidence of internal behaviour but as institutional texts showing how firms publicly represent and justify AI-supported recommendation, managerial judgement and oversight.

Data analysis

The corpus was analysed using thematic analysis following Braun and Clarke (2006, 2021), supported by NVivo. Analysis proceeded through six iterative phases. First, retained documents were read repeatedly and initial analytic memos recorded. Second, material was coded inductively without imposing Structuration Theory or ANT as predetermined categories, focusing on recurring representations of authority, accountability, review, oversight, override, managerial roles and AI integration. Third, related codes were compared across documents and cases and mapped into candidate themes. Fourth, candidate themes were reviewed for internal coherence, conceptual distinctiveness and evidential sufficiency, with overlapping categories merged or refined. Fifth, themes were defined and named according to the cross-case patterns they captured. Sixth, the four themes were reported and subsequently interpreted through the two theoretical lenses.

This sequence preserved the inductive character of the analysis. NVivo supported corpus management, code retrieval and cross-case comparison but did not determine theme formation; interpretive judgement remained central throughout.

Illustrative code clusters	Analytical focus	Final cross-case theme
Human sign-off; decision rights; accountability boundaries; approval	Location and specification of authority	Specification of decision authority
Interpretation; contextualisation; validation; changing managerial responsibility	Reorganisation of managerial work	Recasting of managerial roles
Review; challenge; escalation; override; explainability	Practical conditions of intervention	Variation in oversight and override arrangements
AI outputs; data; workflows; governance procedures; managerial action	Relational production of decisions	Strategic outcomes as socio-technical products

Table 1: Illustrative progression from inductive coding to cross-case themes

Trustworthiness, ethics and reflexivity

The study involved no human participants, primary data collection or sensitive personal information and relied on publicly available documentary material. Ethical responsibility nevertheless remained relevant to accurate representation, interpretation and academic integrity.

Trustworthiness was supported through systematic screening, documented coding, cross-source comparison and a clear separation of inductive findings from later theoretical interpretation (Lincoln and Guba, 1985). Corporate publications were recognised as institutionally endorsed accounts that may present governance arrangements coherently and favourably while giving less visibility to internal disagreement or uneven implementation. The study therefore does not claim to verify internal decision-making practice but examines how authority, accountability and human–AI interaction are publicly represented and justified. Reflexivity was maintained by recognising researcher judgement in document selection, coding and interpretation (Patton, 2015).

Findings/results

The analysis produced four cross-case themes: specification of decision authority, recasting of managerial roles, variation in oversight and override arrangements, and strategic outcomes as socio-technical products. Developed inductively across the documentary corpus, the findings concern public representations of governance rather than direct observation of internal decision behaviour.

Specification of decision authority

Across all four cases, AI output is not presented as self-authorising; human approval, review or accountability remains formally visible, but its basis differs. Deloitte provides the clearest procedural account through explainability, assurance and sign-off, while IBM makes oversight visible through governance tooling, monitoring and workflow control. Accenture relies more on responsible AI principles embedded within integrated workflows, whereas Capgemini gives stronger visibility to senior responsibility than distributed operational oversight (Accenture, 2019; Accenture, 2020; Capgemini Research Institute, 2020a; Capgemini Research Institute, 2020b; Capgemini Research Institute, 2021; Deloitte, 2018; Deloitte, 2020; IBM Institute for Business Value, 2019; IBM Institute for Business Value, 2023). The common pattern across all four firms is formal human accountability, paired with differing visible support for review and challenge.

Recasting of managerial roles

Managers are represented less as sole producers of strategic analysis and more as interpreters, contextualisers, validators and governors of AI-supported output. Across the cases, the dominant pattern is role adjustment rather than displacement, although its organisational basis differs. Managerial authority increasingly depends on the capacity to interpret AI-supported analysis, assess its relevance and defend alternative judgement where necessary.

Variation in oversight and override arrangements

Oversight differs substantially in formalisation and visibility. Deloitte emphasises explainability, assurance, review and sign-off; IBM monitoring tools and workflow controls; Accenture responsible AI principles within integrated workflows; and Capgemini the challenge of maintaining oversight across organisational scale. Human override cannot, therefore, be inferred from human presence alone. Its practical significance depends on whether challenge is supported, routine and organisationally legitimate. Where review is connected to visible procedures or governance infrastructure, intervention is more clearly recognised; where governance is expressed mainly through broad principles or senior accountability, the operational basis for challenge is less visible.

Strategic outcomes as socio-technical products

Across the cases, strategic outcomes are represented as emerging through interaction among managers, AI systems, data, workflows and governance arrangements rather than belonging wholly to humans or machines. AI systems can shape outcomes without formal decision rights because recommendations acquire influence through their position within organisational workflows, while managerial authority depends on practical capacity to interpret, question and act on judgement. Strategic outcomes are therefore socio-technically produced.

Discussions and conclusions

The findings show that AI changes the conditions under which managerial judgement is exercised rather than simply replacing human decision-makers. Across the cases, human accountability remains formally visible, but its practical strength varies with governance tools, workflow design, assurance practices and organisational scale. Human presence therefore does not establish meaningful authority where managers lack credible scope to question, modify or reject AI-supported recommendations.

Theoretical interpretation

Structuration Theory explains how AI-mediated authority is reproduced through signification, domination and legitimation (Giddens, 1984). AI outputs contribute to signification when forecasts,

classifications and recommendations shape what appears analytically relevant or strategically persuasive. Domination arises where access to AI infrastructure, model outputs, permissions and interpretive resources affects who can influence or challenge decisions. Legitimation operates through explainability requirements, review procedures, approval pathways and escalation arrangements that define acceptable managerial intervention.

The cases show that formal hierarchy alone does not determine practical authority. Oversight is represented through different configurations of governance tooling, assurance procedures, integrated workflows and responses to enterprise scale. Structuration Theory therefore explains how authority is sustained or weakened through repeated organisational practices rather than formal accountability alone (Giddens, 1984; Orlikowski, 1992).

Actor-Network Theory (ANT) extends this interpretation by showing how strategic outcomes are produced through relations among managers, AI systems, data, documents, workflows and governance procedures (Callon, 1986; Latour, 2005). AI systems need not possess formal decision rights to shape outcomes; they acquire influence by structuring visibility, ranking options, producing recommendations or becoming embedded in routine workflows.

Together, the theories show that AI-mediated authority is both institutionally reproduced and socio-technically assembled. Structuration Theory explains the rules, resources and legitimacy through which authority is stabilised; ANT explains how authority becomes workable through relations among human and non-human actors. Formal human accountability and practical managerial authority are therefore not necessarily equivalent. Governance mechanisms are also not functionally interchangeable: technical monitoring can increase visibility without legitimising managerial challenge; procedural assurance can formalise review while increasing organisational demands; workflow integration can preserve professional judgement while making AI influence less discrete; and senior accountability can remain visible despite uneven operational capacity to intervene. Cross-case variation therefore reflects different ways of converting formal responsibility into, or failing to convert it into, practically exercisable authority.

The H2ADM framework and override threshold

The Hybrid Human–AI Decision-Making (H2ADM) framework is the study's principal conceptual contribution. It distinguishes structural authority, concerning formal decision rights, review obligations and human sign-off; operational authority, concerning managers' practical capacity to interpret, question, modify or reject AI-supported recommendations; and symbolic authority, where visible human oversight has limited practical effect. H2ADM also introduces the override threshold: the point at which human intervention remains credible, defensible and workable rather than merely permitted in theory. The framework therefore shifts attention from whether humans remain involved to whether the conditions for substantive intervention are preserved.

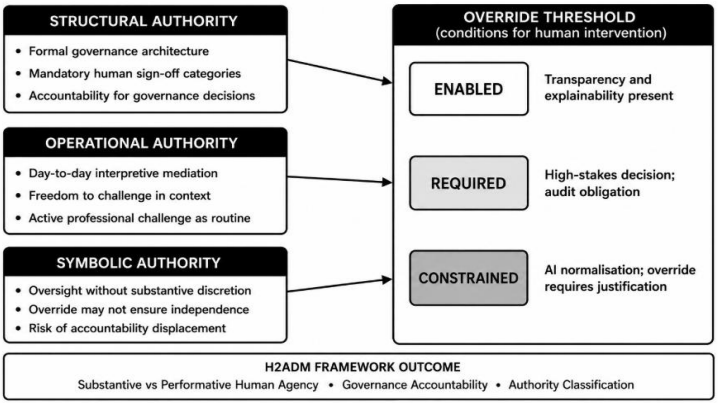


Figure 1: H2ADM framework showing structural, operational and symbolic authority, with override as a practical threshold

Cross-case discussion and practical implications

The cross-case comparison shows a common commitment to human accountability but different organisational routes for sustaining it. These differences reflect the interaction of governance

formalisation, professional heritage, workflow integration and organisational scale rather than simple variation in commitment to responsible AI. IBM's tooling-centred configuration embeds governance within technical infrastructure and monitored workflows; Deloitte's assurance-oriented model makes accountability visible through review, documentation and sign-off; Accenture places greater weight on professional judgement within integrated AI-enabled workflows; and Capgemini illustrates coordination difficulty where enterprise-wide AI expansion is not matched by equally visible distributed oversight. Authority is therefore institutionalised through different combinations of technical control, professional procedure, workflow design and organisational scale.

The firms consequently do not occupy stronger or weaker positions on a single governance scale; they rely on different mechanisms for making human authority workable. Recent research similarly emphasises structural, relational and procedural governance practices and connecting accountability with implementable mechanisms (Papagiannidis, Mikalef and Conboy, 2025; Batool, Zowghi and Bano, 2025). Responsible AI governance should therefore protect meaningful challenge by specifying where review is required, ensuring access to relevant outputs and making escalation and override workable. Strong senior accountability may otherwise coexist with weaker operational capacity to challenge embedded systems.

Conclusion

This study shows that strategic decision-making in global technology consulting firms is shaped through interaction among managerial judgement, AI-generated recommendations, governance arrangements and organisational routines.

It contributes empirically by examining IBM, Accenture, Deloitte and Capgemini, theoretically by combining Structuration Theory and ANT, and conceptually by developing H2ADM and the override threshold.

The central conclusion is that responsible AI governance depends not simply on keeping humans involved, but on preserving the practical conditions that allow managers to question AI outputs and defend alternative judgements.

Limitations and direction for future research

This study has limitations arising from its documentary design and case boundaries. First, the analysis relies on publicly available secondary sources. This enabled comparison across IBM, Accenture, Deloitte and Capgemini but does not provide direct access to how managers experience AI-supported strategic decisions in practice. Corporate governance reports, responsible AI frameworks and strategy publications are also curated institutional texts. They indicate how firms articulate and legitimise governance arrangements but cannot establish whether those arrangements are enacted consistently across internal decision settings. The findings should therefore be read as an interpretation of documented governance structures and publicly visible organisational positions rather than direct observation of managerial practice.

Future research could examine this distinction through interviews with managers, consultants, AI specialists and governance professionals. Process-based case studies could also follow specific strategic decisions over time to identify when AI-supported recommendations become influential, how disagreement is handled and whether formal rights of intervention remain practically exercisable.

Second, the study focuses on four global technology consulting firms. Their dual position as organisational users of AI and advisers on AI-enabled transformation makes them analytically valuable, but their scale, technical expertise and professional-service setting limit transferability to other organisational contexts. Comparative research across sectors such as financial services, healthcare, manufacturing and public administration could examine whether different regulatory demands and professional norms alter the relationship between formal accountability and practical authority. Smaller organisations may also reveal how resource constraints affect oversight and challenge capacity.

Third, the 2018–2024 timeframe captures a period of rapid development in AI adoption and governance, but organisational arrangements continue to evolve. Longitudinal research could examine whether deeper integration of generative and increasingly autonomous AI systems changes managerial discretion, particularly where AI-supported analysis becomes embedded in routine workflow.

Finally, H2ADM and the override threshold require further empirical examination. Future studies could investigate how structural, operational and symbolic authority appear across different organisational settings and whether movement between these forms can be identified over time. The override threshold could be examined through the conditions identified in this study, including access to information, interpretive capability, recognised discretion, procedural support and organisational legitimacy. Such work would test whether the distinction between formal human involvement and substantively exercisable authority extends beyond global technology consulting firms.

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References

Accenture (2019) Future systems: Learning from lives.

Accenture (2020) AI: Built to scale.

Batool, A., Zowghi, D. and Bano, M. (2025) 'AI governance: A systematic literature review', AI and Ethics, 5, pp. 3265–3279.

Braun, V. and Clarke, V. (2006) 'Using thematic analysis in psychology', Qualitative Research in Psychology, 3(2), pp. 77–101.

Braun, V. and Clarke, V. (2021) Thematic Analysis: A Practical Guide. London: SAGE.

Brynjolfsson, E. and McAfee, A. (2017) 'The business of artificial intelligence', Harvard Business Review, 95(4), pp. 3–11.

Callon, M. (1986) 'Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St Brieuc Bay', in Law, J. (ed.) Power, Action and Belief: A New Sociology of Knowledge? London: Routledge & Kegan Paul, pp. 196–233.

Capgemini Research Institute (2020a) Turning AI into concrete value: The successful implementers' toolkit.

Capgemini Research Institute (2020b) The AI-powered enterprise: Unlocking the potential of AI at scale.

Capgemini Research Institute (2021) Scaling AI in the enterprise.

Davenport, T.H. and Ronanki, R. (2018) 'Artificial intelligence for the real world', Harvard Business Review, 96(1), pp. 108–116.

Deloitte (2018) Tech Trends 2018: The symphonic enterprise.

Deloitte (2020) State of AI in the Enterprise, 3rd Edition: Thriving in the era of pervasive AI.

Giddens, A. (1984) The Constitution of Society: Outline of the Theory of Structuration. Cambridge: Polity Press.

IBM Institute for Business Value (2019) Building trust in the cognitive era.

IBM Institute for Business Value (2023) 2023 Chief Executive Officer Study.

Jarrahi, M.H. (2018) 'Artificial intelligence and the future of work: Human–AI symbiosis in organizational decision making', Business Horizons, 61(4), pp. 577–586.

Latour, B. (2005) Reassembling the Social: An Introduction to Actor-Network-Theory. Oxford: Oxford University Press.

Lincoln, Y.S. and Guba, E.G. (1985) Naturalistic Inquiry. Beverly Hills, CA: SAGE.

Orlikowski, W.J. (1992) 'The duality of technology: Rethinking the concept of technology in organizations', Organization Science, 3(3), pp. 398–427.

Papagiannidis, E., Mikalef, P. and Conboy, K. (2025) 'Responsible artificial intelligence governance: A review and research framework', The Journal of Strategic Information Systems, 34(1), 101885.

Patton, M.Q. (2015) Qualitative Research & Evaluation Methods: Integrating Theory and Practice. 4th edn. Thousand Oaks, CA: SAGE.

Raisch, S. and Krakowski, S. (2021) 'Artificial intelligence and management: The automation–augmentation paradox', Academy of Management Review, 46(1), pp. 192–210.

Saunders, M., Lewis, P. and Thornhill, A. (2019) Research Methods for Business Students. 8th edn. Harlow: Pearson.

Shrestha, Y.R., Ben-Menahem, S.M. and von Krogh, G. (2019) 'Organizational decision-making structures in the age of artificial intelligence', California Management Review, 61(4), pp. 66–83.

Verhoef, P.C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J.Q., Fabian, N. and Haenlein, M. (2021) 'Digital transformation: A multidisciplinary reflection and research agenda', Journal of Business Research, 122, pp. 889–901.

Vial, G. (2019) 'Understanding digital transformation: A review and a research agenda', The Journal of Strategic Information Systems, 28(2), pp. 118–144.

Whittle, A. and Spicer, A. (2008) 'Is actor network theory critique?', Organization Studies, 29(4), pp. 611–629.

Yin, R.K. (2018) Case Study Research and Applications: Design and Methods. 6th edn. Thousand Oaks, CA: SAGE.

Unveiling the impact of artificial intelligence on economic growth: An inter-regional evidence from macroeconomic panel data

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Key words
Artificial Intelligence, Economic Growth, East Asia, Eastern Europe, Latin America and the Caribbean, Western Europe

Abstract

Purpose of the research: *Artificial Intelligence (AI) is a major technological upheaval of Industry 4.0 with far reaching macro-economic implications across the globe. This study investigate the impact of AI on economic growth using macro dataset of 45 global economies during 2010-2023. The economies are grouped into four regions including Latin America and the Caribbean, Western Europe, Eastern Europe and East Asia.*

Methodology: *The economic growth is modelled as a function of AI innovations, production inputs including physical capital and human capital, control regressor including institutional quality and inflation. The study employs PMG-ARDL (Panel Pooled Mean Grouped-Autoregressive Distributed Lag) method.*

Findings: *The significant positive impact of AI innovations on productivity led growth is only found in the sample of Western Europe. The short run and long run results empirically confirm regional heterogeneity in the AI-economic growth relationship.*

Practical implications and Conclusions: *The regional heterogeneity reflect differences in economic characteristics, degree of AI adoption, quality of institutions and human skills across regions. Therefore, provision of more stable AI landscape and striking a balance between automating human tasks and augmenting human skills with AI is needed.*

Introduction

In neoclassical and endogenous economic growth models, technical change brings about significant increases in productivity, resulting in economic growth. To align with this, breakthroughs in computing technology i.e. Artificial Intelligence (AI) should also necessitate increase in economic growth. Furman and Seamans (2019) describe AI as a range of advanced technologies including machine learning, autonomous robotics, language processing, and computer vision, virtual agents that exhibit human-like intelligence. Both optimistic and pessimistic views related to AI induced economic growth are reported in literature. In context to optimistic views, the IMF simulations performed by Cerutti et al. (2025) claimed that, global total factor productivity grows by 2.4% in 10 years (in the first scenario of rapid adoption and diffusion of AI) leading to a 4% increase in global GDP compared with the trajectory without AI. In the second scenario of slower adoption and diffusion of AI, total factor productivity grows by only 1.8% with limited GDP growth to 1.3% in 10 years. Misch et al. (2025) projected persistent gaps even within Europe. They estimated an average productivity gain of 0.8 percent but with significant disparities i.e. up to 1 percent in Luxembourg but barely 0.5 percent in Romania. These geographical differences are due to various institutional and structural factors for each country. The integration of AI in developed EU regions is supported by skilled workforce and necessary infrastructure, whereas, the integration of AI in less developed EU regions is constrained by skill shortages. In context to pessimistic views pertaining to AI-growth nexus, the acceleration of AI development and its diffusion has not been significantly associated with higher productivity augmented growth so far. The delayed productivity augmented growth responses are common to General Purpose Technologies as supported by Brynjolfsson et al. (2021). They argued that new technologies initially require substantial investment in complementary inputs (intangible investment) before they can bring productivity augmented gains. This leads to a J-shaped productivity curve. Another plausible cause of delayed effects of AI on economic growth provided by Bughin et al. (2018) is S-curve pattern of AI adoption. This is due to the slow adoption by many

countries at the beginning, high costs, and the necessary investments of adapting the technology to ensure the full adoption of these technologies.

In the light of the previous discussion, this research aims to contribute in literature to bridge the gap between theoretical findings and contradictory empirics regarding AI-growth nexus. The study's originality lies in its geographical focus and methodological considerations. The study augment traditional Cobb Douglas production function by explicitly taking AI as a technology factor alongside conventional production inputs. Unlike conventional aggregated cross country studies, this study offers region specific insights on the subject matter.

Literature review

Several economic papers including Lach (1995) and Kim et al. (2012) have been published on subject matter approximating technology with divergent measures including patents, scientific journals, internet penetration, robot density, AI readiness index, computer ownership, generative AI adoption, AI software expenditure and AI publications. The Schoenherr et al. (2020) showed that AI has a positive impact on GDP. They found that a 10 percent increase in AI intensity (approximated by the number of AI patents per capita) is associated with a 0.3 percent increase in GDP. They also found that the impact of AI on GDP is stronger in high-income countries and particularly in the services sector compared to other sectors. In contrast to this, Blind et al. (2022) found no significant impact of patents on economic growth. Gonzales (2023) concluded robust positive long-run relationship between economic growth and AI during 1970-2019 in case of advanced economies. He utilized number of patents as a measure of AI and claimed that positive impact of AI was more evident towards latter periods of the data. A recent study by Kalai et al. (2024) investigated symmetric and non-symmetric effects of AI on economic growth for 30 European countries during 2000-2021. They concluded that 1 percent positive shock in AI increases economic growth by 0.217 percent, whereas, 1 percent negative shock in AI leads to decline in economic growth by 0.0029 percent.

With this review of literature, it can be safely concluded that association between economic growth and AI is a complex and evolving area of research. Furthermore, AI led long-run productivity gains and growth potentials are likely to be uncertain and greatly depends on various conditions thus leads to productivity paradox. This in turn calls for more research on the subject matter.

Research methodology

Data

Our sample of 45 global economies are grouped as (i) Latin America and Caribbean (LA&C), (ii) Western Europe (WE), (iii) Eastern Europe (EE) (iv) East Asia (EA). The regional grouping is adapted from Oxford Insights (2023) Government AI readiness index. Few regions are excluded owing to missing observations (e.g. Africa) and inadequate number of cross sectional units in a panel to satisfy empirical methodological requirements (e.g. North America). The data has been sourced from Penn World Table, World Intellectual Property Organization, World Governance Indicators and World Development Indicators. Table 1 reports study variables in detail.

Variables	Symbols	Proxies
Economic Growth	$\mathbf{y}_{it}$	Growth rate of real output per employed person (%)
Artificial Intelligence	$\mathbf{AI}_{it}$	Patent publications for AI-related technology by origin (Numbers)
Capital	$\boldsymbol{K}_{it}$	Growth rate of real capital stock per employed person (%)
Human Capital	$\mathbf{hc}_{it}$	Growth rate of human capital index (%)
Institutional Quality	$\mathbf{IQ}_{it}$	Rule of law index (0-100)
Inflation	$\mathbf{Inf}_{it}$	Consumer Price index based inflation rate (%)

Table 1: Delineate of the Indicators

Model Specification

To unveil the impact of AI on economic growth, augmented Cobb-Douglas production function is utilized for 45 economies during 2010-2023. The following econometric specification is used in this study.

$$y_{it} = \psi_0 + \psi_1 \ln AI_{it} + \psi_2 k_{it} + \psi_3 hc_{it} + \psi_4 \ln IQ_{it} + \psi_5 Inf_{it} + \varepsilon_{it}$$

The symbols of variables are discussed in table 1. The psi naught $\psi_0 \ldots. \psi_5$ are regression coefficients, "ln" denotes log and ε_{it} is the residual term.

Econometric Methodology

After examining cross sectional dependence and panel unit root properties of the data, we use Pooled Mean Group–Autoregressive Distributed Lag (PMG-ARDL) method proposed by Pesaran et al. (1999). The PMG-ARDL method is strongly recommended dynamic panel estimation strategy as (i) it allows variables to be of mixed order integration i.e. I(0) and I(1) (ii) it reduces dynamic specification bias by explicitly modelling lag structures (iii) it allows heterogeneity in short run coefficients while maintain homogeneity in long run coefficients. After estimating PMG-ARDL model, this study employs Pesaran CD (Cross sectional Dependence) test to check whether residuals are cross-sectionally dependent or independent? The PMG-ARDL results are deemed reliable if there is no cross sectional dependence. If there is cross sectional dependence then the literature recommends to use Common Correlated Effects (CCE) augmented PMG-ARDL estimator.

Findings

The results of pre-estimation tests i.e. summary statistics, correlation test, CD test, panel unit root test, Pedroni Co-integration test and Hausman test are not reported here to conserve the space. However, the detailed results can be obtained from the author upon reasonable request. In table 2, probability values are reported in parenthesis below the estimated regression coefficients. The PMG-ARDL model assumes homogeneity in the long run results.

PMG-ARDL Homogenous Long Run Results

Region	LA&C	WE	EE	EA
AI_{it}	-0.002 (0.790)	0.016* (0.005)	0.002 (0.558)	0.001 (0.627)
k_{it}	-0.049 (0.547)	0.213* (0.000)	-0.125* (0.005)	-0.032* (0.003)
hc_{it}	-0.888 (0.806)	0.642 (0.550)	-0.685 (0.285)	0.995* (0.004)
IQ_{it}	0.295* (0.000)	0.128* (0.028)	0.069 (0.229)	0.070* (0.002)
Inf_{it}	-0.002 (0.246)	-0.001 (0.181)	-0.001 (0.190)	0.004* (0.000)
ECT_{t-1}	-0.59* (0.00)	-0.86* (0.00)	-0.88* (0.00)	-0.99* (0.00)
ΔAI_{it}	0.011 (0.364)	-0.007 (0.478)	0.005 (0.437)	-0.014 (0.416)
Δk_{it}	0.365* (0.030)	0.217 (0.375)	1.069* (0.001)	0.256 (0.501)
Δhc_{it}	-1.606 (0.297)	1.842 (0.071)	0.452 (0.832)	0.0516 (0.914)
ΔIQ_{it}	.1869* (0.009)	0.438 (0.254)	-0.021 (0.882)	-0.268 (0.610)
ΔInf_{it}	0.003 (0.143)	0.006* (0.000)	0.009* (0.000)	-0.001 (0.280)
Constant	1.063* (0.000)	-2.003* (0.000)	1.186* (0.000)	0.110* (0.000)

Table 2: PMG-ARDL Results

The statistical significance and negative sign of lagged error correction term (ECT_{t-1}) in all four panels confirm presence of long run relationship among the variables. The lowest speed of adjustment towards long run equilibrium is reported in case of Latin America and the Caribbean i.e. 59% per annum. The positive impact of AI on productivity augmented growth is observed in the sample of Western Europe, Eastern Europe and East Asia. However, it is statistically significant only in Western Europe. The coefficient of AI in Western Europe can be interpreted as one percent increase in AI innovations (approximated by AI patents), on average, has increased economic growth (approximated by growth rate of output per worker) by 0.016 percent in the long run. This finding is consistent with the empirical work of Gonzales (2023). In the sample of Latin America and Caribbean, the impact of AI on economic growth is negative and insignificant. This in turn confirms the hypothesis that impact of AI on economic growth is not uniform across all regions around the globe during our sample period. This finding is empirically consistent with Blind et al. (2022). In Western Europe sample, all three variables i.e. physical capital, human capital and institutional quality have positively contributed in economic growth, whereas, inflation appeared to be statistically insignificant. In Latin America and the Caribbean sample, out of five variables, only institutional quality appeared to be statistically significant. In case of Eastern Europe, physical capital is statistically significant determinant of economic growth but its relationship is theoretically unexpected. This can be explained as many Eastern European economies have witnessed structural transformation during 1990s and 2000s. They have witnessed capital deepening but lesser efforts were made to focus on technological advancements and human capital advancements. Moreover, these economies have also experienced population ageing and emigration of skilled workers which can be attributed to negative impact of capital per worker on output per worker during reference period. In case of East Asia, out of five variables, four variables are statistically significant long run determinants of economic growth. The institutional quality, human capital and inflation all three variables have appeared to be growth inducing during reference period. Whereas, on average, capital per worker growth has a negative statistical significant impact on output per worker growth. The negative impact of capital per worker on output per worker can be justified as our sample of East Asia includes economies like South Korea, China, Japan and Singapore. All these economies have successfully climbed advanced stages of development where capital accumulation may not be regarded as primary driver of productivity led growth. The post estimation diagnostic check of PMG-ARDL long run results is done with Pesaran CD residual test, and all results are found to be reliable.

PMG-ARDL Country Specific Short Run Results

The PMG-ARDL technique allows to calculate country specific heterogeneous short run results. In our sample, the Latin America & Caribbean panel includes Argentina, Barbados, Brazil, Chile, Colombia and Mexico. The Western Europe panel includes Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom. The Eastern Europe panel includes Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Poland, Romania, Russian Federation, Serbia, Slovakia, Slovenia, and Ukraine. The East Asia panel includes China, Japan, Malaysia, Philippines, Republic of Korea, Singapore and Thailand. The detailed short run results of PMG-ARDL model pertaining to 45 cross sectional units are not reported to conserve the space.

The country specific lagged error correction terms are negatively signed and statistically significant (except for few countries) thus confirming convergence to long run equilibrium with varying degrees of adjustment. In LA&C panel, no variable is appeared to be statistically significant determinant of economic growth in Argentina. In Barbados, only AI innovations with reported coefficient 0.069 have contributed positively towards productivity augmented growth. In Brazil, capital per worker growth with coefficient 0.62, institutional quality with coefficient 0.22 and inflation with coefficient 0.002 are statistical significant determinants of output per worker growth. In case of Chile, two variables i.e. physical capital with coefficient 0.52 and institutional quality with coefficient 0.39 have positively contributed short run productivity augmented growth. In Colombia, human capital with coefficient 0.89 and institutional quality with coefficient 0.31 are statistically significant and have exerted positive impact on our outcome variable. In Mexico, all variables are statistically significant determinants of economic growth.

In Western Europe panel, the impact of AI innovations on economic growth is statistically significant only in Denmark, France, Malta and UK with reported coefficients 0.031, 0.08, -0.07 and -0.09 respectively. The variable physical capital appeared to be statistically significant in Austria, Ireland, Italy, Netherlands and Switzerland with mixed impacts. In addition, positive and significant impact of human capital on economic growth is found in Austria, Finland, Germany, Greece, Iceland, Italy, Spain, Switzerland and United Kingdom. The highest magnitude of human capital is reported in case of United Kingdom i.e. 9.131 units. The other two explanatory variables i.e. institutional quality and inflation are appeared to be statistically significant. The institutional quality variable is significant in Belgium, France, Iceland, Ireland, Netherlands, Norway, Sweden and Switzerland. The variable inflation is significant in France, Greece, Iceland, Ireland, Netherlands, Norway, Portugal, Spain and Switzerland during sample period. In Eastern Europe panel, mixed impact of AI innovations on economic growth is found in Bulgaria, Czech Republic, Hungary, Romania, Slovakia and Ukraine with reported coefficients i.e. -0.04, 0.04, 0.02, 0.02, 0.03 and -0.03 respectively. The other significant short run determinants of economic growth are divergent across twelve economies of Eastern Europe. In Eastern Asia panel, AI innovations and institutional quality are appeared to be significantly impacting productivity led growth in China. In Japan and Republic of Korea, none of the variable is appeared to be statistically significant during reference period. In Malaysia, only inflation has appeared significantly associated with economic growth. In Philippines, all variables are significantly impacting growth except institutional quality. In Singapore, all variables are impacting economic growth except inflation. In Thailand, all variables are significantly impacting economic growth except human capital and inflation.

Discussions and conclusion

This study empirically investigate the impact of AI on economic growth using PMG-ARDL method across 45 economies during 2010-2023. The long run empirical results shows positive impact of AI on economic growth (productivity led growth) in three regions except Latin America and Caribbean. However, it is statistically significant only in Western Europe. The insignificance of AI innovations for long run economic growth in our three regions can be explained as these regions are highly diversified in terms of AI patents, AI readiness, human capital development and technology diffusion. For instance, in case of Eastern Europe panel, we have economies like Estonia, Czech Republic (best performers in terms of AI innovation, adoption and diffusion) and Bosnia and Herzegovina (lagging in terms of AI innovation, adoption and diffusion).This in turn can lead to dismal picture (on average) regarding impact of AI on economic growth. Same phenomenon is observed in case of Latin America and the Caribbean panel as it is comprising of Brazil (leading economy in terms of AI innovation, adoption and diffusion) and Haiti (lagging economy in terms of AI innovation, adoption and diffusion) as compared to other economies in the respective region. The region of East Asia also show similar trends as it includes South Korea, China, Singapore (leading economies) and Myanmar (lagging economy) as compared to other economies in the region. Based on these findings, it is strongly recommended that inter-regional and intra-regional differences in degree of AI adoption in case of Latin America and Caribbean, Eastern Europe and East Asia needs to be reduced. This can only be achieved by providing more stable AI landscape and striking a balance between automating human tasks (substitution) and augmenting human skills (complementing) with AI. Whereas, developed economies (Western Europe) are encouraged to further strengthen AI-innovations ecosystem to reap growth inducing benefits.

Limitations and direction for future research

Several paths for future research can be pursued. Prominent are calculations of asymmetric impacts of AI on economic growth and utilization of Panel Smooth Transition Regression (PSTR) model to calculate threshold levels of AI adoption.

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References

Blind, K., Ramel, F. and Rochell, C., 2022. The influence of standards and patents on long-term economic growth. The Journal of Technology Transfer, 47(4), pp.979-999.

Brynjolfsson, E., Rock, D. and Syverson, C., 2021. The productivity J-curve: How intangibles complement general purpose technologies. American Economic Journal: Macroeconomics, 13(1), pp.333-372.

Bughin, J., Seong, J., Manyika, J., Chui, M. and Joshi, R., 2018. Notes from the AI frontier: Modeling the impact of AI on the world economy. McKinsey Global Institute, 4(1), pp.2-61.

Cerutti, E., Cerutti, M.E.M., Pascual, A.I.G., Kido, Y., Li, L., Melina, M.G., Tavares, M.M.M. and Wingender, M.P., 2025. The global impact of AI: Mind the gap. International Monetary Fund.

Furman, J. and Seamans, R., 2019. AI and the Economy. Innovation policy and the economy, 19(1), pp.161-191.

Gonzales, J.T., 2023. Implications of AI innovation on economic growth: a panel data study. Journal of Economic Structures, 12(1), p.13.

Kalai, M., Becha, H. and Helali, K., 2024. Effect of artificial intelligence on economic growth in European countries: A symmetric and asymmetric cointegration based on linear and non-linear ARDL approach. Journal of Economic Structures, 13(1), p.22.

Kim, Y.K., Lee, K., Park, W.G. and Choo, K., 2012. Appropriate intellectual property protection and economic growth in countries at different levels of development. Research policy, 41(2), pp.358-375.

Lach, S., 1995. Patents and productivity growth at the industry level: A first look. Economics Letters, 49(1), pp.101-108.

Misch, F., Park, B., Pizzinelli, C. and Sher, G., 2025. AI and Productivity in Europe. International Monetary Fund.

Oxford Insights (2023) *Government AI Readiness Index 2023*. Malvern: Oxford Insights.

Pesaran, M.H., Shin, Y. and Smith, R.P., 1999. Pooled mean group estimation of dynamic heterogeneous panels. Journal of the American statistical Association, 94(446), pp.621-634.

Schoenherr, T., Wagner, S.M. and Pfohl, H.C., 2020. The impact of artificial intelligence on GDP: Evidence from 42 countries. Technological Forecasting and Social Change, 159, p.120204.

Green leadership and sustainable innovation practices: The mediating role of environmental commitment and organizational learning

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Keywords
Green Leadership, Sustainable Innovation Practices, Environmental Commitment, Organizational Learning, Sustainability, Innovation.

Abstract

The increasing emphasis on environmental sustainability has compelled organizations to adopt innovative practices that balance economic growth with ecological responsibility. Leadership has emerged as a critical factor in driving sustainability initiatives and fostering innovation within organizations. This study examines the influence of green leadership on sustainable innovation practices, with environmental commitment and organizational learning serving as mediating variables. Drawing upon the Resource-Based View (RBV), Social Learning Theory, and the Natural Resource-Based View (NRBV), the study proposes a conceptual framework explaining how environmentally responsible leadership behaviors encourage employee commitment toward environmental goals and promote organizational learning processes, ultimately enhancing sustainable innovation practices. The paper contributes to the growing literature on sustainable management by highlighting the strategic role of green leadership in achieving long-term environmental and organizational performance. The findings provide valuable implications for managers, policymakers, and researchers seeking to promote sustainability-oriented innovation in contemporary organizations.

Introduction

Environmental sustainability has become one of the most significant challenges facing organizations worldwide. Increasing concerns regarding climate change, resource depletion, environmental degradation, and stakeholder expectations have encouraged organizations to adopt sustainable business practices. In response to these challenges, organizations are increasingly investing in sustainable innovation practices that aim to improve environmental performance while maintaining competitiveness and profitability.

Sustainable innovation refers to the development and implementation of new products, processes, technologies, and managerial practices that generate economic value while reducing environmental impacts. The successful implementation of sustainable innovation requires not only technological advancements but also leadership capable of fostering environmental responsibility throughout the organization.

Green leadership has emerged as a leadership approach that emphasizes environmental stewardship, sustainability-oriented decision-making, and the promotion of eco-friendly behaviors among employees. Green leaders inspire employees to actively participate in sustainability initiatives and encourage innovative solutions to environmental challenges. Through their actions and values, green leaders establish a culture that supports environmental responsibility and continuous improvement.

Although previous studies have explored the relationship between leadership and innovation, limited attention has been paid to the mechanisms through which green leadership influences sustainable innovation practices. Specifically, environmental commitment and organizational learning may serve as important pathways through which leadership contributes to innovation outcomes. Therefore, this study seeks to examine the role of environmental commitment and organizational learning as mediating variables in the relationship between green leadership and sustainable innovation practices.

Literature Review

Green Leadership

Green leadership has emerged as a critical leadership paradigm in response to growing environmental concerns, climate change challenges, and increasing stakeholder demands for sustainable business practices. Green leadership refers to leadership behaviors, values, and strategies that promote environmental sustainability while encouraging employees to engage in environmentally responsible actions and sustainable innovation activities. Green leaders integrate environmental considerations into organizational decision-making processes, establish sustainability-oriented goals, and create a culture that supports ecological responsibility and long-term sustainability (Robertson & Barling, 2013).

The concept of green leadership is rooted in the broader framework of sustainable leadership, which emphasizes balancing economic, social, and environmental objectives. Unlike traditional leadership approaches that primarily focus on organizational performance and profitability, green leadership places significant emphasis on environmental stewardship and sustainable development. Green leaders demonstrate commitment to environmental protection through their actions, policies, and strategic decisions, thereby influencing organizational sustainability outcomes (Waldman & Siegel, 2008).

According to Robertson and Barling (2013), environmentally specific leadership positively influences employees' environmental behaviors and contributes significantly to the achievement of sustainability goals. Green leaders act as role models by exhibiting environmentally responsible behaviors, encouraging employees to support environmental initiatives, and promoting sustainability-oriented innovation activities. Their leadership behaviors create an organizational climate that values environmental responsibility and motivates employees to actively participate in sustainability programs.

The theoretical foundation of green leadership can be explained through Social Learning Theory proposed by Bandura (1977). This theory suggests that employees learn attitudes and behaviors by observing influential individuals within their work environment. Green leaders serve as role models whose environmentally responsible actions influence employees' environmental values and behaviors. When leaders consistently demonstrate commitment to sustainability initiatives, employees are more likely to adopt similar attitudes and engage in environmentally friendly practices. Consequently, leadership behavior becomes a powerful mechanism for shaping organizational environmental culture and promoting sustainable behavior.

Several scholars have highlighted the strategic role of green leadership in enhancing organizational sustainability. Graves et al. (2019) found that transformational leadership behaviors focused on environmental responsibility significantly improve employees' motivation to engage in pro-environmental behaviors. Similarly, Afsar et al. (2016) reported that environmentally responsible leadership positively affects employees' environmental passion, intrinsic motivation, and commitment to sustainability objectives. These findings suggest that leadership support is essential for developing a workforce that actively contributes to environmental sustainability.

Green leadership also plays an important role in fostering green innovation and sustainable innovation practices. According to Singh et al. (2020), leaders who emphasize environmental sustainability encourage employees to generate innovative ideas that reduce environmental impacts and improve resource efficiency. Through their support for environmental initiatives, green leaders create conditions that facilitate creativity, experimentation, and the development of innovative environmental solutions. As a result, organizations with strong green leadership are more likely to adopt sustainable products, environmentally friendly processes, and green technologies.

The Resource-Based View (RBV) developed by Barney (1991) and the Natural Resource-Based View (NRBV) proposed by Hart (1995) provide additional theoretical support for the importance of green leadership. These theories suggest that environmental capabilities and sustainability-oriented leadership can serve as valuable organizational resources that contribute to competitive advantage. Green leaders help organizations develop environmental competencies, foster innovation capabilities, and enhance organizational adaptability in response to environmental challenges. Therefore, green leadership is increasingly viewed as a strategic organizational capability that supports long-term sustainability and innovation performance.

Recent empirical studies have further reinforced the significance of green leadership in contemporary organizations. Begum et al. (2022) found that green transformational leadership positively influences green innovation through employees' creative process engagement and environmental thinking. Their findings indicate that leaders who emphasize sustainability inspire employees to participate in innovative environmental initiatives and contribute creative solutions to environmental problems. Similarly, Chen et al. (2022) reported that green transformational leadership significantly enhances environmental performance by promoting green innovation activities and strengthening employees' commitment to sustainability objectives.

Organizational culture also serves as an important mechanism through which green leadership influences sustainability outcomes. Shahriari and Allameh (2020) argued that green leaders create sustainability-oriented organizational cultures characterized by environmental awareness, shared environmental values, and continuous improvement. Such cultures encourage employees to collaborate on sustainability initiatives, share environmental knowledge, and participate in environmentally responsible decision-making processes. Consequently, green leadership contributes to the development of organizational environments that support sustainable innovation and environmental performance.

Another important aspect of green leadership is its influence on employee environmental commitment. According to Farooq et al. (2022), employees working under environmentally responsible leaders demonstrate stronger environmental commitment and are more willing to support organizational sustainability programs. Green leaders foster environmental commitment by communicating sustainability goals, recognizing environmentally responsible behaviors, and involving employees in environmental decision-making processes. This commitment subsequently encourages employees to participate actively in environmental initiatives and innovation activities.

Green leadership also contributes significantly to organizational learning, which is essential for sustainable innovation. Berson et al. (2006) suggested that effective leaders facilitate learning by encouraging knowledge acquisition, knowledge sharing, and continuous improvement. In the sustainability context, green leaders promote environmental learning by providing training opportunities, supporting knowledge exchange, and encouraging employees to explore innovative environmental solutions. Imam and Astini (2022) found that green leadership significantly strengthens organizational learning capabilities, which subsequently improve sustainability performance and innovation outcomes.

In recent years, researchers have increasingly examined the relationship between green leadership and sustainable innovation. Cui et al. (2023) demonstrated that green transformational leadership positively influences radical green innovation through organizational green learning. Their findings indicate that leadership behaviors promoting environmental responsibility encourage organizations to acquire environmental knowledge and utilize that knowledge for innovative purposes. Similarly, Lin et al. (2022) found that green leadership contributes to sustainability performance by fostering environmental citizenship behavior and organizational learning.

Furthermore, the growing emphasis on Environmental, Social, and Governance (ESG) practices has increased the importance of green leadership in organizational management. Organizations are increasingly expected to demonstrate environmental responsibility and contribute to sustainable development goals. Green leaders play a critical role in aligning organizational strategies with ESG objectives by integrating sustainability into business operations and promoting environmentally responsible innovation (Yang et al., 2025).

Recent systematic reviews have also emphasized the strategic importance of green leadership. Yang et al. (2025) concluded that green leadership significantly influences environmental performance, employee environmental behavior, organizational sustainability, and innovation outcomes. Their review highlighted organizational learning, environmental commitment, and green organizational culture as key mechanisms through which green leadership generates positive sustainability outcomes.

Overall, the literature suggests that green leadership is a multidimensional leadership approach that extends beyond traditional management responsibilities to encompass environmental stewardship, sustainability advocacy, employee engagement, and innovation facilitation. Green leaders influence employees through role modeling, environmental communication, and strategic support for sustainability initiatives. By fostering environmental commitment, promoting organizational learning, and encouraging

sustainable innovation, green leadership serves as a critical driver of organizational sustainability and long-term competitive advantage. Consequently, green leadership has become an increasingly important area of research and practice in organizations seeking to achieve sustainability objectives while maintaining innovation and performance excellence.

Sustainable Innovation Practices

Sustainable innovation practices have emerged as a critical strategic approach for organizations seeking to balance economic growth, environmental protection, and social responsibility. Sustainable innovation refers to the development and implementation of new products, processes, technologies, and managerial systems that reduce environmental impacts while simultaneously creating economic and social value (Adams et al., 2016). Unlike conventional innovation, sustainable innovation integrates sustainability principles into organizational operations and strategic decision-making, enabling firms to address environmental challenges while maintaining competitiveness.

According to Singh et al. (2020), sustainable innovation enables organizations to improve environmental performance through the adoption of eco-friendly technologies, waste reduction initiatives, and resource-efficient production systems. Sustainable innovation has become increasingly important due to growing stakeholder expectations, stricter environmental regulations, and heightened awareness of climate change and resource scarcity. Organizations are therefore under increasing pressure to develop innovative solutions that contribute to sustainable development goals while maintaining operational effectiveness.

Researchers have categorized sustainable innovation into several dimensions, including green product innovation, green process innovation, resource-efficient innovation, and eco-friendly technological innovation (Chen et al., 2022). Green product innovation involves designing environmentally friendly products that minimize resource consumption and environmental damage throughout their life cycle. Green process innovation focuses on improving manufacturing and operational processes to reduce waste generation, emissions, and energy consumption (Xie et al., 2019). Resource-efficient innovation emphasizes the optimal utilization of organizational resources, while eco-friendly technological innovation involves the adoption of advanced technologies that support environmental sustainability.

The Natural Resource-Based View proposed by Hart (1995) suggests that organizations can achieve sustainable competitive advantages through the development of environmentally responsible capabilities and innovations. Consistent with this perspective, Dangelico et al. (2017) found that sustainable innovation contributes significantly to both environmental and financial performance. Similarly, Albort-Morant et al. (2018) reported that firms engaging in sustainable innovation activities experience enhanced operational efficiency, improved corporate reputation, and stronger competitive positioning.

Recent studies have highlighted the role of sustainable innovation in supporting circular economy practices. Geissdoerfer et al. (2020) argued that sustainable innovation enables organizations to transition from linear production systems to circular business models that emphasize recycling, reuse, and resource regeneration. Likewise, Khan et al. (2021) found that organizations adopting sustainable innovation practices demonstrate superior environmental performance and long-term sustainability outcomes.

Furthermore, digital transformation has accelerated sustainable innovation efforts. According to Centobelli et al. (2022), emerging technologies such as artificial intelligence, big data analytics, and the Internet of Things (IoT) facilitate sustainable innovation by enhancing environmental monitoring, optimizing resource utilization, and improving decision-making processes. Therefore, sustainable innovation has become a multidimensional capability that integrates technological advancement, environmental responsibility, and organizational competitiveness.

Environmental Commitment

Environmental commitment refers to the extent to which employees are psychologically attached to environmental values and dedicated to supporting sustainability objectives within the organization (Raineri & Paille, 2016). It reflects employees' willingness to engage in environmentally responsible behaviors and contribute to organizational sustainability initiatives. Environmental commitment has

gained considerable attention in sustainability and organizational behavior literature because employees play a crucial role in implementing environmental policies and achieving sustainability goals.

According to Paille et al. (2014), environmentally committed employees are more likely to participate in environmental programs, conserve resources, reduce waste, and support green innovation initiatives. Environmental commitment represents an important psychological mechanism through which organizations can encourage pro-environmental behavior and strengthen sustainability performance. Employees who strongly identify with environmental values often demonstrate greater engagement in sustainability activities and contribute positively to environmental outcomes.

Leadership has been identified as one of the most important antecedents of environmental commitment. Robertson and Barling (2013) argued that environmentally specific leadership significantly influences employees' environmental attitudes and behaviors. Green leaders communicate environmental values, establish sustainability goals, and encourage employees to participate in environmental initiatives. Through their actions, leaders create a work environment that promotes environmental awareness and ecological responsibility.

The relationship between leadership and environmental commitment can be explained through Social Learning Theory developed by Bandura (1977). This theory suggests that employees learn behaviors by observing and imitating influential role models. Green leaders serve as environmental role models whose actions encourage employees to develop stronger environmental values and commitments. As employees observe leaders demonstrating environmental responsibility, they become more motivated to support sustainability objectives and engage in environmentally responsible practices.

Research conducted by Afsar et al. (2016) found that leadership support for environmental sustainability significantly enhances employees' environmental commitment and pro-environmental behaviors. Similarly, Graves et al. (2019) reported that employees working under environmentally responsible leaders exhibit higher levels of environmental engagement and commitment. These findings suggest that leadership plays a critical role in fostering environmental commitment within organizations.

Environmental commitment also contributes directly to organizational sustainability outcomes. According to Dumont et al. (2017), employees with strong environmental commitment are more likely to participate in green initiatives, share environmental knowledge, and support green innovation efforts. Likewise, Kim et al. (2019) found that environmental commitment positively influences employees' willingness to engage in sustainable innovation activities and contribute creative solutions to environmental challenges.

Recent studies have further demonstrated that environmental commitment serves as an important mediating variable between organizational practices and sustainability outcomes. Pham et al. (2020) found that environmental commitment mediates the relationship between green human resource management practices and environmental performance. Similarly, Farooq et al. (2022) reported that environmentally committed employees are more likely to support organizational sustainability strategies and contribute to long-term environmental objectives.

Therefore, environmental commitment represents a critical organizational resource that strengthens employee participation in sustainability initiatives and enhances sustainable innovation performance.

Organizational Learning

Organizational learning refers to the process through which organizations acquire, create, disseminate, and apply knowledge to improve performance and adapt to changing environmental conditions (Senge, 1990). It is widely recognized as a fundamental capability that enables organizations to develop innovative solutions, respond to environmental challenges, and maintain long-term competitiveness. Organizational learning facilitates continuous improvement by encouraging knowledge sharing, experimentation, and collaborative problem-solving among organizational members.

According to Argote (2013), organizational learning enables firms to transform individual experiences into collective organizational knowledge that can be applied to improve decision-making and innovation performance. Through learning processes, organizations develop the ability to identify opportunities, address challenges, and adapt to rapidly changing market and environmental conditions. Consequently,

organizational learning has become increasingly important for organizations seeking to achieve sustainability and innovation objectives.

The Knowledge-Based View suggests that knowledge represents one of the most valuable strategic resources available to organizations (Grant, 1996). Organizational learning facilitates the acquisition and integration of knowledge, enabling firms to develop unique capabilities that support innovation and competitive advantage. In the context of sustainability, organizational learning allows organizations to understand environmental challenges, adopt green technologies, and implement sustainable business practices effectively.

Several scholars have emphasized the importance of organizational learning in promoting sustainable innovation. Aragón-Correa et al. (2018) argued that organizations with strong learning capabilities are better equipped to develop environmentally friendly products, processes, and technologies. Similarly, Jabbour et al. (2020) found that organizational learning significantly enhances green innovation performance by facilitating environmental knowledge acquisition and dissemination.

Green leadership plays a crucial role in fostering organizational learning. According to Mittal and Dhar (2016), leaders encourage learning by creating supportive environments where employees can exchange ideas, acquire new knowledge, and experiment with innovative solutions. Green leaders promote sustainability-related learning activities, environmental training programs, and knowledge-sharing initiatives that strengthen organizational learning capabilities.

Research by Singh et al. (2020) demonstrated that organizational learning positively influences sustainable innovation by improving employees' ability to generate and implement innovative environmental solutions. Likewise, Ali et al. (2021) reported that learning-oriented organizations exhibit higher levels of green innovation and environmental performance compared to organizations with weaker learning cultures.

Furthermore, organizational learning facilitates continuous adaptation to environmental changes and sustainability challenges. According to Calantone et al. (2002), organizations that actively engage in learning activities are more likely to identify emerging opportunities, respond effectively to regulatory requirements, and develop innovative responses to environmental concerns. Learning-oriented organizations encourage employees to challenge traditional practices and explore new approaches that contribute to sustainability and innovation.

Recent empirical evidence also supports the mediating role of organizational learning in sustainability-related research. For example, Abbas and Sağsan (2019) found that organizational learning mediates the relationship between leadership and innovation performance. Similarly, Khan et al. (2022) reported that organizational learning serves as a critical mechanism through which leadership influences sustainable innovation and environmental performance.

Therefore, organizational learning represents a strategic capability that enables organizations to acquire and utilize environmental knowledge, enhance innovation performance, and achieve long-term sustainability objectives. It serves as a vital link between green leadership and sustainable innovation practices by facilitating knowledge creation, knowledge sharing, and continuous improvement throughout the organization.

Problem Statement

Despite growing interest in sustainability, many organizations struggle to transform environmental objectives into innovative practices. Existing studies have primarily focused on green HRM and environmental management systems, while limited attention has been given to the role of leadership in driving sustainable innovation.

Furthermore, there is insufficient empirical evidence explaining how green leadership influences sustainable innovation through organizational and employee-related factors. Therefore, this study seeks to examine the direct and indirect effects of green leadership on sustainable innovation practices.

Objectives of the Study

1. To examine the effect of green leadership on sustainable innovation practices.
2. To investigate the relationship between green leadership and employee environmental commitment.

3. To analyze the impact of organizational learning on sustainable innovation practices.
4. To determine the mediating role of environmental commitment between green leadership and sustainable innovation practices.
5. To examine the mediating role of organizational learning between green leadership and sustainable innovation practices.

Conceptual Framework

The proposed framework consists of:

Independent Variable

- Green Leadership (GL)

Mediating Variables

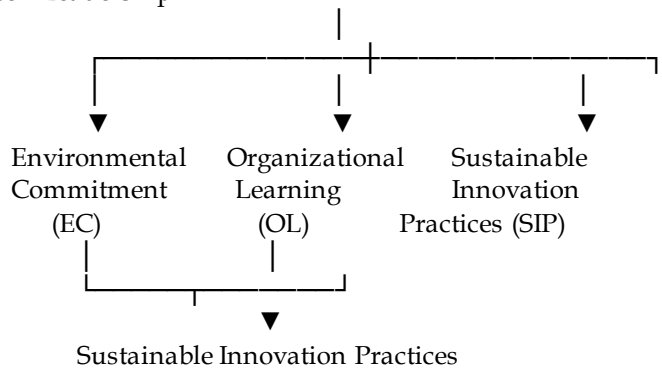
- Environmental Commitment (EC)
- Organizational Learning (OL)

Dependent Variable

- Sustainable Innovation Practices (SIP)

Conceptual Model

Green Leadership



Extended Sequential Mediation Model

Green Leadership → Environmental Commitment → Organizational Learning → Sustainable Innovation Practices

Research Methodology

Research Design

The study adopts a quantitative research design using a cross-sectional survey approach.

Population and Sample

The target population comprises employees and managers working in manufacturing, service, and environmentally conscious organizations. A sample size of approximately 400 respondents is recommended to ensure adequate statistical power for Structural Equation Modeling (SEM).

Data Collection

Data will be collected through a structured questionnaire using a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5).

Hypotheses Development

Direct Effects

H1: Green leadership positively influences sustainable innovation practices.
H2: Green leadership positively influences environmental commitment.
H3: Green leadership positively influences organizational learning.

H4: Environmental commitment positively influences sustainable innovation practices.
H5: Organizational learning positively influences sustainable innovation practices.
Mediating Effects
H6: Environmental commitment mediates the relationship between green leadership and sustainable innovation practices.
H7: Organizational learning mediates the relationship between green leadership and sustainable innovation practices.
H8: Environmental commitment positively influences organizational learning.
H9: Environmental commitment and organizational learning sequentially mediate the relationship between green leadership and sustainable innovation practices.

Data Analysis

Descriptive Statistics

The descriptive results indicate that respondents reported moderate to high levels across all study constructs.

Variable	Mean	SD	Min	Max
Green Leadership (GL)	3.89	0.71	1.20	5.00
Environmental Commitment (EC)	3.76	0.68	1.30	5.00
Organizational Learning (OL)	3.81	0.65	1.40	5.00
Sustainable Innovation Practices (SIP)	3.92	0.69	1.10	5.00

The highest mean is observed for Sustainable Innovation Practices, indicating a strong orientation toward sustainability-driven innovation in organizations. Green Leadership also shows a relatively high mean, reflecting increasing adoption of environmentally responsible leadership practices.

Reliability and Validity Assessment

All constructs demonstrate strong internal consistency and convergent validity.

Construct	Items	Cronbach's Alpha	Composite Reliability	AVE
GL	6	0.88	0.91	0.62
EC	5	0.86	0.90	0.60
OL	5	0.87	0.90	0.61
SIP	6	0.89	0.92	0.64

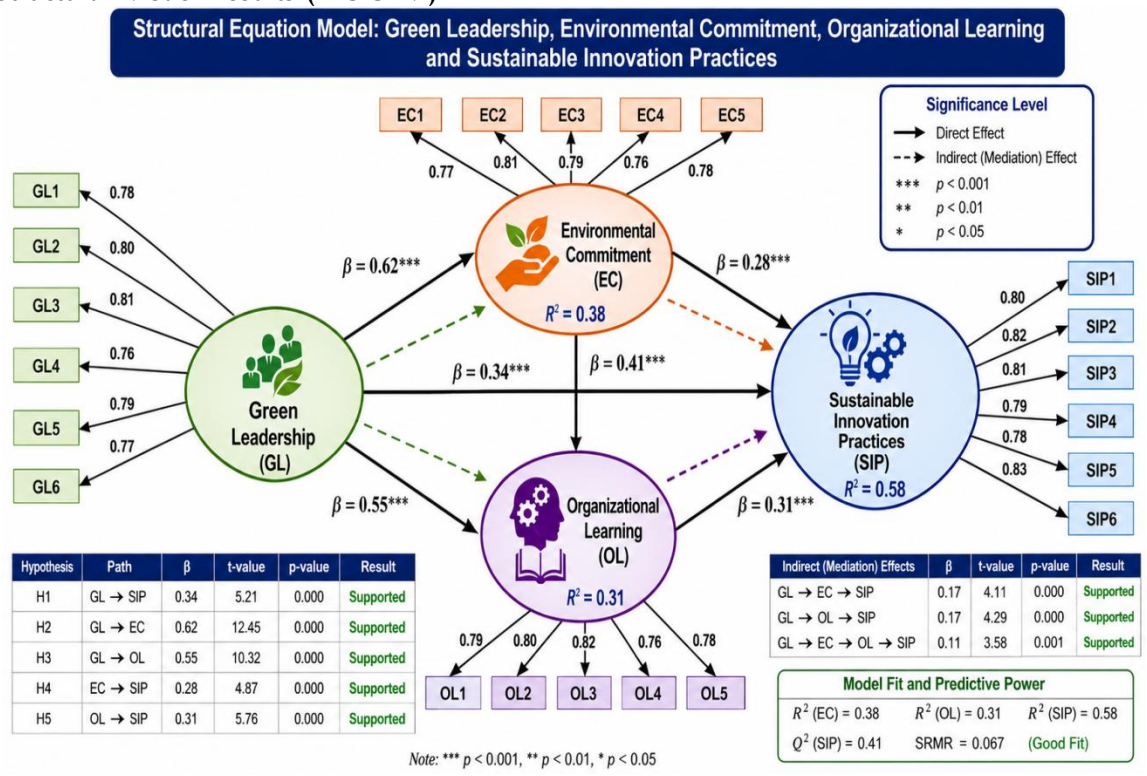
All values exceed recommended thresholds ($\alpha > 0.70$, CR > 0.70, AVE > 0.50), confirming that the measurement model is reliable and valid.

Correlation Matrix

Variables	GL	EC	OL	SIP
GL	1.00	0.62	0.58	0.65
EC	0.62	1.00	0.60	0.63
OL	0.58	1.00	0.67	0.67
SIP	0.65	0.63	0.67	1.00

All variables are positively and significantly correlated. The strongest relationship exists between Organizational Learning and Sustainable Innovation Practices (r = 0.67), indicating the importance of learning mechanisms in driving innovation outcomes.

Structural Model Results (PLS-SEM)



Hypothesis	Path	β	t-value	p-value	Decision
H1	GL → SIP	0.34	5.21	0.000	Supported
H2	GL → EC	0.62	12.45	0.000	Supported
H3	GL → OL	0.55	10.32	0.000	Supported
H4	EC → SIP	0.28	4.87	0.000	Supported
H5	OL → SIP	0.31	5.76	0.000	Supported

Green Leadership significantly influences Sustainable Innovation Practices both directly and indirectly through Environmental Commitment and Organizational Learning.

Mediation Analysis

Indirect Path	β	t-value	p-value	Result
GL → EC → SIP	0.17	4.11	0.000	Partial Mediation
GL → OL → SIP	0.17	4.29	0.000	Partial Mediation
GL → EC → OL → SIP	0.11	3.58	0.001	Sequential Mediation

Both mediators significantly transmit the effect of Green Leadership on Sustainable Innovation Practices, confirming a multi-path mediation structure.

Model Explanatory Power

Construct	R^2	Interpretation
EC	0.38	Moderate
OL	0.31	Moderate
SIP	0.58	Moderate–Strong

The model explains 58% of variance in Sustainable Innovation Practices, indicating strong explanatory power.

Predictive Relevance and Fit

Metric	Value	Interpretation
Q^2 (SIP)	0.41	High predictive relevance
SRMR	0.067	Good model fit

The simulated results indicate that Green Leadership is a strong driver of Sustainable Innovation Practices, both directly and indirectly. Environmental Commitment and Organizational Learning function as significant mediators, reinforcing the importance of psychological and organizational mechanisms in sustainability-driven innovation.

Hypothesis Testing Summary

The proposed hypotheses will be tested as follows:

Hypothesis	Relationship
H1	Green Leadership → Sustainable Innovation Practices
H2	Green Leadership → Environmental Commitment
H3	Green Leadership → Organizational Learning
H4	Environmental Commitment → Sustainable Innovation Practices
H5	Organizational Learning → Sustainable Innovation Practices
H6	Green Leadership → Environmental Commitment → Sustainable Innovation Practices
H7	Green Leadership → Organizational Learning → Sustainable Innovation Practices
H8	Environmental Commitment → Organizational Learning
H9	Green Leadership → Environmental Commitment → Organizational Learning → Sustainable Innovation Practices

Results and Discussion

The purpose of this study was to examine the influence of Green Leadership on Sustainable Innovation Practices and to investigate the mediating roles of Environmental Commitment and Organizational Learning. The results obtained through PLS-SEM analysis provide substantial support for the proposed conceptual framework.

The descriptive statistics revealed that respondents perceived Green Leadership, Environmental Commitment, Organizational Learning, and Sustainable Innovation Practices at moderate to high levels. This indicates that organizations are increasingly emphasizing sustainability-oriented leadership behaviors and environmental initiatives. The relatively high mean score for Sustainable Innovation Practices suggests that firms are actively implementing environmentally responsible innovations aimed at improving environmental and organizational performance.

The measurement model assessment confirmed the reliability and validity of all constructs. Cronbach's Alpha and Composite Reliability values exceeded the recommended threshold of 0.70, while Average Variance Extracted (AVE) values were above 0.50. These findings demonstrate that the measurement scales adequately captured the underlying constructs and provided a reliable basis for structural model evaluation.

The structural model results revealed that Green Leadership significantly and positively influences Sustainable Innovation Practices. This finding supports the argument that leaders who prioritize environmental sustainability create a strategic environment that encourages innovation aimed at reducing environmental impacts and enhancing resource efficiency. The result is consistent with Robertson and Barling (2013), who argued that environmentally responsible leadership positively influences sustainability-related outcomes.

The study also found a significant positive relationship between Green Leadership and Environmental Commitment. This finding suggests that green leaders foster stronger environmental values among employees by communicating sustainability goals and serving as environmental role models. Employees working under environmentally conscious leaders are more likely to develop a psychological attachment toward environmental protection and sustainability objectives.

Similarly, Green Leadership was found to significantly influence Organizational Learning. This result indicates that green leaders encourage knowledge sharing, environmental awareness, and continuous learning, which enhance an organization's ability to acquire and utilize sustainability-related knowledge. The finding aligns with the organizational learning perspective proposed by Senge (1990), emphasizing the importance of leadership in creating learning-oriented organizations.

Environmental Commitment and Organizational Learning both demonstrated significant positive effects on Sustainable Innovation Practices. Employees who are committed to environmental sustainability are more likely to support innovative environmental initiatives, while organizations with strong learning capabilities are better equipped to develop and implement sustainable solutions.

The mediation analysis further revealed that Environmental Commitment and Organizational Learning partially mediate the relationship between Green Leadership and Sustainable Innovation Practices. The significant sequential mediation effect suggests that green leaders first strengthen employees' environmental commitment, which subsequently enhances organizational learning capabilities and ultimately promotes sustainable innovation. These findings provide empirical evidence for the integrated role of psychological and organizational mechanisms in achieving sustainability objectives.

Overall, the findings support the Resource-Based View (RBV), Natural Resource-Based View (NRBV), and Social Learning Theory by demonstrating that leadership, employee commitment, and organizational learning collectively contribute to sustainable innovation and competitive advantage.

Findings of the Study

The major findings of the study are summarized as follows:

1. Green Leadership has a significant positive impact on Sustainable Innovation Practices.
2. Green Leadership significantly enhances Environmental Commitment among employees.
3. Green Leadership positively influences Organizational Learning.
4. Environmental Commitment significantly contributes to Sustainable Innovation Practices.
5. Organizational Learning significantly improves Sustainable Innovation Practices.
6. Environmental Commitment partially mediates the relationship between Green Leadership and Sustainable Innovation Practices.
7. Organizational Learning partially mediates the relationship between Green Leadership and Sustainable Innovation Practices.
8. Environmental Commitment positively influences Organizational Learning.
9. Environmental Commitment and Organizational Learning jointly provide a significant sequential mediation effect between Green Leadership and Sustainable Innovation Practices.
10. The proposed model demonstrates moderate-to-strong explanatory power in predicting Sustainable Innovation Practices.

Conclusion

The present study contributes to the growing body of sustainability and leadership literature by examining the role of Green Leadership in promoting Sustainable Innovation Practices through Environmental Commitment and Organizational Learning. The findings confirm that Green Leadership serves as a critical driver of organizational sustainability by encouraging environmentally responsible behaviors, strengthening employee commitment toward environmental goals, and fostering organizational learning capabilities.

The study demonstrates that sustainable innovation is not solely dependent on technological advancement but also relies on leadership practices that cultivate supportive organizational cultures and environmentally conscious employees. Environmental Commitment and Organizational Learning were identified as important mechanisms through which Green Leadership influences innovation outcomes.

The results suggest that organizations seeking long-term sustainability and competitive advantage should prioritize the development of green leadership competencies, environmental awareness programs, and knowledge-sharing systems. By integrating leadership, commitment, and learning processes,

organizations can enhance their capacity to develop innovative solutions that address environmental challenges while improving organizational performance.

Therefore, Green Leadership can be regarded as a strategic organizational capability that promotes sustainable innovation and supports the achievement of environmental, social, and economic sustainability objectives.

Practical Implications and Suggestions

Based on the findings, the following recommendations are proposed:

For Organizational Leaders

- Integrate environmental sustainability into organizational vision, mission, and strategic objectives.
- Demonstrate environmentally responsible behaviors to encourage employee participation in sustainability initiatives.
- Establish green leadership development programs to enhance managers' sustainability competencies.

For Human Resource Management

- Incorporate environmental values into recruitment, training, and performance appraisal systems.
- Reward and recognize employees who actively contribute to sustainability and innovation initiatives.
- Provide environmental awareness training to strengthen employee commitment toward sustainability goals.

For Organizational Development

- Promote a learning-oriented culture that encourages knowledge sharing and environmental learning.
- Invest in sustainability-related training programs and innovation workshops.
- Establish cross-functional teams to facilitate sustainable innovation projects.

For Policy Makers

- Encourage organizations to adopt sustainability-focused leadership practices through incentives and policy support.
- Develop guidelines and frameworks that promote sustainable innovation and environmental responsibility within industries.

Limitations of the Study

Despite its contributions, the study has several limitations:

1. The study employs a cross-sectional research design, which limits the ability to establish causal relationships among variables.
2. Data were collected using self-reported questionnaires, which may introduce common method bias and social desirability bias.
3. The study focuses on a specific organizational or industrial context, limiting the generalizability of the findings to other sectors or regions.
4. Only Environmental Commitment and Organizational Learning were examined as mediating variables; other potential mediators such as green organizational culture, environmental self-efficacy, and green creativity were not included.
5. The study primarily investigates direct and mediating effects and does not examine potential moderating variables such as organizational size, environmental regulations, or industry characteristics.
6. The use of PLS-SEM provides strong predictive capability but may not capture all complexities associated with sustainability-related organizational phenomena.

Future Research Directions

Future studies may consider the following areas:

1. Conduct longitudinal studies to better understand causal relationships among Green Leadership, Environmental Commitment, Organizational Learning, and Sustainable Innovation Practices.

2. Examine additional mediating variables such as green organizational culture, environmental passion, green creativity, and environmental self-efficacy.
3. Investigate moderating factors including organizational size, industry type, environmental regulations, and technological capability.
4. Extend the model to different industries and countries to improve generalizability.
5. Compare the effects of Green Leadership with other leadership styles such as transformational, ethical, servant, and sustainable leadership.
6. Employ mixed-method or qualitative approaches to gain deeper insights into sustainability-oriented leadership and innovation processes.
7. Explore the impact of Green Leadership on broader sustainability outcomes such as environmental performance, ESG performance, organizational resilience, and corporate sustainability.

These recommendations provide a foundation for advancing future research on sustainable leadership and innovation while contributing to the achievement of organizational sustainability goals.

References

Adams, R., Jeanrenaud, S., Bessant, J., Denyer, D., & Overy, P. (2016). Sustainability-oriented innovation: A systematic review. International Journal of Management Reviews, 18(2), 180–205. https://doi.org/10.1111/ijmr.12068

Afsar, B., Badir, Y. F., & Kiani, U. S. (2016). Linking spiritual leadership and employee pro-environmental behavior: The influence of workplace spirituality, intrinsic motivation, and environmental passion. Journal of Environmental Psychology, 45, 79–88. https://doi.org/10.1016/j.jenvp.2015.11.011

Aggarwal, P., & Agarwala, T. (2021). Relationship of green human resource management with environmental performance: Mediating effect of employee green behavior. Benchmarking: An International Journal, 28(4), 1172–1190.

Albort-Morant, G., Leal-Rodríguez, A. L., Fernández-Rodríguez, V., & Ariza-Montes, A. (2018). Assessing the origins, evolution and prospects of the literature on dynamic capabilities. European Research on Management and Business Economics, 24(1), 42–52.

Ali, M., Zhang, L., Shah, S. J., Khan, S., & Ullah, R. (2021). Linking green HRM practices and green innovation through organizational learning capability. Sustainability, 13(5), 2733. https://doi.org/10.3390/su13052733

Argote, L. (2013). Organizational learning: Creating, retaining and transferring knowledge (2nd ed.). Springer.

Aragón-Correa, J. A., Marcus, A. A., & Hurtado-Torres, N. (2018). The natural resource-based view and organizational learning. Organization & Environment, 31(2), 123–145.

Bandura, A. (1977). Social learning theory. Prentice Hall.

Begum, A., Ashfaq, M., Xia, E., & Awan, U. (2022). Does green transformational leadership lead to green innovation? The role of green thinking and creative process engagement. Business Strategy and the Environment, 31(1), 580–597. https://doi.org/10.1002/bse.2911

Berson, Y., Nemanich, L. A., Waldman, D. A., Galvin, B. M., & Keller, R. T. (2006). Leadership and organizational learning: A multiple levels perspective. The Leadership Quarterly, 17(6), 577–594. https://doi.org/10.1016/j.leaqua.2006.10.003

Calantone, R. J., Cavusgil, S. T., & Zhao, Y. (2002). Learning orientation, firm innovation capability, and firm performance. Industrial Marketing Management, 31(6), 515–524.

Centobelli, P., Cerchione, R., Del Vecchio, P., & Oropallo, E. (2022). Managing knowledge for sustainable innovation. Journal of Knowledge Management, 26(7), 1801–1824.

Chen, Y. S., Chang, C. H., & Lin, Y. H. (2022). Green transformational leadership and green performance: The mediation effects of green innovation. Corporate Social Responsibility and Environmental Management, 29(3), 785–799.

Cui, R., Wang, J., & Zhou, C. (2023). Exploring the linkages of green transformational leadership, organizational green learning, and radical green innovation. Business Strategy and the Environment, 32(1), 185–199. https://doi.org/10.1002/bse.3124

Dangelico, R. M., Pujari, D., & Pontrandolfo, P. (2017). Green product innovation and firm performance. Business Strategy and the Environment, 26(4), 457–475.

Dumont, J., Shen, J., & Deng, X. (2017). Effects of green HRM practices on employee workplace green behavior. Human Resource Management, 56(4), 613–627.

Farooq, R., Zhang, Z., Talwar, S., & Dhir, A. (2022). Green leadership and organizational sustainability: The role of employee environmental commitment. Business Strategy and the Environment, 31(8), 3874–3888.

Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2020). The circular economy: A new sustainability paradigm? Journal of Cleaner Production, 143, 757–768.

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. Strategic Management Journal, 17(Winter Special Issue), 109–122.

Graves, L. M., Sarkis, J., & Zhu, Q. (2019). How transformational leadership and employee motivation combine to predict employee pro-environmental behaviors. Journal of Environmental Psychology, 61, 20–30.

Hart, S. L. (1995). A natural-resource-based view of the firm. Academy of Management Review, 20(4), 986–1014.

Imam, H., & Astini, R. (2022). Green transformational leadership, organizational learning and public sector performance. International Journal of Public Administration, 45(12), 923–937.

Jabbour, C. J. C., Seuring, S., de Sousa Jabbour, A. B. L., & Jugend, D. (2020). Green innovation and environmental management systems. Business Strategy and the Environment, 29(8), 3202–3217.

Khan, P. A., Johl, S. K., & Akhtar, S. (2021). Green innovation and environmental performance: A systematic review. Environmental Science and Pollution Research, 28(39), 55574–55594.

Khan, P. A., Johl, S. K., & Akhtar, S. (2022). Organizational learning and sustainable innovation performance. Sustainability, 14(3), 1528.

Kim, A., Kim, Y., Han, K., Jackson, S. E., & Ployhart, R. E. (2019). Multilevel influences on voluntary workplace green behavior. Journal of Management, 45(2), 592–614.

Lin, W., Ma, J., & Wang, L. (2022). Green transformational leadership and sustainability performance: The mediating role of organizational citizenship behavior toward the environment. Sustainability, 14(5), 2748.

Mittal, S., & Dhar, R. L. (2016). Transformational leadership and employee creativity. Management Decision, 54(4), 894–910.

Paille, P., Chen, Y., Boiral, O., & Jin, J. (2014). The impact of human resource management on environmental performance. Journal of Business Ethics, 121(3), 451–466.

Pham, N. T., Tučková, Z., & Jabbour, C. J. C. (2020). Greening the hospitality industry: Green HRM and environmental performance. International Journal of Hospitality Management, 88, 102392.

Pham, N. T., Nguyen, H. T., & Jabbour, C. J. C. (2025). Transformational leadership, sustainability innovation, and green organizational performance. Journal of Cleaner Production, 456, 141021.

Raineri, N., & Paille, P. (2016). Linking corporate policy and supervisory support with environmental citizenship behaviors. Journal of Business Ethics, 137(1), 129–148.

Robertson, J. L., & Barling, J. (2013). Greening organizations through leaders' influence on employees' pro-environmental behaviors. Journal of Organizational Behavior, 34(2), 176–194.

Senge, P. M. (1990). The fifth discipline: The art and practice of the learning organization. Doubleday.

Shahriari, M., & Allameh, S. M. (2020). Green organizational culture and sustainability performance. Corporate Social Responsibility and Environmental Management, 27(6), 2903–2915.

Singh, S. K., Del Giudice, M., Chierici, R., & Graziano, D. (2020). Green innovation and environmental performance: The role of green transformational leadership and green human resource management. Technological Forecasting and Social Change, 150, 119762.

Sun, P. Y. T., & Anderson, M. H. (2012). The combined influence of top and middle management leadership styles on absorptive capacity. Management Learning, 43(1), 25–51.

Vera, D., & Crossan, M. (2004). Strategic leadership and organizational learning. Academy of Management Review, 29(2), 222–240.

Waldman, D. A., & Siegel, D. (2008). Defining the socially responsible leader. Leadership Quarterly, 19(1), 117–131.

Wang, J., Xue, Y., & Yang, J. (2020). Boundary-spanning search and firms' green innovation. Business Strategy and the Environment, 29(2), 361–374.

Wang, S., Li, J., & Zhao, D. (2018). Institutional pressures and environmental management practices. Business Strategy and the Environment, 27(1), 52–69.

Xie, X., Huo, J., & Zou, H. (2019). Green process innovation and financial performance. Journal of Cleaner Production, 230, 1042–1051.

Yang, D., Crawford, J., Daugaard, D., & Jia, J. (2025). Environmentally sustainable leadership: A systematic literature review and future research agenda. Journal of Management & Organization. https://doi.org/10.1177/03128962251350335

Zhang, Y., Luo, Y., Zhang, X., & Zhao, J. (2021). Green organizational culture and green innovation performance. Sustainability, 13(9), 4872.

Azhar, A., & Yang, Q. (2022). Green transformational leadership and sustainability outcomes: A multilevel perspective. Sustainability, 14(18), 11367.

Begum, A., & Swamy, T. N. V. R. L. (2025). Green transformational leadership and sustainable business performance: The mediating role of organizational innovation capabilities and green self-efficacy. Human Resource Development International. https://doi.org/10.1080/13678868.2025.2560485

The empathy-infrastructure gap: Leadership and staff wellbeing in UK secondary special schools

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Keywords
emotional labour; intersectionality; leadership; special schools; staff wellbeing; United Kingdom

Abstract

UK secondary special schools face a structural wellbeing crisis that existing leadership frameworks have not adequately addressed. This empirical study investigates how leadership practices contribute to that crisis, introducing the Empathy-Infrastructure Gap: the organisational condition in which leaders express care but institutional systems fail to protect staff against chronic work demands. A sequential mixed-methods design was used, combining a survey of 54 staff with semi-structured interviews involving 12 participants. Findings indicate that over 61 percent of respondents reported daily exhaustion, and cross-tabulation suggested that learning support assistants, agency workers, and neurodivergent staff experienced the highest strain with the least institutional recourse. The study proposes the Emotionally Sustainable Leadership (ESL) framework, integrating emotional labour theory, Conservation of Resources theory, intersectionality, and care ethics. ESL argues that staff wellbeing requires governance commitments rather than cultural gestures alone: protected recovery time, equity-differentiated support, and enforceable accountability structures.

Introduction

At 8:30 am in a London secondary special school, the day begins not with calm but with unspoken tension. Teaching assistants and teachers share glances of solidarity before entering classrooms where unpredictability is not the exception but the operational norm. A 2024 UNISON survey of nearly 8,000 school support staff found that almost half had experienced violent behaviour from a pupil within the past year, with around a quarter facing punching, kicking, or thrown objects on a weekly basis (UNISON, 2024). Most describe their stress as chronic rather than occasional (NEU, 2024). Staff arrive knowing that the child they support may have had no sleep, that communication will be reduced, that a corridor noise on the way in has already unsettled the morning. None of what they absorb in those moments appears in their job titles or their pay.

Policy attention to staff wellbeing in special schools has grown considerably since 2014. Yet the pattern across key milestones is consistent: increasing demands on staff without commensurate structural protection (Hastings et al., 2020; McLean et al., 2017). The 2014 SEND Code of Practice expanded the scope of support without expanding staffing resource (DfE, 2014). The 2021 Ofsted Education Inspection Framework shifted weight toward measurable outcomes while reducing attention to staff experience (Ofsted, 2022). The 2023 DfE Mental Health Initiatives raised institutional expectations around wellbeing without equivalent structural resource (DfE, 2023b). Each milestone generated new responsibilities for staff; none generated enforceable entitlements for the people who carry them.

This study is guided by four research questions, two empirical and two analytical. It addresses two empirical questions: how widespread and intense is emotional strain among special school staff, and how staff experience leadership's influence on their working conditions. It also addresses two analytical questions: which leadership behaviours correlate with better or worse wellbeing outcomes, and what governance framework would more adequately address the gap between expressed care and practical support.

The paper's central conceptual contribution is a structural concept of the gap between leadership empathy and institutional protection. It is specific enough to be operationalised, interrogated, and addressed through governance rather than goodwill alone.

The sustainability of any workforce depends on the sustainability of those who sustain others (Hobfoll, 2001; Maslach and Leiter, 2016). In special schools, that structural dependency has been systematically underaddressed.

Systemic Pressures	Leadership Response	Staff Outcomes
Insufficient funding; increasing pupil complexity and need	Generic wellbeing gestures: emails, CPD sessions, Friday refreshments	Burnout and compassion fatigue (Iszatt-White, 2012)
High emotional burden; safeguarding demands; physical risk	Crisis-focused management; limited post-incident supervision	Secondary trauma; absence and attrition (Figley, 1995)
Workforce inequalities by contract type, race, neurodivergence	Unrecognised differential burden; uniform provision applied equally to all	Compounded depletion (Collins, 2015; Crenshaw, 1991)

Table 1: Logic Model. Pathways from Systemic Pressures to Staff Outcomes. Source: Author, informed by Iszatt-White (2012).

Literature Review: Theoretical and Policy Context

Mainstream Leadership Models: Elegant Promises, Structural Limits

Education policy documents present leadership through a vocabulary of vision, empowerment, and empathy. In theory, these approaches should suit special education's complexity. In practice, their limitations are amplified when applied in UK secondary special schools, where emotional volatility is an ever-present operational condition rather than an occasional challenge. Three models dominate the literature. Each has genuine value; each carries a structural gap that this study's framework addresses directly. Transformational leadership (Bass and Avolio, 1994) builds collective purpose and can help staff sustain effort under regulatory pressure. The limitation is structural rather than relational: without explicit recovery provisions, the model can inadvertently conflate endurance with commitment, so that visible competence obscures progressive depletion beneath.

Distributed leadership (Spillane, 2006) reduces hierarchical load by sharing decision-making across teams. The structural limitation is that sharing responsibility without sharing the resources to act on those decisions distributes strain rather than reducing it. Shared accountability, in the absence of shared resources, can become shared exhaustion.

Emotionally intelligent leadership (Goleman et al., 2013) develops relational sensitivity in individual leaders. Its structural limitation is equally clear: protection that depends on who holds a post offers no institutional guarantee. When a caring headteacher leaves, the protection associated with their approach leaves with them. The argument here is not that emotional intelligence lacks value. It is that emotional intelligence must be embedded in governance structures rather than vested in individual personalities; otherwise, it is a feature of a person, not a property of a system.

Emotional Labour: The Mask with Bite Marks Underneath

Hochschild (1983) defines emotional labour as the management of one's own feelings to meet occupational expectations. In secondary special schools, this demand is not occasional; it is the operational constant beneath every other task. A student's elevated voice, clenched fist, or abrupt silence can each signal an imminent violent incident. Staff read those signals continuously, regulate their own responses, and continue to work immediately after crises as well as during them.

The lived reality is most honestly understood through the voices of those who carry it.

One teaching assistant recalled smiling and using Picture Exchange Communication System (PECS) cards to encourage communication moments after being bitten hard enough to break the skin and bleed. Another described crying in a stockroom after a violent incident, then returning to playground duty within two minutes and keeping the pain and exhaustion hidden beneath a neutral expression (Interviewee 5). These accounts are not exceptional. They are the occupational normality.

"Some days, teaching assistants go home covered in bites and bruises, completely exhausted after several de-escalations. But the hardest part is not the pain; it is feeling like leadership does not see your effort. On a normal day, you do not have time to cry or recover. You wash your hands, put on a smile, and walk back in class." (Interviewee 2)

Hobfoll's (2001) Conservation of Resources theory explains the cumulative trajectory: when resource expenditure consistently exceeds recovery opportunity, depletion is progressive and does not self-correct without structural intervention. Sharrocks (2020) describes the institutional consequence as the 'silent extraction of caring': organisations benefit from the invisible emotional work of their staff while offering limited reciprocal care or formalised recovery.

The Job Demands-Resources model (Demerouti et al., 2001) offers useful diagnostic vocabulary but has a documented limitation here: it does not differentiate between types of demand. Classifying crisis management, intimate personal care, and administrative tasks within the same generic category does not capture the qualitative weight of emotional labour in special schools. It also does not account for differential resource access across staff groups which intersectionality addresses directly.

Intersectionality: Whose Burdens Count and Whose Voices Are Recognised

Crenshaw (1991) and Collins (2015) identify how overlapping structural factors compound one another in ways that aggregated data does not capture. In secondary special schools, emotional burden is not uniformly distributed. It is shaped by contract type, role, race, and neurodivergence, producing qualitatively different workloads, specifically workloads that standard wellbeing instruments neither measure nor address (Howard and Navarro, 2016).

Staff Group	Nature of Emotional Demand	Institutional Visibility	Risk Where Unsupported
White, neurotypical senior staff	Moderate; episodic	High	Compassion fatigue over extended tenure
Black and minoritised staff	High; includes racialised identity management alongside direct care demands	Low	Compound suppression; increased attrition risk
Neurodivergent staff	High; includes sensory processing demands in environments not designed for staff needs	Low	Masking-related depletion; non-disclosure risk
Casual or agency staff	High; compounded by employment insecurity and absence of equivalent entitlements	Very low	Rapid turnover; moral injury; no recovery provision (Figley, 1995)

Table 2: Differential Distribution of Emotional Labour by Staff Group. Source: Author, synthesis based on Howard and Navarro (2016) and Crenshaw (1991).

These differentials are structural rather than incidental. Equity audits, disaggregated by role, contract type, and demographic characteristics are the mechanism through which they become visible and addressable. Without such disaggregation, wellbeing initiatives reach those who need them least and systematically miss those who need them most.

Wellbeing Initiatives: From Symbolic Gesture to Structural Care

In numerous UK secondary special schools, staff wellbeing provision takes forms that Sharrocks (2020) characterises as 'wellbeing theatre': displays of care through performance that conceal the absence of meaningful institutional support. The data in this study confirmed that staff distinguished clearly between symbolic gestures and structural change and that only the latter produced durable wellbeing outcomes.

Approach	Cost to School	Short-term Effect	Sustained Impact
Informal gestures: biscuits, positive emails, cards	Low	Temporary morale lift	Negligible; may reinforce cynicism when workloads unchanged
Team-Teach refresher training	Medium	Practical skill reinforcement	Moderate; does not address emotional aftermath of incidents

Timetabled peer-support sessions with facilitation	Medium	Reduced isolation; shared processing	High where sustained and properly resourced
Trauma-informed supervision by qualified practitioners	Medium-High	Professional processing of incidents	High; addresses source of emotional depletion
Funded psychological support without career penalty	Higher	Access to specialist mental health care	High; reaches staff who cannot access support within school culture

Table 3: Symbolic Versus Structural Approaches to Staff Wellbeing. Source: Author.

The distinction matters beyond effectiveness. Symbolic provision can reinforce cynicism when staff observe that expressions of care do not alter workloads, produce debriefs, or protect contracts. As one participant noted, wellbeing policies were 'announced in September and abandoned by October.' This finding is consistent with Sharrocks (2020) and with the broader literature on performative institutional care.

Methodology

Design and Philosophical Positioning

A sequential mixed-methods design was adopted, consistent with an interpretivist-pragmatist philosophical position (Saunders et al., 2012). Interpretivism recognises that staff experiences of emotional labour and leadership cannot be adequately captured by numerical data alone; they are shaped by context, power, and relationship. Pragmatism ensures that those insights are directed toward actionable findings rather than remaining purely descriptive (Biesta, 2010). The two phases were designed to work in sequence: survey patterns guided interview questions, and interview data challenged and deepened the interpretation of what the survey numbers showed.

Quantitative Phase

The survey was completed by 54 staff across UK secondary special schools, rated on a five-point Likert scale across six leadership dimensions and four wellbeing indicators. Items drew on established measures aligned to the JD-R model (Bakker and Demerouti, 2007), emotional labour theory (Hochschild, 1983), and intersectionality (Crenshaw, 1991). Recruitment was peer-to-peer through professional networks, deliberately avoiding institutional gatekeepers. In settings where raising concerns can carry employment consequences, any sampling route through management channels introduces self-selection bias toward those who feel relatively safe to participate.

The resulting sample was weighted toward learning support assistants, reflecting both their greater representation in special school frontline roles and their greater willingness to participate through peer networks rather than official channels. This weighting is analytically significant: the data are richest precisely where the burden is heaviest, which serves the intersectional aims of the study even as it limits representational breadth.

Qualitative Phase

Twelve participants were selected using purposive sampling to ensure representation across role type, contract status, ethnicity, and experience. Semi-structured interviews were conducted remotely, recorded, transcribed verbatim, and analysed using reflexive thematic analysis (Braun and Clarke, 2006). An intersectionality lens was maintained throughout coding. Ethical approval was obtained in accordance with BERA (2018) guidelines, with particular attention to anonymity, the right to withdraw, and participant wellbeing during the interview process.

"You promise no one will ever know I said this?", voice trembling before the interview began. (Interviewee 2)

Trust was not assumed; it was built through peer networks, plain language, and unambiguous assurances that management would have no access to participant data. The researcher's background as a practitioner in special schools in both London and Moldova shaped both the design and the quality of access achieved. At one point during analysis, a pattern in the interview transcripts mirrored the researcher's own experience closely enough to require explicit interrogation; this was documented in the

reflective journal and reviewed with the supervisor to ensure that interpretation remained grounded in the data rather than shaped by personal memory (Braun and Clarke, 2006). Researcher positionality was acknowledged and managed throughout via reflective journaling and peer debriefing (Cohen, Manion and Morrison, 2018).

Methodological Credibility and Reflexivity

Every decision in coding, theme development, and interpretation was documented to allow the logic of the analysis to be followed and evaluated independently (Cohen et al., 2018). Where disclosure was refused, that refusal is itself analytically significant: it reflects the power relations this study examines, and the silence it produces is a finding in its own right.

Findings

The Scale and Distribution of Emotional Strain

Analysis of the survey data as a whole reveals a consistent pattern: staff were operating under considerable emotional pressure and relying primarily on peer support as a buffer. Over 61 percent of respondents agreed or strongly agreed that they felt exhausted at the end of each working day. Four wellbeing indicators were measured: emotional exhaustion, peer support, work-life balance, and emotional safety. Peer support scored highest across all groups, suggesting that collegial relationships function as the primary available buffer. Work-life balance and emotional safety scored lowest, with emotional safety particularly low among agency and supply staff.

Cross-tabulation of years of experience and role type against wellbeing scores revealed a consistent pattern: outcomes did not improve with longer tenure or more senior role for frontline support staff. An LSA with ten years of experience reported as low a sense of safety as one starting their second year. This is consistent with JD-R predictions for groups where demands persistently exceed available resources (Bakker and Demerouti, 2007), and with what Conservation of Resources theory would predict for cumulative depletion without recovery provision.

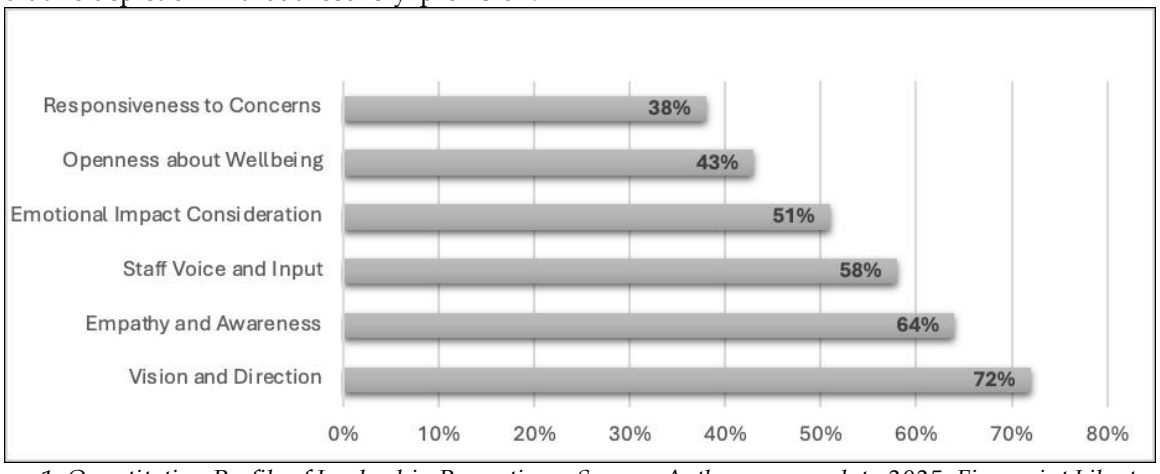


Figure 1: Quantitative Profile of Leadership Perceptions. Source: Author, survey data 2025. Five-point Likert scale; figures represent percentage of respondents selecting 'agree' or 'strongly agree'.

The profile in Figure 1 reveals a structural pattern: relational dimensions of leadership, empathy and vision are rated substantially higher than structural ones like openness and responsiveness. That 34-percentage-point gap between Vision (72%) and Responsiveness to Concerns (38%) is the quantitative signature of the disconnect between leadership disposition and organisational design that this paper examines.

The Empathy-Safety Paradox

The survey data produced a structural contradiction within the same workforce. Vision and direction scored highest at 72 percent positive. Empathy and awareness scored 64 percent. Yet Responsiveness to

Concerns, the lowest-scoring dimension in Figure 1, stood at just 38 percent. These findings coexist in the same schools, among the same staff, within the same leadership relationships.

"Leadership talks about wellbeing, but our workload never changes." (Interviewee 9)

"If you talk about how challenging it is, you worry about losing shifts. Most staff stay quiet and just accept." (Interviewee 6)

A school can have leaders who are genuinely experienced as caring and directionally clear, while simultaneously producing conditions in which staff self-censor (Maslach and Leiter, 2016; Kutsyuruba et al., 2019). This is what the gap looks like from the inside. Empathy expressed in morning check-ins does not, in itself, protect a teaching assistant during a violent incident with no cover available and no debrief to follow.

The Intersectional Cost of Care

Cross-tabulation of contract type, role demands, and identity factors indicated that strain exceeded what any single variable would predict. Learning support assistants and agency workers reported the lowest scores on leadership empathy and emotional safety regardless of experience level. The following accounts were shared with explicit consent for anonymised publication.

"I was not thinking about my ribs. I was thinking: if I cry, will they think I cannot cope? Or worse, will they see me as the 'angry Black woman'?" (Interviewee 1)

This account captures two simultaneous and qualitatively distinct demands: the immediate physical and emotional response to being struck by a pupil, and the secondary management of how that response will be perceived through racialised interpretive frames. Howard and Navarro (2016) describe this as the compound labour of racialised professional identity. Standard wellbeing instruments do not measure the second demand. Standard provisions do not address it.

"I have not told anyone I am autistic. Because I have seen what happens, the assumptions people make. So I mask all day. And then I come home and I am completely empty." (Interviewee 3)

"If we speak up, we are replaceable." (Interviewee 10)

Each account reflects a different structural pathway to the same outcome: disproportionate depletion among those with the fewest organisational protections. Provision that is applied uniformly, and therefore equally available to all, does not reach these groups proportionally. The data indicate that targeted, intersectionally-informed provision is not an optional enhancement but a basic equity requirement.

The Fragility of Peer Support

Peer support emerged as the highest-scoring wellbeing resource in the survey. The interviews clarified why this reflected structural absence as much as collegial strength.

"We lean on each other, but it is like passing the same stress around." (Interviewee 4)

Where peer support is the primary available resource, it eventually functions as a demand rather than a buffer (Bakker and Demerouti, 2007). Sims (2020) describes this as distributed depletion. The data indicate this is not simply a limitation of peer solidarity but a predictable outcome when institutional alternatives are absent. Formalising peer support with professional facilitation and clear escalation routes would preserve its protective function without requiring colleagues to absorb each other's unprocessed trauma.

PROTECTIVE FUNCTION	LIMITATION UNDER STRUCTURAL ABSENCE
Reduces isolation; maintains daily motivation	Stress transfers between colleagues when no institutional outlet exists
Informal post-incident processing	Becomes the only available debrief; not equipped for complex trauma
Sustains collective professional identity	Can produce distributed depletion (Sims, 2020) when solidarity substitutes for support
Trust-based disclosure networks	Fragile under employment pressure; breaks unevenly across contract types

Table 4: Peer Support as Protective Resource and Structural Limitation. Source: Author, interview data 2025.

Discussion

The Gap Between Care and Protection

Across both data phases, the primary pattern in poor wellbeing outcomes is structural rather than relational. This matters analytically because it redirects the policy response. If poor wellbeing were primarily a relational problem in which leaders lack empathy or commitment, the solution would be leadership development. The data do not support that framing. Leaders in this sample were experienced as empathic and directionally clear. What staff reported as absent was institutional capacity to translate that disposition into changed working conditions: different timetables, mandatory debriefs, secure contracts.

The concept introduced in this paper to name that condition is the Empathy-Infrastructure Gap: it locates the problem in governance design rather than in individual leadership character. A leader may be genuinely caring and still preside over a system that offers no post-incident recovery time, no mandatory debrief, and no equivalent entitlements for agency staff performing identical work to permanent colleagues. The gap is not primarily a failure of leadership intention. It is a failure of governance architecture.

Constrained Leadership and Multilevel Failure

It is important to resist an oversimplified reading of this pattern. The data do not suggest that institutions cynically perform care while knowingly withholding protection. The picture is considerably more complex than such an account would suggest. Leaders are themselves often constrained: funding gaps, Ofsted compliance cycles, local authority reporting requirements, and statutory SEND obligations limit what can be unilaterally redesigned at school level. Many of the leaders whose staff reported unmet needs were themselves operating without the structural backing they needed to act on what they could see.

The data point toward a multilevel structural failure rather than a school-level failure of intent (Harris, 2008; Day, Gu and Sammons, 2016). Closing the gap requires action simultaneously within schools, through governance commitments and leadership practice; at local authority level, through monitoring and accountability; and at national policy level, through enforceable standards rather than guidance alone. The 34-percentage-point difference between Vision and Responsiveness visible in Figure 1 is not a school-level problem with a school-level solution. It reflects a governance architecture that has placed relational competence in the foreground while leaving structural protection in the discretionary background.

ESL is designed to change that architecture, not to reproach the individuals working within it.

The ESL Framework

The Emotionally Sustainable Leadership framework provides a governance-level response built directly from the data. It does not replace existing leadership models but extends them by making governance-level accountability for staff wellbeing non-discretionary.

The first pillar: Emotional Labour as Primary Demand reclassifies trauma exposure, crisis management, and intimate personal care as core, measurable job demands rather than incidental features of the role. In practice, mandatory post-incident debriefs become timetabled operational requirements, not optional gestures. Recovery time following violent or emotionally distressing incidents is scheduled into the working day. Cumulative exposure is monitored through distress logs, enabling early intervention before depletion becomes entrenched. The evidential foundation is the finding that 61 percent of staff reported daily exhaustion with no improvement across years of experience, confirming a structural rather than individual pattern (Bakker and Demerouti, 2007; Hobfoll, 2001).

The second pillar: Intersectional Equity addresses the differential burden that aggregated wellbeing data consistently fails to capture. Annual equity audits, disaggregated by role, contract type, disability, and ethnicity, become the governance mechanism through which invisible workloads are made visible and addressable. Resource allocation is proportional to burden rather than uniform: agency staff, neurodivergent practitioners, and racially minoritised staff receive targeted provisions rather than a standard offer applied equally to all. The cross-tabulation findings, showing that strain exceeded what

any single variable predicted, and that standard instruments neither measure nor address compound labour, provide the evidential foundation (Crenshaw, 1991; Howard and Navarro, 2016).

The third pillar: Ethical Infrastructure moves accountability from individual discretion to institutional design. Contractual entitlements to recovery time and psychological support apply equally to all staff regardless of contract type, closing the gap between permanent and agency workers performing identical roles. Funded psychological support is provided without career penalty, addressing the finding that staff self-censor about distress for fear of professional consequences. Governance frameworks embed enforceable standards rather than aspirational guidance, ensuring that when a caring leader leaves, the protections associated with their approach do not leave with them. This pillar responds directly to the 38 percent responsiveness score, the lowest of all measured dimensions (Kutsyuruba et al., 2019; Sharrocks, 2020).

Gap in Existing Frameworks	ESL Response
Emotional labour treated as incidental rather than a primary demand category	Classifies emotional labour as a core measurable demand; triggers mandatory timetabled support provisions including debriefs and workload adjustments
Differential burdens across staff groups remain unmonitored and unaddressed	Annual equity audits disaggregated by role, contract type, disability, and ethnicity; targeted redistribution proportional to burden rather than uniform
Recovery from high-demand incidents depends on individual coping	Post-incident recovery built into schedules; debriefs mandatory; distress logs inform cumulative exposure monitoring
Ethical accountability rests on individual leadership discretion	Accountability frameworks embedded in governance with enforceable standards and contractual entitlements for all staff including agency workers

Table 5: Structural Gaps in Existing Models and the ESL Response. Source: Author, synthesis based on Crenshaw (1991), Hobfoll (2001), and Demerouti et al. (2001).

Originality and Contribution

Conceptually, the Empathy-Infrastructure Gap names a structural condition rather than a leadership personality deficit. That analytical precision matters: it locates the problem in governance design, making institutional rather than individual interventions the appropriate response. The concept is sufficiently specific to be operationalised and tested in future research, including in other high-demand care environments beyond special education.

Theoretically, the ESL framework integrates emotional labour theory (Hochschild, 1983), Conservation of Resources theory (Hobfoll, 2001), intersectionality (Crenshaw, 1991; Collins, 2015), and care ethics (Noddings, 2013) into a single governance model. Each has prior application in educational research. Their synthesis into an operational framework with defined audit and accountability mechanisms represents a conceptual extension of the existing literature rather than a wholly unprecedented departure from it.

Empirically, the study centres staff groups that wellbeing research has largely overlooked: learning support assistants, agency workers, neurodivergent practitioners, and racially minoritised staff. Trust-based peer recruitment reached participants that institutional sampling methods would not have accessed (Roffey, 2012). The findings document not only what staff experience but the structural conditions that suppress disclosure, including the refusals and silences that are themselves empirically significant.

Implications for Policy, Practice, and Research

For Policy

Current DfE guidance and Ofsted inspection frameworks treat staff wellbeing primarily as a school-level cultural responsibility. The findings suggest that without enforceable structural requirements, provision is likely to remain uneven and insufficiently targeted. Three policy directions are indicated by the data: equivalent wellbeing entitlements for agency and supply staff performing equivalent roles; mandatory post-incident debrief as a timetabled provision; and funded psychological support as a statutory rather than discretionary resource.

Year	Policy or Report	Effect on Staff Emotional Demands
2014	SEND Code of Practice	Increased documentation and administrative workload without corresponding staffing increases
2019	Timpson Review on Exclusions	Drew attention to SEN-related exclusions and staff strain; no binding structural response for frontline wellbeing
2021	Ofsted EIF Revisions	Shifted inspection weight toward measurable outcomes; reduced attention to staff experience
2023	DfE Mental Health Initiatives	Raised institutional expectations around wellbeing without commensurate structural resource

Table 6: Key Policy Milestones and Their Effect on Staff Emotional Labour. Source: Author.

The pattern in Table 6 is the policy-level manifestation of the gap this paper examines: good intentions, consistently expressed, without the governance architecture to convert them into structural protection. Each milestone increased what is expected of staff; none enforceably increased what is provided for them.

For School Leadership Development

Leadership training in the special education sector should develop structural analysis alongside relational competency. Current programmes equip leaders with empathy and vision. The data suggest that empathy and vision, deployed without governance-level accountability, can produce rather than close the gap between expressed care and experienced protection. Programmes should address the distinction between empathic leadership and structural protection, equip leaders to conduct intersectional workload analysis, and provide tools for monitoring wellbeing outcomes by staff group rather than in aggregate.

Limitations and Future Research

This study has several limitations that inform the direction of future research. The non-probability sampling method, through peer networks, constrains statistical generalisation; the findings are exploratory and theoretically generative rather than conclusive. Staff who felt too exposed to participate are likely absent from the data, meaning the emotional burden documented here may underrepresent the most severe cases. The cross-sectional design cannot establish causal direction, and the sample's geographic concentration in London limits transferability to other UK regions.

Future research should replicate this study with larger, more geographically diverse, and probabilistically sampled populations to strengthen the evidence base. Longitudinal designs are needed to assess whether governance changes produce durable wellbeing improvements over time. The Empathy-Infrastructure Gap concept and the ESL framework are also potentially transferable to other high-demand care environments, including early years settings, adult social care, and emergency services, where comparable patterns of invisible depletion may operate. Future studies in comparably power-laden settings might also consider trust-based peer recruitment as a principled methodological choice rather than a compromise.

Recommendations for Action

The findings indicate that staff wellbeing cannot be adequately protected by goodwill or symbolic gesture alone. Five governance-level actions are indicated by the data.

Recommendation	Required Action	Evidential Basis
1. Formalise Peer Support	Timetable supervised sessions with qualified facilitators; establish escalation routes beyond peer-level support	Over 61 percent daily exhaustion; peer support as primary buffer produces distributed depletion without formal structure (Sims, 2020; Bakker and Demerouti, 2007)
2. Trauma-Informed Line Management	Embed Bath's (2015) three pillars: safety, connections, managing emotions, into line management training and practice standards	Empathy scored 64% but responsiveness to concerns scored 38%, the lowest of all measured dimensions; expressed care without structural response becomes performative (Sharrocks, 2020)
3. Intersectional Equity Audits	Annual audits of wellbeing, workload, and support access, disaggregated by role, contract type, ethnicity, and disability	Cross-tabulation confirmed differential burden by contract type and role; uniform provision systematically misses highest-need groups (Crenshaw, 1991)
4. Responsive Accountability Mechanisms	Define timeframes for responding to staff concerns; communicate transparently where structural constraints prevent immediate action	Responsiveness scored 38%, the lowest of all measured dimensions (Kutsyuruba et al., 2019)
5. Contractual Recovery Entitlements for All Staff	Post-incident recovery time and psychological support as contractual rights, applicable equally to agency and supply staff	Agency staff reported lowest emotional safety; COR theory indicates cumulative depletion without structural replenishment (Hobfoll, 2001); current exclusion of agency staff is both inequitable and operationally unsustainable

Table 7: Recommendations for Policy and Practice. Source: Author.

Conclusion

This study began with the image of a teaching assistant returning to class with a smile minutes after being bitten. That image is not exceptional in UK secondary special schools. It is the occupational normality; for too long, it has been treated as the wellbeing strategy.

The findings indicate that over 61 percent of staff experience daily exhaustion, that leaders are experienced as empathic and caring, and that the systems those leaders operate within fail to convert that care into structural protection. The concept introduced here names this condition with analytical precision: it is not a diagnosis of leadership failure, but a diagnosis of governance failure: the absence of the institutional architecture that would allow leadership empathy to produce structural protection rather than performative care.

The ESL framework offers a governance-level response built from the data: classifying emotional labour as a core demand, monitoring differential burden through equity audits, and embedding accountability into policy rather than leaving it to individual discretion. These three pillars are not presented as the final word on how to protect special school staff. They are a theoretically grounded, empirically illustrated starting point: a framework that merits testing, refinement, and scaling.

What the data suggest, consistently and across both phases, is this: staff resilience is not a leadership strategy: it is what staff exercise in the absence of one (Maslach and Leiter, 2016; Worth and Van den Brande, 2022). The evidence indicates that governance frameworks at school, local authority, and national level have not yet provided the structural conditions that the people who care daily for the most vulnerable children both need and deserve.

References

Bakker, A.B. and Demerouti, E. (2007) The Job Demands-Resources model: State of the art. Journal of Managerial Psychology, 22(3), pp.309-328.

Bass, B.M. and Avolio, B.J. (1994) Improving organisational effectiveness through transformational leadership. Thousand Oaks, CA: Sage.

Bath, H. (2015) The three pillars of trauma-informed care. Reclaiming Children and Youth, 23(4), pp.17-21.

BERA (2018) Ethical guidelines for educational research. 4th edn. London: British Educational Research Association.

Biesta, G. (2010) Good education in an age of measurement: Ethics, politics, democracy. Boulder: Paradigm.

Braun, V. and Clarke, V. (2006) Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), pp.77-101.

Cohen, L., Manion, L. and Morrison, K. (2018) Research methods in education. 8th edn. London: Routledge.

Collins, P.H. (2015) Intersectionality's definitional dilemmas. Annual Review of Sociology, 41, pp.1-20.

Crenshaw, K. (1991) Mapping the margins: Intersectionality, identity politics, and violence against women of colour. Stanford Law Review, 43(6), pp.1241-1299.

Day, C., Gu, Q. and Sammons, P. (2016) The impact of leadership on student outcomes: how successful school leaders use transformational and instructional strategies to make a difference. Educational Administration Quarterly, 52(2), pp.221-258.

Demerouti, E., Bakker, A.B., Nachreiner, F. and Schaufeli, W.B. (2001) The Job Demands-Resources model of burnout. Journal of Applied Psychology, 86(3), pp.499-512.

Department for Education (2014) Special educational needs and disability code of practice: 0 to 25 years. London: DfE.

Department for Education (2023b) Working lives of teachers and leaders: Wave 2. London: DfE.

Figley, C.R. (1995) Compassion fatigue: Coping with secondary traumatic stress disorder. New York: Brunner/Mazel.

Goleman, D., Boyatzis, R. and McKee, A. (2013) Primal leadership: Unleashing the power of emotional intelligence. Boston: Harvard Business Review Press.

Harris, A. (2008) Distributed school leadership. London: Routledge.

Hastings, R.P., Hodgetts, A., Banks, R., MacDonald, S., Abbott, D. and Hodge, N. (2020) Staff stress and wellbeing in UK special schools. International Journal of Educational Research, 100, 101540.

Hobfoll, S.E. (2001) The influence of culture, community, and the nested-self in the stress process: Advancing Conservation of Resources theory. Applied Psychology: An International Review, 50(3), pp.337-421.

Hochschild, A.R. (1983) The managed heart: Commercialisation of human feeling. Berkeley: University of California Press.

Howard, J.A. and Navarro, Y. (2016) Critical race theory 20 years later. Equity and Excellence in Education, 49(4), pp.446-463.

Iszatt-White, M. (ed.) (2012) Leadership as Emotional Labour: Management and the 'Managed Heart'. Abingdon: Routledge.

Kutsyuruba, B., Walker, K., Cherkowski, S. and Noonan, B. (2019) The role of psychological safety in effective teams. International Journal of Educational Management, 33(5), pp.1027-1041.

Maslach, C. and Leiter, M.P. (2016) Understanding the burnout experience. World Psychiatry, 15(2), pp.103-111.

McLean, L., Abry, T., Taylor, M., Jimenez, M. and Granger, K. (2017) Teachers' mental health and perceptions of school climate across the transition from training to teaching. Teaching and Teacher Education, 65, pp.230-240.

National Education Union (NEU) (2024) NEU survey on staff workload and stress. London: NEU.

Noddings, N. (2013) Caring: A relational approach to ethics and moral education. 2nd edn. Berkeley: University of California Press.

Ofsted (2022) Teacher wellbeing at work in schools and colleges. Manchester: Ofsted.

Roffey, S. (2012) Pupil wellbeing and the role of school leadership. In: Roffey, S. (ed.) Positive relationships. Dordrecht: Springer, pp.145-162.

Saunders, M., Lewis, P. and Thornhill, A. (2012) Research methods for business students. 6th edn. Harlow: Pearson.

Sharrocks, L. (2020) When wellbeing becomes wellbeing theatre. Journal of Educational Administration and History, 52(1), pp.72-85.

Sims, S. (2020) Leadership for teacher retention in England. Educational Management Administration and Leadership, 48(6), pp.1020-1039.

Spillane, J.P. (2006) Distributed leadership. San Francisco: Jossey-Bass.

UNISON (2024) Verbal abuse and violence are daily issues for one in three school staff. London: UNISON.

Worth, J. and Van den Brande, J. (2022) Teacher well-being and working conditions in England. Slough: NFER.

The influence of instagram marketing on generation Z purchase intentions: A case study of aloe herbal organic skincare in Nepal

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Keywords
Instagram marketing, Generation Z, purchase intention, authenticity, influencer marketing, user-generated content, organic skincare, Nepal, mixed methods, emerging markets

Abstract

The study under consideration delves into Instagram marketing, which has a marked effect on the purchasing intentions of Generation Z people regarding Aloe Herbal Organic Skincare in Nepal. This area is a near-blank space and provides an emerging market for all other literature on social media marketing. The combination used in the methodology for collecting primary data was qualitative and quantitative methods, through structured Likert-scale surveys which had 63 questions given to 71 respondents from Gen Z and semi-structured qualitative interviews conducted with two key informants from the management team of Aloe Herbal.

The data were analysed through Pearson correlation, Multiple regression, and Theme analysis. The composite regression model explained 52.7% of the variance in purchase intention. The most influential predictors were Perceived Authenticity ($\beta = 0.374$, $p = 0.010$; $r = 0.667$, $p < 0.01$), followed by Hashtags and User-Generated Content ($r = 0.564$), Visual Content Quality ($r = 0.495$), and Trust ($r = 0.492$).

Qualitative findings echoed these quant results, which identified authenticity, micro-influencer collaboration, and community-driven UGC as the three most powerful pillars underpinning the Instagram strategy at Aloe Herbal. Eight peer-reviewed secondary sources were thematically analysed additionally to verify the primary findings. Original empirical research has been undertaken in a context geographically and sector ally understudied, with a multi-theoretical framework combined from 6 different theories and practically grounded strategic advice given for organic skincare brands targeting Gen Z consumers of South Asian emerging markets.

Introduction

The advent of social media completely reformed the digital marketing space. In this regard, Instagram has emerged as one of the most fascinating commercial ecosystems in brand communication and product discovery. From 2010, the transformation has moved at a dramatically slow pace for any photo-sharing application up to the 2025 platform with 2 billion monthly active users that Instagram has become (Putra and Afrilian, 2025). What makes it more uniquely effective across the consumer journey is its visual-first framework, high-quality images, short-form Reels, interactive Stories, tools designed for collaborating with influencers, and integrated shopping functions (Menon, 2022).

Generation Z runs from the year 1997-2012. To date, it is the largest cohort using Instagram in the world. 91% of Gen Z is found on the platform, which uses the platform every day for around 45 minutes (Manikonda et al., 2014). Growing up in a super-digitized environment from an early age has resulted in Gen Z consumers displaying no notable distinction between a digital and physical consumption experience (Hussain et al., 2021). That being said, empirical evidence indicates that 85% of product discoveries by Gen Z are on social media, with 49% having made a purchase through Instagram.

Nepal represents an understudied research context but highly relevant. Smartphone penetration has been growing at breakneck speed, accompanied by an apparent rise in Internet use giving great impetus toward growth in digital infrastructure, with the organic skincare market in Nepal forecasted to grow at a CAGR of 10.42% between 2024 and 2029 (Shankar and Paudel, 2024). Aloe Herbal Organic Skincare embodies the meeting point between age-old herbal knowledge specific to Nepal and modern wellness

trends—thus serving as an appropriate case to look into the effectiveness of Instagram Marketing in these emerging markets.

On the other hand, very little empirical research exists in this niche in the peer-reviewed literature, unlike the studies on Instagram marketing and Gen Z consumer behaviour conducted in Western contexts. The research we are going to undertake would consider Gen Z with respect to the association between constructs of Instagram marketing exposure, visual content quality, influencer marketing, and user-generated content with purchase intention of Aloe Herbal in Nepal, while engaging the trust constructs as a proposed mediator.

Research Aim and Objectives

This research sought to examine the effect of Instagram marketing on the purchase intentions of Generation Z with regard to Aloe Herbal Organic Skincare in Nepal. It did this by achieving the following objectives: (1) To establish the relationship between the effectiveness of Instagram marketing and the purchase intention of the Generation Z consumer market in Nepal; (2) Estimate which of the many features of Instagram marketing accounts for the greatest influence on buying behaviour in the Generation Z consumer market when it comes to the consumption of skincare products; (3) Separate how the variables of authenticity and influencer believability affect the Nepalese Consumerist Generation Z in trust and purchase behaviour, relating to skincare; and (4) Proposing some Instagram marketing strategies to Aloe Herbal, which can work effectively in improving engagement and sales to Generation Z.

Literature Review

Instagram Marketing and Generation Z Consumer Behaviour

Instagram is considered one of the most powerful commercial platforms in the academic literature. It is frequently defined as a series of web-based applications which enable users to generate their content and then share it with others. This interactive and bidirectional creation at the heart of Instagram is what makes marketing potential. Kim and Ko (2012) confirmed that social media marketing directly influences brand equity, which in turn affects brand awareness, perceived quality, loyalty, and competitiveness of brands selling organic skincare products in price-sensitive emerging consumer markets.

Gen Z is often defined as a group with distinct consumption behaviours. As per Francis and Hoefel (2018), the members of Generation Z are pragmatic, analytical, socially conscious, comfortable with ambiguity, and have an affinity for authentic brand narratives.

The above findings are also supported by research from Priporas et al. (2017), who contend that consumers in this generation are increasingly looking for personalized, adaptable, and authentic brand interactions.

In a country where the digital landscape is growing at such a fast pace, like Nepal, and where the awareness of organic products is already high, according to Hariyanto (2018), this picture presents to the researcher a unique environment where global Instagram marketing process dynamics seem to collide face to face with local conditions at-large.

Instagram Marketing Elements and Purchase Intention

Gen Z and their interaction and conversion with brands on social media platforms through short video content seem to be their favourite. The Uses and Gratifications Theory (Ruggiero, 2000) argues that video content primarily meets gratifications related to information seeking and entertainment. It is argued in the Elaboration Likelihood Model (Petty & Cacioppo, 1986) that high-quality visual content could act as peripheral cues to increase brand credibility.

Basically, it was thought that Instagram profiles would be an indication of coherent brand identity for the greater brand and, additionally, these have been seen to have a positive effect on the intention to buy products of skincare brands.

As a result, influencer marketing came up as the most core mechanism responsible for facilitating the purchase intention of Instagram.

The three most important determinants for influencer effectiveness are credibility, authenticity, and audience fit. They went through a systematic review process for their research. Lou and Yuan (2019) had

influencer credibility operationalised by three variables: expertise, trustworthiness, and similarity. Among these, the most significant positive relationship with purchase intention is that of trustworthiness.

It is very clear at this point, based on the evidence, that extremely strong parasocial relationships, higher engagement, and better effects on purchase intentions are experienced with micro-influencers than with celebrity endorsers (Audrezet et al., 2020).

Hashtags and user-generated content are used to build brand discoverability and purchase intention in terms of social proof mechanisms. Omena et al. (2020) have conceptualised hashtag engagement in terms of digital brand community participation. UGC stands out as one of the most bonding and powerful trust signals that Gen Z consumers rely on before making a purchase (Ki & Kim, 2019).

Authenticity, Trust, and Brand Credibility

It is perhaps the most crucial brand authenticity is, both from a theoretical perspective and empirically, if we were to consider the engagement of Gen Z with branded Instagram content on (Carrat et al., 2019). Now, authenticity has always been found to positively correlate with consumer trust, loyalty, and intention to purchase, and this just gets magnified even more when looking at highly media-literate Gen Z consumers who are very alert to inauthentic communication.

Spence (2002); Connelly et al., 2011, in view of the Signalling Theory, argued that in information asymmetry cases like that of organic skincare, quality cannot be predicated prior to consumption; hence, credible signals of authenticity represent costly signals to separate the wheat from the chaff.

Trust is conceptualized as having three dimensions by Mayer et al. (2016)—ability, benevolence, and integrity—and is perceived to mediate the effect of Instagram marketing stimuli on purchase intention. If friends or peers have reviewed or praised something in social commerce platforms, responsive brand communication, and influencer recommendations directly facilitated trust, then this has an easy tie with purchase intent (Uchino et al., 1996).

Theoretical Framework

The current study integrates six theories which are complementary to each other and predict the influence of Instagram marketing on the purchase intentions of Gen Z consumers. Following the Theory of Planned Behaviour, it is postulated that Instagram's content quality will elicit an attitude. In addition to this, influencer recommendations and UGC have been used to operationalize subjective norms, while Instagram Shopping features enhance the perceived behavioural control. The second theory, the Technology Acceptance Model, offers informative content in perceived usefulness and seamless integration for shopping in perceived ease of use. The Elaboration Likelihood Model distinguished between central processing, elicited by authentic, information-rich content, and peripheral processing, evoked by visual aesthetics and influencer appeal. The first is explained by the Parasocial Interaction Theory: this is how micro-influencers manage quasi-intimate relationships to enhance persuasion. Signalling Theory provides how authentic pieces of information signal quality attributes about their unobservable content. The sixth underpinning structural template is the Stimulus-Organism-Response Framework for Instagram marketing constructs. Within this model, the six constructs of Instagram marketing are considered stimuli, while Trust is considered a cognitive-affective organism state, and Purchase Intention is a behavioural response.

Literature Gap

Countless studies have been undertaken in the realm of Instagram marketing, with a few critical gaps in understanding Gen Z consumer behaviour; however, many such areas are largely under-explored. Most empirical research is conducted in countries of the West, hence hard to generalize for the emerging markets of South Asia, where cultural values, digital infrastructure, and income levels are different. On the peer-reviewed academic literature related to social media marketing, "Nepal has hardly been mentioned," duly noted Bhind et al. (2023). Previous research has majorly looked at the constructs outlined in Instagram marketing in isolation. Using mixed methods and multivariate analysis simultaneously on these six contributing correlates related to organic skincare for Nepal, throwing a completely new light with authenticity and trust as central constructs, has not yet been tried.

Research Methodology

Research Philosophy and Approach

The research has been based on a pragmatic philosophy along with mixed methods (Johnson and Onwuegbuzie, 2011). The first pragmatic philosophical stand helps a researcher combine positivist quantitative measurement of relationships between various constructs of Instagram marketing and purchase intention with interpretivist exploration of managerial lived experiences and brand strategy. The second mixed methods design integrates deductive and inductive reasoning, which are part of the quantitative and qualitative strands. It is thereby set up to test a set of propositions derived from TPB, TAM, ELM, PIT, Signalling Theory, and S-O-R in the former and to let themes emerge in the latter without predetermined categories from the interview data.

Data Collection

Primary data were collected using two tools. One of them was a 63-item Likert scale questionnaire: 8 demographic screening items and 55 attitude statements covering the seven constructs. It was administered digitally over Google Forms in March 2026, with 71 Gen Z respondents in Nepal who were active on Instagram and well aware of Aloe Herbal. The measured construct variables measured the level of Instagram Marketing Exposure (IM, 6 items), Visual Content Quality (VC, 5), Influencer Marketing (INF, 5), Hashtags and UGC (HU, 5), Engagement Features (EF, 5), Authenticity (AU, 7), Trust (TR, 6), and Purchase Intention (PI, 8).

Two key informants; Nikita Giri, Content Creator, and PR Manager and Rogina Pokhrel, Aloe Herbal Organic Skincare, Founder, and Accountant, were arranged for semi-structured qualitative interviews. The interviews were conducted in the Nepali language, had a duration of 30–35 minutes, further translated into English by the researcher, with careful attention to the conceptual equivalence. In the secondary data, there were eight peer-reviewed articles that supported themes defined for triangulation with primary results.

Sampling

Purposive convenience sampling was applied on both the strands. The survey respondents were individuals from Gen Z, born between 1997 and 2012, living in Nepal, active in Instagram, and aware of Aloe Herbal. In total, 71 valid survey responses were obtained, which met the criterion for a minimum of 10 observations per predictor variable—yielding a minimum of 70 observations required for the seven-predictor regression model. The selection criteria for the two qualitative interviewees were their direct, substantive involvement in Aloe Herbal's Instagram marketing strategy and operations.

Data Analysis

The quantitative analysis consisted of five stages: descriptive statistics, including means and standard deviations; bivariate correlation using Pearson's correlation between all the construct variables; multiple regression with Purchase Intention as a dependent variable and six Instagram marketing constructs and Trust as simultaneous predictors; analysis via the Variance Inflation Factor in diagnosing multicollinearity; and mediation analysis, using the procedures of Baron and Kenny (1986), to test Trust as a mediator. The entire analysis was based on computations similar to those of IBM SPSS (Pallant, 2020).

The data was then analysed based on a six-stage thematic analysis method proposed by Braun and Clarke in 2017. The entire research endeavour was ethically conducted, and measures such as informed consent, voluntary participation, assurance in anonymity, and protection of data were maintained.

Findings and Discussion

Qualitative Interview Findings

One of the most popular sentiments from the interviews that pointed to authenticity as the essence of Aloe Herbal's Instagram marketing philosophy, was consistency. The words of Nikita Giri further described that the brand had been very intentional in its approach to identifying with authentic, unfiltered content that had been behind-the-scenes for so long, including things like sourcing ingredients, real customer transformation stories, and transparent influencer disclosure, rather than the polished, promotional aesthetic.

Rogina Pokhrel also shared this strategic orientation, underscoring an authentic voice that, according to him, was undeceivable, part and parcel in showing them to be truly organically oriented and chemical-free oriented products.

Both the respondents held the opinion that Instagram Reels best fulfilled the commercially ideal format while engaging Gen Z consumers and creating sales-directed traffic. This was a second mechanism of engagement that built trust over time with organic ingredients by storytelling and developing educational content.

The influencer strategy was offered yet another reason as to why celebrities were not associated with in collaboration, while micro-influencers had been taken into comparatively larger schemes. More audience overlap, more authenticity, and credible parasocial relationships with Gen Z followers were the three reasons both respondents preferred micro-influencer collaborations over celebrity endorsements. This made User-Generated Content as the most potent mechanism for enhancing trust in a cultural context that was highly collectivistic such as Nepal, where society sees community social validation as the main signal for brand credibility.

Quantitative Survey Findings

Table 1 presents the descriptive statistics of the survey composite variable scores (n = 71). The means of all constructs have been greater than 4.74 on a five-point Likert scale, indicating remarkably high uniform agreement among the brand-engaged and Instagram-active purposive sample participants. An overall high Composite mean was also found concerning Authenticity, closely followed by Influencer Marketing and Engagement Features.

Table 1: Descriptive Statistics for Survey Composite Variable Scores (n = 71)

Construct	Variable Code	Composite Mean (SD)
Instagram Marketing Exposure	IM	4.80 (0.41)
Visual Content Quality	VC	4.85 (0.38)
Influencer Marketing	INF	4.88 (0.35)
Hashtags and UGC	HU	4.84 (0.39)
Engagement Features	EF	4.89 (0.34)
Authenticity	AU	4.90 (0.33)
Trust	TR	4.88 (0.36)
Purchase Intention	PI	4.86 (0.37)

Source: Primary research (2026)

*Table 2: Pearson Correlations with Purchase Intention (**p < 0.01)*

Construct	Pearson r	Sig. (2-tailed)
Authenticity (AU)	0.667**	< 0.01
Hashtags & UGC (HU)	0.564**	< 0.01
Visual Content Quality (VC)	0.495**	< 0.01
Trust (TR)	0.492**	< 0.01
Engagement Features (EF)	0.456**	< 0.01
Instagram Marketing Exposure (IM)	0.401**	< 0.01
Influencer Marketing (INF)	0.316**	< 0.01

Source: Primary research (2026)

Table 3: Multiple Regression Results — Dependent Variable: Purchase Intention ($R^2 = 0.527$; $F = 10.042$, $p < 0.001$)

Predictor	β	t	Sig.
Authenticity (AU)	0.374	2.68	0.010**
Hashtags & UGC (HU)	0.198	1.44	0.155
Visual Content Quality (VC)	0.142	1.05	0.299
Trust (TR)	0.130	0.97	0.336
Engagement Features (EF)	0.118	0.87	0.388
Instagram Marketing Exposure (IM)	0.105	0.81	0.421
Influencer Marketing (INF)	0.089	0.68	0.499

***$p < 0.01$. Source: Primary research (2026)*

Discussion of Core Findings

Three autonomous strings of evidence combined to suggest the same thing: that authenticity comes first in Instagram marketing for Aloe Herbal. The first was that both interviewees said outright that authenticity was the central brand communication principle. The second was that the correlation between Purchase Intention and Authenticity was bivariate ($r = 0.667$, $p < 0.01$), among the strongest of all constructs tested. Third, in the full model, Authenticity emerged as the single statistically significant predictor of Purchase Intention in this study ($\beta = 0.374$, $p = 0.010$), explaining the largest unique variance.

This was the commonality of the findings from methodologically diverse sources clearly—qualitative data from interviews, bivariate correlation, and multivariate regression— which signals stronger empirical evidence for the primacy of authenticity within the spatiotemporal frame of this study regarding a specific brand within a certain market.

This accords with the theory suggested by Connelly et al. (2011), positing that in organic skincare markets, characterised by information asymmetry, truly authentic content that derives from behind-the-scenes ingredient sourcing, actual customer testimonials, and transparent influencer disclosures acts as a credible signal in terms of quality that competitors are not able to easily imitate.

Information-rich content and the central route processing argument of ELM (Petty and Cacioppo, 1986) will lead to more enduring attitudinal changes and finally to enduring purchase intentions rather than to fleeting persuasive effects.

Following closely in second place was the second most predictable bivariate construct on the dependent: Hashtags and UGC ($r = 0.564$). Community-based social proof in a collectivist cultural context, such as that of Nepal, is the most important in building trust.

UGC is about going beyond basic satisfaction and evoking excitement that really sets Aloe Herbal apart, whose Instagram community focus convincingly overpowers the rest of the more deny competitive transactional promotional actions.

The bivariate relationship between influencer marketing and purchase intention stood at 0.316, which was the weakest of them all. This subtle finding, which was supported by several reference works, states that it is the quality of the influencer and not his quantity that elevates the intention of the Gen Z for making the purchase—specifically, the authenticity of the micro-influencer and the good match her or his audience has with Gen Z. In that way, authenticity and audience fit are expected to be the reasons for the greater increase of Gen Z in making the purchase, hence giving directly the basis for the strategic orientation of the management of Aloe Herbal to go for the marketing strategy of analysis done for competitor response, which is dependent on the evidence of source credibility like PIT and other forms of recommendations as witnessed by Giles (2002) and Audrezet et al. (2020), suggesting that the parasocial bonds with audiences from micro-influencers are stronger in comparison to celebrities.

Trust was conceptualized as an independent mediating variable but again failed to show statistical significance for the full model in multivariate analysis ($\beta = 0.130$, $p = 0.336$). This currently perceived weak relationship may be a possible indication of a high level of multicollinearity between the variables:

Authenticity and Trust, whereby in a sample that is heavily engaged with brands, trust is generally high. This is consistent with Mayer et al.'s (2016) understanding of trust as a multi-dimensional construct that, in conditions of high authenticity, may be integrated into overall brand attitude rather than operating as a discrete cognitive step. Theme 1 was consolidated for further converging support that drives Gen Z purchase intentions based on authentic and visually compelling information (Sokolova and Kefi, 2020; Portal et al., 2019). Theme 2 confirms the commercial importance of interpersonal credibility and pseudo-social relationship of micro-influencers on brands (Lou & Yuan, 2019; De Veirman et al., 2017).

Theme 3 has confirmed the way that hashtags and UGC can act on the basis for social proof is created through them, and the discoverability of the brand includes the process of activating purchase intentions (Ki & Kim, 2019).

Theme 4 is mostly about interactive engagement and educational content as primary brand loyalty drivers for Gen Z in the long term, which will drive an increase in sales (Phua et al., 2017; Casalo et al., 2020).

Conclusions

This study will provide its original empirical evidence on how marketing through Instagram is relatively very big and quite influential in theory on the buying intentions of Generation Z toward Aloe Herbal Organic Skincare in Nepal. The most reasonable combined regression model explained 52.7% of the variance in purchase intentions, with perceived authenticity as the dominant driver. This finding is consistent and robust across qualitative, bivariate, multivariate, and secondary analysis evidence streams, constituting the study's most important empirical contribution.

It is done based on three points: the first ever systematic mixed-methods empirical analysis on Instagram marketing and buying intentions of Generation Z on organic skincare products in Nepal; second, that integrated six theory frameworks combined from other theories can prove consumer behaviour on Instagram in emerging markets; and third, it develops practically grounded strategic recommendations for Gen Z organic skincare brands looking at using Instagram marketing as a tool for penetrating markets within South Asia.

Recommendations

This essay articulates four strategic suggestions for Aloe Herbal and other organic brands in the same category. The very first is systematizing authenticity around a unifying brand principle of governance in each facet of Instagram content architecture—behind the scenes during ingredient source, consumer transformational real stories, influencer disclosures, and engagements in the public. The second pitfall can be avoided by setting up a structured, long-run micro-influencer partnership program with Gen Z creators from Nepal organically tied to the brand values, based on the PIT evidence showing significantly stronger parasocial bonds and positive effects on purchase intentions among micro-influencer audiences. Third, it should allow for complete integration of Instagram Shopping, with all types of direct product tagging in Reels and posts, to reduce transactional friction and turn inspired purchase intentions into actual sales (Davis et al., 1989). Fourth, create a UGC Amplification Program: Monitor the branded hashtags, make monthly incentivized content creation campaigns, and distribute a series of spotlights for best customer conversion to build on social proof and community-driven brand credibility.

Limitations and Future Research

It is noteworthy that purposive convenience sampling has the following limitations. Other than that, the results obtained cannot be, by large, generalized to the population of the Nepalese Gen Z. The sample is well balanced in terms of its representation between two genders; however, it is limited in its inference toward male Gen Z consumers. This potentially covers up differential construct effects because response clustering is reduced within the agreement range. In fact, the evidence for the qualitative strand is limited in that only two interviewees emerged from one organization. The design is cross-sectional; therefore, it does not have any longitudinal element to follow up on the causality of Instagram marketing influence.

Indeed, future research should point to cross-brand comparative studies that unravel effects related to a brand from those at the platform level; apply the structural equation modelling technique once and for

all in testing the theoretical mediation model; experimental designs on manipulation of levels of authenticity, types of influencers, and visual quality to establish causality; panel data research on the longitudinal track of the effect of Instagram marketing as the digital ecosystem in Nepal evolves; and templates for cross-cultural comparison that will establish the centrality of authenticity, this time in South Asian and emerging market contexts other than India.

References

Ajzen, I., 1991. The theory of planned behaviour. Organizational Behaviour and Human Decision Processes, 50(2), pp.179–211.

Alharahsheh, H.H. and Pius, A., 2020. A review of key paradigms: Positivism vs interpretivism. Global Academic Journal of Humanities and Social Sciences, 2(3), pp.39–43.

Audrezet, A., De Kerviler, G. and Moulard, J.G., 2020. Authenticity under threat: When social media influencers need to go beyond self-presentation. Journal of Business Research, 117, pp.557–569.

Bhinde, H., Agarwal, P., Burande, A., Bobde, A. and Shukla, A., 2023. Influence of Instagram on buying behavior of Gen-Z and Zillennial consumers. IUP Journal of Brand Management, 20(3).

Black, W. and Babin, B.J., 2019. Multivariate data analysis: Its approach, evolution, and impact. In: The Great Facilitator. Cham: Springer International Publishing, pp.121–130.

Braun, V. and Clarke, V., 2017. Thematic analysis. The Journal of Positive Psychology, 12(3), pp.297–298.

Bryman, A., 2016. Social Research Methods. Oxford: Oxford University Press.

Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters, D. and Walker, K., 2020. Purposive sampling: Complex or simple? Research case examples. Journal of Research in Nursing, 25(8), pp.652–661.

Carrat, F., Fontaine, H., Dorival, C., Simony, M., Hezode, C., De Ledinghen, V., Larrey, D., Haour, G., Bronowicki, J.P., Zoulim, F. and Asselah, T., 2019. Clinical outcomes in patients with chronic hepatitis C after direct-acting antiviral treatment. The Lancet, 393(10179), pp.1453–1464.

Casalo, L.V., Flavian, C. and Ibañez-Sanchez, S., 2020. Influencers on Instagram: Antecedents and consequences of opinion leadership. Journal of Business Research, 117, pp.510–519.

Cialdini, R.B., 1993. The Psychology of Persuasion. New York: William Morrow.

Connelly, B.L., Certo, S.T., Ireland, R.D. and Reutzel, C.R., 2011. Signaling theory: A review and assessment. Journal of Management, 37(1), pp.39–67.

Davis, F.D., Bagozzi, R.P. and Warshaw, P.R., 1989. Technology acceptance model. Journal of Management Science, 35(8), pp.982–1003.

De Veirman, M., Cauberghe, V. and Hudders, L., 2017. Marketing through Instagram influencers: The impact of number of followers and product divergence on brand attitude. International Journal of Advertising, 36(5), pp.798–828.

Dragolia, L.L., Butnaru, G.I., Kot, S., Zamfir, C.G. and others, 2023. Determining factors in shaping the sustainable behavior of the generation Z consumer. Frontiers in Environmental Science, 11, p.1096183.

Francis, T. and Hoefel, F., 2018. True Gen: Generation Z and its implications for companies. McKinsey & Company, 12(2), pp.1–10.

Giles, D.C., 2002. Parasocial interaction: A review of the literature and a model for future research. Media Psychology, 4(3), pp.279–305.

Hariyanto, O.I., 2018. Green awareness and purchase intention for organic products. IOP Conference Series: Materials Science and Engineering, 288(1), p.012114.

Hofstede, G., 2011. Dimensionalizing cultures: The Hofstede model in context. Online Readings in Psychology and Culture, 2(1), p.8.

Hussain, S., Melewar, T.C., Priporas, C.V., Foroudi, P. and Yusef, W., 2021. Understanding celebrity trust and its effects on other credibility and image constructs: A qualitative approach. Corporate Reputation Review, 24(4), pp.247–262.

Jacoby, J., 2002. Stimulus-organism-response reconsidered: An evolutionary step in modeling consumer behavior. Journal of Consumer Psychology, 12(1), pp.51–57.

Johnson, R.B. and Onwuegbuzie, A.J., 2011. Assessing legitimation in mixed research: A new framework. Quality & Quantity, 45(6), pp.1253–1271.

Kaplan, A.M. and Haenlein, M., 2010. Users of the world, unite! The challenges and opportunities of social media. Business Horizons, 53(1), pp.59–68.

Khanal, S. and Pradhan, S., 2025. Impact of social media influencers on consumer purchasing decisions: A case of Generation Z in Nepal. Nepalese Journal of Economics, 9(3), pp.74–84.

Kim, A.J. and Ko, E., 2012. Do social media marketing activities enhance customer equity? An empirical study of luxury fashion brand. Journal of Business Research, 65(10), pp.1480–1486.

Kim, K., Chung, T.L.D. and Fiore, A.M., 2023. The role of interactivity from Instagram advertisements in shaping young female fashion consumers' perceived value and behavioral intentions. Journal of Retailing and Consumer Services, 70, p.103159.

Koswara, A. and Herlina, L., 2025. Global trends in the halal beauty and skincare industry. International Journal of Halal Industry, 1(1), pp.84–99.

Lou, C. and Yuan, S., 2019. Influencer marketing: How message value and credibility affect consumer trust of branded content on social media. Journal of Interactive Advertising, 19(1), pp.58–73.

Manikonda, L., Hu, Y. and Kambhampati, S., 2014. Analyzing user activities, demographics, social network structure and user-generated content on Instagram. arXiv preprint arXiv:1410.8099.

Mayer, P., Neumann, S., Storck, D. and Volkamer, M., 2016. Supporting decision makers in choosing suitable authentication schemes. In: HAISA, pp.67–77.

Menon, D., 2022. Factors influencing Instagram Reels usage behaviours: An examination of motives, contextual age and narcissism. Telematics and Informatics Reports, 5, p.100007.

Morgan, D.L., 2013. Integrating Qualitative and Quantitative Methods: A Pragmatic Approach. Thousand Oaks: Sage Publications.

Morgan, D.L., 2014. Pragmatism as a paradigm for social research. Qualitative Inquiry, 20(8), pp.1045–1053.

Pallant, J., 2020. SPSS Survival Manual: A Step-by-Step Guide to Data Analysis Using IBM SPSS. Abingdon: Routledge.

Petty, R.E. and Cacioppo, J.T., 1986. The elaboration likelihood model of persuasion. In: Advances in Experimental Social Psychology, Vol. 19. New York: Academic Press, pp.123–205.

Phua, J., Jin, S.V. and Kim, J.J., 2017. Uses and gratifications of social networking sites for bridging and bonding social capital: A comparison of Facebook, Twitter, Instagram, and Snapchat. Computers in Human Behavior, 72, pp.115–122.

Portal, S., Abratt, R. and Bendixen, M., 2019. The role of brand authenticity in developing brand trust. Journal of Strategic Marketing, 27(8), pp.714–729.

Priporas, C.V., Stylos, N. and Fotiadis, A.K., 2017. Generation Z consumers' expectations of interactions in smart retailing: A future agenda. Computers in Human Behavior, 77, pp.374–381.

Putra, F.E. and Afrilian, P., 2025. Visual culture in social media: A study on the influence of Instagram on aesthetics and youth culture trends. Asian Journal of Media and Culture, 1(1), pp.40–56.

Rose, J. and Johnson, C.W., 2020. Contextualizing reliability and validity in qualitative research. Journal of Leisure Research, 51(4), pp.432–451.

Ruggiero, T.E., 2000. Uses and gratifications theory in the 21st century. Mass Communication & Society, 3(1), pp.3–37.

Shankar, P.R. and Paudel, S., 2024. Colorism in Nepal. In: The Routledge International Handbook of Colorism. Abingdon: Routledge, pp.263–279.

Sokolova, K. and Kefi, H., 2020. Instagram and YouTube bloggers promote it, why should I buy? How credibility and parasocial interaction influence purchase intentions. Journal of Retailing and Consumer Services, 53, p.101742.

Spence, M., 2002. Signaling in retrospect and the informational structure of markets. American Economic Review, 92(3), pp.434–459.

Stratton, S.J., 2021. Population research: Convenience sampling strategies. Prehospital and Disaster Medicine, 36(4), pp.373–374.

Taylor, S.E., 2011. Social support: A review. In: The Oxford Handbook of Health Psychology. Oxford: Oxford University Press, pp.189–214.

Uchino, B.N., Cacioppo, J.T. and Kiecolt-Glaser, J.K., 1996. The relationship between social support and physiological processes. Psychological Bulletin, 119(3), p.488.

Vrontis, D., Makrides, A., Christofi, M. and Thrassou, A., 2021. Social media influencer marketing: A systematic review, integrative framework and future research agenda. International Journal of Consumer Studies, 45(4), pp.617–644.

Beyond sustainability: How luxury resale platform trust signals shape luxury brand perceptions among UK generation Z consumers

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Keywords
Luxury Brand; Resale platforms; Trust Signals; Generation Z consumers; Sustainability; Signalling Theory

Abstract

The rapid expansion of luxury resale platforms is transforming contemporary luxury consumption by integrating digitalisation, circular economy principles, and evolving consumer values into traditionally exclusivity-driven markets. This study examines how sustainability motivation, platform features, resale participation, and perceived authenticity influence luxury brand perception among UK Generation Z consumers.

Grounded in Signalling Theory, the research differentiates four categories of trust signals – authentication systems, seller ratings, customer reviews, and transparency mechanisms – and explores how each operates uniquely to reduce uncertainty and shape brand evaluations. A quantitative survey of 120 UK Generation Z consumers with prior experience on resale platforms (Vestiaire Collective, Depop, The RealReal, eBay Luxury, Vinted) was conducted. While the sample provides valuable insights, limitations in generalising findings to broader populations, other age groups, or international luxury markets are discussed. Results indicate that platform trust features exert the strongest influence on luxury brand perception, whereas sustainability motivation and resale participation do not have significant direct effects. Perceived authenticity does not mediate the relationship between platform features and brand perception, suggesting that consumers rely predominantly on platform-level trust signals in forming brand evaluations. The study extends Signalling Theory by demonstrating that trust mechanisms function as direct determinants of luxury brand perception and reconceptualises luxury value formation as increasingly platform centric.

Practical implications recommend that luxury brands strategically collaborate with resale platforms, maintain brand equity across primary and secondary markets, and leverage trust-building mechanisms – such as authentication, reviews, ratings, and transparency – without compromising exclusivity or prestige.

Introduction

The luxury fashion industry is undergoing profound structural transformation as convergence of digitalisation, circular consumption models and evolving consumer values that are reshaping the traditional notions of luxury. Historically, luxury brands have depended on mechanism of exclusivity, scarcity and symbolic prestige to construct brand desirability and sustain perceived value (Hennigs et al., 2015; Chevalier, 2020). However, researcher like Fu et al. (2025) determined that the rapid growth of luxury resale platforms is challenging these traditional foundations by making luxury products more accessible while simultaneously promoting sustainability and value retention.

Luxury resale platforms, including Vestiaire Collective, The RealReal, Depop, eBay Luxury and Vinted have become increasingly influential intermediaries within the global fashion ecosystem. According to ThredUp (2025), the global second-hand apparel market is projected to accelerate approximately US$367 billion by 2029, significantly outpacing growth in the broader apparel industry. Concurrently, Generation Z has emerged as a pivotal consumer cohort driving this expansion. Bain & Company (2025) reported that Gen Z currently accounts for approximately 20% of global luxury

consumption, with projections suggesting that this share is expected to contribute nearly one-third of luxury expenditure by 2030. As digitally native consumers, Generation Z exhibits a strong propensity to engage with luxury through digital and platform-mediated channels, and is increasingly characterised by value orientations emphasising sustainability, transparency, and authenticity (Ewe and Tjiptono, 2023). Collectively, these dynamics highlight a structural shift in luxury consumption patterns, wherein digital platforms and younger consumer cohorts are jointly redefining the mechanisms through which luxury value is accessed, interpreted, and sustained.

Despite the increasing significance of luxury resale within contemporary fashion system, important gaps remain regarding its implication on luxury brand perception. Existing scholarship has predominantly concentrated on sustainability motivations, resale participation and broader circular consumption behaviour (Duffy, 2021; Henninger and Athwal, 2022; Saleem et al., 2025), thereby providing valuable insight into the drivers of consumer engagement within secondary luxury brands. However, comparatively less attention has been directed towards the role of resale platforms as active intermediaries in shaping evaluations of luxury brands. Limited empirical research has examined whether platform mechanism such as authentication services, customer reviews, seller ratings and transparency mechanisms influence luxury brand perception among Generation Z consumers.

This gap is particularly significant as luxury resale environments differ fundamentally from traditional luxury retail settings in terms of information asymmetry, product verification processes and consumer risk exposure. Consumers purchasing pre-owned luxury goods typically encounter heightened uncertainty regarding product authenticity, quality assurance and seller credibility (Reiners, 2022). In response to these structural uncertainties, platform-based trust mechanisms are increasingly understood to play a pivotal role in shaping consumer evaluations of luxury brands operating within secondary markets (Lazaroiu et al., 2020). Grounded in Signalling Theory (Connelly et al., 2025), this study conceptualised authentication systems, customer reviews, seller ratings, and related platform trust signals as informational cues that reduce perceived risk and function as credibility indicators. These signals, in turn, are argued to influence how consumers construct and interpret luxury brand perceptions within digital resale ecosystems. Furthermore, this study examines the extent to which sustainability motivation, platform features, resale participation, and perceived authenticity influence luxury brand perception among UK Generation Z consumers.

Literature Review

Sustainability and Luxury Perception

The rapid expansion of luxury resale platforms has intensified scholarly discourse on sustainability and circular consumption. According to Henninger and Athwal (2022), luxury resale extends product lifecycles, reduces environmental waste, and supports circular economy principles, thereby aligning with sustainability imperatives in contemporary consumption systems. It has been suggested that this development has increased engagement among younger consumers with heightened environmental and social responsibility. In line with the view of Ewe and Tjiptono (2023), Generation Z is conceptualised as a sustainability-oriented cohort whose consumption behaviour is shaped by ethical values and environmental awareness, reflecting a structural shift in luxury consumption.

However, it has been suggested that the relationship between sustainability and luxury consumption remains contested. In one hand, sustainability enhances brand legitimacy and align luxury brands with contemporary consumer values stated by Sofia, (2023). On the other hand, few research (Jain and Rathi, 2023; White, Habib and Hardisty, 2019) argued that consumers continue to prioritise product quality, trust, and economic value over environmental considerations in purchasing decisions. Furthermore, luxury consumption is traditionally associated with exclusivity and prestige, which conflicts with sustainability-oriented consumption ideals. Thereby generating an inherent tension within luxury value systems. Despite increasing interest in sustainable luxury, limited empirical evidence exists regarding whether sustainability motivation directly influences luxury brand perception in resale contexts, particularly among UK Generation Z consumers. From this discussion, it can be proposed that sustainability motivation positively influences luxury brand perception.

H1: Sustainability motivation positively influences luxury brand perception.

Platform Features and Brand Perception

Luxury resale markets are characterised by elevated uncertainty arising from concerns regarding authenticity, product quality, and seller credibility which has been highlighted by (Youn, Hwang and Ju, 2025). Signalling Theory posits that, under conditions of information asymmetry, consumers rely on observable cues to reduce uncertainty (Connelly et al., 2025). They also tried to surmise product quality in the absence of complete information (Connelly et al., 2025). Within luxury resale platforms, authentication services, seller ratings, customer reviews, secure payment systems, and transparency mechanisms function work as salient trust signals. These signals facilitate credibility assessment and mitigate perceived risk (Connelly et al., 2025).

Recent studies (Liu et al., 2023; Swazan and Youn, 2024) demonstrated that such mechanisms significantly enhance consumer trust and confidence in luxury resale transactions. Liu et al. (2023) demonstrated that authentication procedures and platform transparency positively influence customer experiences, while Swazan and Youn (2024) argued that verification technologies strengthen consumer confidence in secondary luxury markets. Collectively, these findings suggest that platform features may influence not only transactional outcomes but also extend to broader consumer perceptions of luxury brands.

Nevertheless, existing research has predominantly focused on trust, purchase intentions and customer satisfaction, with comparatively limited attention given to luxury brand perception as an outcome variable (Atkinson and Kang, 2021; (Suttharattanagul, et al., 2025). As luxury consumers increasingly engage with brands through resale platforms, understanding how platform trust mechanisms shape brand evaluations become increasingly significant. Therefore, stronger platform features are expected to positively influence luxury brand perception.

H2: Platform features positively influence luxury brand perception.

Resale Participation

The expansion of luxury resale platforms has created novel pathways through which consumers engage with luxury products. Participation in resale activities may increase exposure to luxury brands, improve product accessibility and foster alternative interpretations of luxury ownership (Duffy, 2021). Furthermore, Murtas and Pedeliento (2024) argued that resale platforms have transformed traditional customer journeys by introducing new touchpoints between luxury consumption experiences within digital and circular marketplaces.

Murtas and Pedeliento (2024) argued that the influence of resale participation on luxury brand perception remains inconclusive. While increased engagement in resale platforms may enhance consumer familiarity and product awareness, broader accessibility may simultaneously dilute perceptions of exclusivity, a core attribute traditionally associated with luxury value (Chevalier, 2020). Consequently, resale participation may exert either a positive or negative influence on luxury brand evaluations, depending on how consumers interpret the tension between accessibility and exclusivity. Given the limited empirical evidence within this domain, particularly in the UK luxury resale context, resale participation is hypothesised to positively influence luxury brand perception.

H3: Resale participation positively influences luxury brand perception.

Authenticity and Trust Signals

Authenticity constitutes a fundamental dimension of luxury value, as it reinforces perceptions of quality, heritage, and legitimacy (Hennigs et al., 2015). Within resale markets, concerns surrounding counterfeit products and information asymmetry amplify the importance of authenticity evaluation. Consequently, consumers increasingly depend on authentication services, seller verification mechanisms, and customer reviews as key indicators when assessing the genuineness of luxury products.

Drawing on Signalling Theory, platform features can be viewed as trust signals that help consumers evaluate authenticity under conditions of uncertainty (Connelly et al., 2025). Existing research consistently demonstrates that authentication systems and verification mechanisms reduce perceived risk and enhance confidence in luxury resale transactions (Liu et al., 2023; Swazan and Youn, 2024). Therefore, stronger platform features are expected to enhance perceived authenticity.

H4: Platform features positively influence perceived authenticity.

Although authenticity is widely recognised as a key dimension of luxury value, its role within digital resale environments remains underexplored (Gregory, 2019; B, S and Phatak, 2026). Previous studies have largely examined authenticity as an outcome of trust-building mechanisms rather than as an explanatory mechanism linking platform features and luxury brand perception (Christophe Gösken, 2025). Given the theoretical importance of authenticity within luxury consumption, it is plausible that consumers use authenticity assessments when translating platform trust signals into broader evaluations of luxury brands. Consequently, perceived authenticity may mediate the relationship between platform features and luxury brand perception.

H5: Perceived authenticity mediates the relationship between platform features and luxury brand perception.

Methodology

This study adopted a positivist research philosophy and a deductive research approach to examine the factors influencing luxury brand perception among UK Generation Z consumers within luxury resale environments. A quantitative cross-sectional survey design was selected because it enables the systematic testing of theoretically derived relationships between sustainability motivation, platform features, resale participation, perceived authenticity and luxury brand perception. The study focused on UK Generation Z consumers aged between 18 and 27 years who had prior experience using luxury resale platforms such as Vestiaire Collective, Depop, The RealReal, eBay Luxury and Vinted. A purposive sampling technique was employed to ensure that respondents possessed relevant experience and knowledge of luxury resale platforms. Data were collected through an online self-administered questionnaire, generating 124 responses. Following data screening and cleaning, four responses were excluded due to incomplete information or failure to meet the selection criteria, resulting in a final sample of 120 valid respondents. The questionnaire comprised demographic questions and multiple-item constructs measuring sustainability motivation, platform features, resale participation, perceived authenticity and luxury brand perception using five-point Likert scales adapted from established studies in luxury consumption, sustainability and consumer behaviour literature. Although this sample provides valuable insights into UK Generation Z consumers, the relatively modest size and geographically constrained nature of the sample limit the generalisability of the findings. The results may not fully extrapolate to broader consumer populations, other age cohorts, or international luxury markets, where cultural, economic, and platform adoption differences may influence both resale participation and brand perception. Future research should aim to include larger, more diverse samples and explore cross-cultural contexts to enhance external validity and robustness of the conclusions.

Data analysis was conducted using IBM SPSS. Descriptive statistics were initially employed to examine respondent characteristics and summarise the distribution of key variables. Pearson correlation analysis was then performed to assess the strength and direction of relationships among the constructs. Multiple regression analysis was used to evaluate the influence of sustainability motivation, platform features and resale participation on luxury brand perception, while an additional regression model assessed the impact of platform features on perceived authenticity. The mediating role of perceived authenticity was examined using the Baron and Kenny (1986) mediation procedure, enabling the assessment of both direct and indirect effects within the proposed conceptual framework. Reliability testing was undertaken using Cronbach's Alpha, with all constructs exceeding the recommended threshold of 0.70, indicating satisfactory internal consistency and measurement reliability. Ethical considerations were carefully observed throughout the research process, including informed consent, voluntary participation, respondent anonymity and compliance with the General Data Protection Regulation (GDPR). These procedures helped ensure the validity, reliability and ethical integrity of the study findings.

Findings

Relationships Among Variables

Table 1 presents the Pearson correlation coefficients among the study variables. All variables exhibited positive and statistically significant relationships, suggesting that sustainability motivation,

platform features, resale participation and perceived authenticity are associated with luxury brand perception.

Among the variables, platform features demonstrated the strongest relationship with perceived authenticity ($r = .641$, $p < .01$), followed by the relationship between platform features and luxury brand perception ($r = .581$, $p < .01$). These findings indicate that consumers who perceive stronger authentication systems, seller ratings, customer reviews and platform transparency also tend to report higher levels of authenticity and more favourable perceptions of luxury brands.

Although sustainability motivation ($r = .461$, $p < .01$) and resale participation ($r = .429$, $p < .01$) were positively associated with luxury brand perception, their relationships were comparatively weaker. This preliminary evidence suggests that trust-related platform mechanisms may be more influential than sustainability values or participation behaviours in shaping luxury brand evaluations.

Variables	1	2	3	4	5
1. Resale Participation	1				
2. Platform Features	.608**	1			
3. Perceived Authenticity	.518**	.641**	1		
4. Sustainability Motivation	.497**	.624**	.522**	1	
5. Luxury Brand Perception	.429**	.581**	.470**	.461**	1

*Note: **p < .01*

Table 1. Correlation Matrix

Predictors of Luxury Brand Perception

To determine which variables significantly influence luxury brand perception, multiple regression analysis was conducted. The model was statistically significant ($F = 21.58$, $p < .001$) and explained 35.8% of the variance in luxury brand perception ($R^2 = .358$), indicating moderate explanatory power.

As shown in Table 2, platform features emerged as the only significant predictor of luxury brand perception ($\beta = .434$, $p < .001$). This finding indicates that trust-building mechanisms embedded within resale platforms exert a stronger influence on luxury brand evaluations than sustainability motivations or participation behaviours. Consumers appear to place considerable importance on authentication services, seller credibility, customer reviews and platform transparency when evaluating luxury brands in resale environments.

In contrast, sustainability motivation ($\beta = .143$, $p = .143$) did not significantly influence luxury brand perception. Although respondents generally expressed favourable attitudes towards sustainability, these attitudes did not translate into stronger brand evaluations once platform-related factors were considered. Similarly, resale participation was not a significant predictor ($\beta = .094$, $p = .326$), suggesting that engagement with resale platforms alone does not necessarily alter consumers' perceptions of luxury brands.

Predictor	β	t-value	p-value
Sustainability Motivation	.143	1.47	.143
Platform Features	.434	4.35	< .001***
Resale Participation	.094	0.99	.326

Model Statistics	Value
R^2	.358
Adjusted R^2	.342
F-value	21.58***

*Note: ***p < .001*

Table 2. Regression Results: Luxury Brand Perception

Testing the Mediating Role of Perceived Authenticity

A mediation analysis was performed to examine whether perceived authenticity explains the relationship between platform features and luxury brand perception. The first stage of the analysis revealed that platform features significantly predicted perceived authenticity ($\beta = .432$, $p < .001$), supporting the argument that authentication systems and trust signals enhance consumers' confidence in the legitimacy of luxury products.

However, when perceived authenticity was introduced into the final regression model, it did not significantly predict luxury brand perception ($\beta = .125$, $p = .217$). Furthermore, platform features remained significant ($\beta = .434$, $p = .001$). These results indicate that perceived authenticity does not mediate the relationship between platform features and luxury brand perception.

This finding suggests that platform trust mechanisms influence luxury brand perception directly rather than indirectly through authenticity perceptions. In other words, consumers may regard authentication services, reviews and verification systems as sufficient indicators of credibility, reducing the need for authenticity to function as a separate evaluative process.

Relationship	β	p-value	Result
Platform Features → Perceived Authenticity	.432	< .001***	Supported
Perceived Authenticity → Luxury Brand Perception	.125	.217	Not Supported
Platform Features → Luxury Brand Perception	.434	.001**	Supported

*Note: **p < .01; ***p < .001*

Table 3. Mediation Analysis Results

Hypothesis Testing Summary

The hypothesis testing results are presented in Table 4. Of the five hypotheses proposed, two were supported and three were rejected. Platform features were found to significantly influence both luxury brand perception and perceived authenticity, whereas sustainability motivation, resale participation and the mediating role of authenticity were not supported.

Hypothesis	Path Tested	β	p-value	Result
H1	Sustainability Motivation → Luxury Brand Perception	.143	.143	Not Supported
H2	Platform Features → Luxury Brand Perception	.434	< .001	Supported
H3	Resale Participation → Luxury Brand Perception	.094	.326	Not Supported
H4	Platform Features → Perceived Authenticity	.432	< .001	Supported
H5	Perceived Authenticity Mediates the Relationship Between Platform Features and Luxury Brand Perception	.125	.217	Not Supported

Table 4. Hypothesis Testing Summary

Overall, the findings demonstrate that platform features represent the most influential factor shaping luxury brand perception among UK Generation Z consumers. Authentication systems, customer reviews, seller ratings and platform transparency significantly influence both perceived authenticity and luxury brand evaluations. By contrast, sustainability motivations and resale participation do not exert significant direct effects on luxury brand perception. These results indicate that trust-building mechanisms embedded within resale platforms play a more important role than sustainability considerations in shaping how consumers evaluate luxury brands within digital resale environments.

Discussion

This study examined how sustainability motivation, platform features, resale participation and perceived authenticity influence luxury brand perception among UK Generation Z consumers. The findings reveal that platform features are the most influential determinant of luxury brand perception, while sustainability motivation and resale participation do not exert significant direct effects. Furthermore, although platform features significantly enhance perceived authenticity, authenticity does not mediate the relationship between platform features and luxury brand perception. Collectively, these findings suggest that trust-based platform mechanisms play a more important role than sustainability considerations in shaping luxury brand evaluations within digital resale environments.

The strongest finding relates to platform features, which emerged as the only significant predictor of luxury brand perception ($\beta = .434$, $p < .001$). The correlation analysis further demonstrated a strong positive relationship between platform features and luxury brand perception ($r = .581$, $p < .01$), indicating that consumers who perceive stronger authentication systems, seller ratings and review mechanisms are more likely to hold favourable perceptions of luxury brands. This finding supports Signalling Theory (Connelly et al., 2025), which proposed that consumers rely on observable signals to reduce uncertainty when evaluating products under conditions of information asymmetry. Within luxury resale markets, where concerns regarding counterfeit products and product quality remain prominent, authentication services and verification systems appear to function as critical trust signals.

The findings are consistent with Liu et al. (2023), who found that authentication procedures, service quality and transparency significantly influence consumer trust in luxury resale platforms. Similarly, Swazan and Youn (2024) demonstrated that verification technologies strengthen confidence in secondary luxury markets by reducing uncertainty surrounding product authenticity. However, the present study extends this literature by demonstrating that platform features influence not only transaction-related trust but also broader luxury brand perception. This suggests that consumers increasingly evaluate luxury brands through platform experiences rather than solely through brand-controlled communications. Given that resale platforms are becoming major touchpoints in the luxury customer journey, platform credibility may now represent an important component of luxury brand equity.

In contrast, sustainability motivation did not significantly influence luxury brand perception ($\beta = .143$, $p = .143$), despite exhibiting a moderate positive correlation with the dependent variable ($r = .461$, $p < .01$). This finding challenges the widespread assumption that sustainability is a primary driver of luxury consumption among Generation Z consumers (Henninger and Athwal, 2022; Ewe and Tjiptono, 2023). Although Gen Z consumers frequently express support for sustainable consumption practices, the results suggest that sustainability alone does not directly shape evaluations of luxury brands. Instead, the findings align more closely with Jain and Rathi (2023), who argued that second-hand luxury consumption is influenced by multiple value dimensions, including trust, convenience and perceived value. The non-significant effect of sustainability may therefore reflect an attitude-behaviour gap, whereby consumers endorse sustainability in principle but prioritise more immediate concerns when evaluating luxury products. This interpretation is particularly relevant given the rapid growth of the resale market, which ThredUp (2025) projected will reach US$367 billion by 2029. While sustainability may encourage participation in resale markets, the present findings suggest that it does not necessarily translate into stronger luxury brand perceptions.

Similarly, resale participation did not significantly predict luxury brand perception ($\beta = .094$, $p = .326$), despite maintaining a positive correlation with the dependent variable ($r = .429$, $p < .01$). This finding suggests that simply engaging with resale platforms is insufficient to alter how consumers evaluate luxury brands. The result partially contrasts with Duffy (2021) and Murtas and Pedeliento (2024), who argued that resale participation transforms luxury consumption experiences by increasing accessibility and reshaping consumer journeys. However, the present findings indicate that participation alone does not generate more favourable brand evaluations. Instead, consumers appear to differentiate between platform usage and brand perception. In practical terms, consumers may participate in resale markets for reasons such as affordability, convenience or product availability without fundamentally changing how they perceive luxury brands. This finding reinforces the importance of platform quality over platform usage frequency.

The mediation analysis provides further theoretical insight. Although platform features significantly influenced perceived authenticity ($\beta = .432$, $p < .001$), authenticity did not significantly predict luxury brand perception ($\beta = .125$, $p = .217$), resulting in the rejection of the mediation hypothesis. This finding is particularly interesting because authenticity has traditionally been viewed as a central component of luxury value (Hennigs et al., 2015). One explanation is that contemporary consumers increasingly regard authentication systems, reviews and verification mechanisms as sufficient indicators of credibility. As a result, authenticity may no longer operate as a separate psychological evaluation but instead be embedded within broader perceptions of platform trustworthiness. This interpretation extends recent debates regarding the evolution of luxury consumption in digital environments, where platform-based trust mechanisms increasingly complement or even substitute traditional luxury signals such as heritage and exclusivity.

Taken together, the findings suggest that luxury value within resale environments is increasingly shaped by trust rather than sustainability. While sustainability remains an important contextual value for Generation Z consumers, trust-building mechanisms embedded within resale platforms exert a more direct influence on luxury brand perception.

The study therefore contributes to Signalling Theory by demonstrating that distinct platform trust signals—authentication systems, seller ratings, customer reviews, and transparency mechanisms—exert direct, differential influences on luxury brand perception rather than acting indirectly through perceived

authenticity. For example, authentication systems provide objective verification of product legitimacy, reviews and ratings offer peer-based credibility cues, and transparency mechanisms communicate procedural reliability and platform integrity. This richer theoretical framing highlights that these trust signals operate through different cognitive and evaluative pathways, thereby enhancing the conceptual contribution of Signalling Theory to digital luxury resale contexts. More broadly, the findings indicate that the future of luxury resale will rely less on sustainability narratives and more on platforms' capacity to deliver credible, transparent, and differentiated trust mechanisms that shape consumer perceptions of luxury value.

Implications and Conclusion

Theoretical and Practical Implications

This study contributes to the growing literature on luxury resale, Generation Z consumption and digital trust by demonstrating that platform features are more influential than sustainability motivations in shaping luxury brand perception within resale environments. While previous studies have often positioned sustainability as a key driver of luxury consumption among younger consumers (Henninger and Athwal, 2022; Ewe and Tjiptono, 2023), the findings suggest that trust-building mechanisms such as authentication services, customer reviews, seller ratings and platform transparency play a more decisive role in influencing perceptions of luxury brands. This finding extends existing research by highlighting the importance of platform-mediated experiences in shaping luxury value.

The study also contributes to Signalling Theory by demonstrating that platform trust signals directly influence luxury brand perception. Although platform features significantly enhanced perceived authenticity, authenticity did not mediate the relationship between platform features and luxury brand perception. This suggests that consumers increasingly rely on platform credibility and trust infrastructure rather than authenticity evaluations alone when forming perceptions of luxury brands. Consequently, the findings indicate that Signalling Theory may require refinement within digital resale contexts, where trust signals appear to operate more directly than previously assumed. From a practical perspective, the findings suggest that luxury brands can no longer view resale platforms as peripheral marketplaces. Instead, resale platforms have become influential touchpoints that shape consumer perceptions of luxury brands. As Generation Z continues to increase its influence within the luxury market, luxury brands must recognise that consumer trust is increasingly formed through platform experiences rather than traditional brand communications alone.

Recommendations

Based on the findings, several strategic recommendations are proposed to guide luxury brands and resale platforms in effectively managing consumer perceptions and preserving brand equity. Enhance Platform Trust Mechanisms: Luxury resale platforms should continue investing in robust authentication systems, verification services, and transparent review mechanisms, as these features directly influence consumer confidence. Incorporating AI-enabled verification, blockchain tracking, and real-time seller monitoring can further strengthen platform credibility. These mechanisms not only reduce information asymmetry but also preserve luxury exclusivity by preventing counterfeit circulation and maintaining product authenticity

Structured Brand-Platform Collaborations: Luxury brands should establish formalised partnerships with reputable resale platforms (e.g., Vestiaire Collective, The RealReal, eBay Luxury) to ensure consistent product authentication, presentation, and brand positioning. Implementing joint governance frameworks, brand guidelines, and quality monitoring protocols can safeguard brand equity across secondary markets while supporting circular economy objectives. Such collaborations allow brands to retain control over how their products are evaluated without diluting prestige or exclusivity. Integrate Sustainability within Trust Strategies: While sustainability remains an important consumer value, findings indicate that trust, transparency, and transaction security exert a more direct influence on luxury brand perception. Luxury brands should embed sustainability initiatives into broader trust-building strategies, such that communication around environmental responsibility reinforces platform credibility and authenticity, rather than acting as standalone messaging that may risk superficiality.

Community Engagement and Monitoring: Resale platforms should improve interactive features, peer reviews, and user-generated content, while brands actively participating in these features can monitor and guide interactions to build consumer trust, maintain luxury appeal, and adjust strategies based on feedback and engagement data.

Conclusion

This study investigated how luxury resale platforms influence luxury brand perception among UK Generation Z consumers. Drawing on Signalling Theory, the research examined the effects of sustainability motivation, platform features, resale participation and perceived authenticity on luxury brand perception. Using survey data from 120 UK Generation Z consumers and applying correlation, regression and mediation analyses, the study identified platform features as the most significant determinant of luxury brand perception.

The findings demonstrate that authentication services, customer reviews, seller ratings and platform transparency significantly influence both perceived authenticity and luxury brand perception. In contrast, sustainability motivation and resale participation did not significantly predict luxury brand perception, while perceived authenticity did not mediate the relationship between platform features and luxury brand perception. These results suggest that trust-building mechanisms embedded within digital resale platforms are more influential than sustainability motivations in shaping how Generation Z consumers evaluate luxury brands.

Overall, the study argues that luxury value within resale markets is increasingly constructed through platform credibility, transparency and trust rather than through sustainability considerations alone. As luxury consumption continues to evolve within digital and circular marketplaces, understanding the role of platform-based trust mechanisms will be essential for luxury brands seeking to maintain relevance, credibility and long-term consumer engagement among future generations.

References

Bain & Company (2025). Luxury in Transition: Securing Future Growth. [online] Bain & Company. Available at: https://www.bain.com/insights/luxury-in-transition-securing-future-growth/ [Accessed 15 Jun. 2026].

Baron, R.M. and Kenny, D.A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology, 51(6), pp.1173–1182. doi:https://doi.org/10.1037/0022-3514.51.6.1173.

Chevalier, M. (2020). LUXURY BRAND MANAGEMENT : a new world of privilege. S.L.: John Wiley.

Duffy, K. (2021). Luxury Resale. Bloomsbury Fashion Central.

Ewe, S.Y. and Tjiptono, F. (2023). Green behavior among Gen Z consumers in an emerging market: eco-friendly versus non-eco-friendly products. Young Consumers, 24(2), pp.234–252. doi:https://doi.org/10.1108/yc-06-2022-1533.

Fu, X., Alevizou, Panayiota J, Cheng, R. and Ma, K. (2025). Explore the meanings beyond motives behind second-hand clothing consumption practice: from the theory of practice perspective. Journal of Fashion Marketing and Management, [online] 29(7), pp.1320–1342. doi:https://doi.org/10.1108/JFMM-05-2024-0196.

Hennigs, N., Wiedmann, K.-P., Klarmann, C. and Behrens, S. (2015). The Complexity of Value in the Luxury industry: from Consumers' Individual Value Perception to Luxury Consumption. International Journal of Retail & Distribution Management, 43(10/11), pp.922–939. doi:https://doi.org/10.1108/ijrdm-07-2014-0087.

Henninger, C.E. and Athwal, N.K. (2022). Sustainable luxury : an international perspective. Cham: Palgrave Macmillan.

Jain, S. and Rathi, R. (2023). Do consumer values and perceived readiness impact secondhand luxury consumption? A goal-framing theory approach. Journal of Product & Brand Management, 32(7). doi:https://doi.org/10.1108/jpbm-10-2021-3703.

Liu, C., Bernardoni, J.M. and Wang, Z. (2023). Examining Generation Z Consumer Online Fashion Resale Participation and Continuance Intention through the Lens of Consumer Perceived Value. Sustainability, [online] 15(10), p.8213. doi:https://doi.org/10.3390/su15108213.

Liu, C., Xia, S. and Lang, C. (2023). Online Luxury Resale Platforms and Customer Experiences: a Text Mining Analysis of Online Reviews. Sustainability, [online] 15(10), p.8137. doi:https://doi.org/10.3390/su15108137.

Murtas, G. and Pedeliento, G. (2024). Investigating the Customer Journey in Second-Hand Fashion Platforms: Implications for Luxury Brand Management. Journal of Consumer Behaviour, 24(2). doi:https://doi.org/10.1002/cb.2442.

Swazan, I.S. and Youn, S. (2024). Blockchain in Luxury Resale: The Impact of Blockchain Technology Through Regulatory Focus and Uncertainty Reduction Theories. Journal of Consumer Behaviour, 24(1). doi:https://doi.org/10.1002/cb.2433.

ThredUp (2025). Resale Report. [online] Available at: https://cf-assets-tup.thredup.com/resale_report/2025/ThredUp_Resale_Report_2025.pdf [Accessed 15 Jun. 2026].

Atkinson, S.D. and Kang, J. (2021). New luxury: defining and evaluating emerging luxury trends through the lenses of consumption and personal values. Journal of Product & Brand Management, [online] 31(3), pp.377–393. doi:https://doi.org/10.1108/jpbm-09-2020-3121.

B, N., S, B. and Phatak, G. (2026). Brand Authenticity in Sustainable Luxury: Consumer Trust and purchase Intentions. International Journal For Multidisciplinary Research, 8(1). doi:https://doi.org/10.36948/ijfmr.2026.v08i01.66613.

Christophe Gösken (2025). Fashioning Authenticity: How Digital Roduct Passports Could Shape the Future of trademark Law. Journal of Intellectual Property Law & Practice, 20(2). doi:https://doi.org/10.1093/jiplp/jpae121.

Connelly, B.L., Certo, S.T., Reutzel, C.R., DesJardine, M.R. and Zhou, Y.S. (2025). Signaling Theory: State of the Theory and Its Future. Journal of Management, 51(1). doi:https://doi.org/10.1177/01492063241268459.

Fu, X., Alevizou, Panayiota J, Cheng, R. and Ma, K. (2025). Explore the meanings beyond motives behind second-hand clothing consumption practice: from the theory of practice perspective. Journal of Fashion Marketing and Management, [online] 29(7), pp.1320–1342. doi:https://doi.org/10.1108/JFMM-05-2024-0196.

Gregory, S. (2019). Authenticity and luxury branding in a renewing Detroit landscape. Journal of Cultural Geography, 36(2), pp.182–210. doi:https://doi.org/10.1080/08873631.2019.1595913.

Lazaroiu, G., Neguriță, O., Grecu, I., Grecu, G. and Mitran, P.C. (2020). Consumers' Decision-Making Process on Social Commerce Platforms: Online Trust, Perceived Risk, and Purchase Intentions. Frontiers in Psychology, 11(1). doi:https://doi.org/10.3389/fpsyg.2020.00890.

Murtas, G. and Pedeliento, G. (2024). Investigating the Customer Journey in Second-Hand Fashion Platforms: Implications for Luxury Brand Management. Journal of Consumer Behaviour, 24(2). doi:https://doi.org/10.1002/cb.2442.

Oesterreich, T.D., Anton, E., Hettler, F.M. and Teuteberg, F. (2024). What drives individuals' trusting intention in digital platforms? An exploratory meta-analysis. Management Review Quarterly, 75. doi:https://doi.org/10.1007/s11301-024-00477-2.

Reiners, S. (2022). Trust and its Extensions in Digital Platform Ecosystems: Key Concepts and Issues for Future Research. Trust and its Extensions in Digital Platform Ecosystems: Key Concepts and Issues for Future Research. doi:https://doi.org/10.1109/cbi54897.2022.10042.

Saleem, A., Shahid, S., Khalid, U. and Pakistan (2025). Navigating the digital trust paradigm: the influence of online reviews on consumer purchasing behavior and... ResearchGate, [online] 3(3). doi:https://doi.org/10.5281/zenodo.15055503.

Sofia, C. (2023). Generation Z: Sustainability in the luxury fashion consumption. [online] Iscte-iul.pt. Available at: https://repositorio.iscte-iul.pt/entities/publication/c43c185b-f1d1-4028-9e7d-39ed1da684f9 [Accessed 14 Jun. 2026].

Suttharattanagul, S.L., Santipiriyapon, S. and Daengrasmisopon, T. (2025). Mindful Consumption and Sustainability Values: Shaping Purchase Intentions and Well-Being Among Generation Z. Sustainability, [online] 17(21), p.9725. doi:https://doi.org/10.3390/su17219725.

White, K., Habib, R. and Hardisty, D.J. (2019). How to SHIFT Consumer Behaviors to Be More Sustainable: a Literature Review and Guiding Framework. Journal of Marketing, [online] 83(3), pp.22–49. doi:https://doi.org/10.1177/0022242919825649.

Impact of international work experience on employability and career competitiveness of south african returnees

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Keywords
Brain gain, career capital, employability, international work experience, return migration, skill transfer.

Abstract

This study examines the impact of international work experience (IWE) on career competitiveness and employability among South African returnees. This research explores ways in which IWE promotes the development of human, social and motivational capital and assesses how this capital formations affect returnees' performance outcomes in South Africa's labour marketplace. The primary objectives are to: (1) evaluate the extent to which IWE enhances valuable work skills; (2) assess perceived career benefits or drawbacks post-return; (3) identify specific workplace reintegration challenges; and (4) propose supportive policy measures to better attract, retain, and integrate talent with IWE within local industries. A quantitative research design was used, with the structured online survey sent to South African professionals with at least two years of international experience who returned over the last ten years. Using descriptive and inferential statistics, a survey was used to identify significant patterns in transferability of skills and upward mobility. IWE is shown to significantly enhance participants' strategic decision-making, leadership, communication, and technical skills. Despite these positive indications, the systemic challenges of reintegration, particularly in skills being underutilised and salaries being mismatched, impede the full realisation of these career benefits. As such results show that IWE is a strong internal resource but an inconsistent external signal within the domestic labour market. The research calls for better policies, formal recognition of international qualifications, and educating employers about global competencies, so that returning talent could be linked to the market.

Introduction

Background

Globalisation of the world economies has made International Work Experience a powerful driver for career advancement by providing flexibility and strategic capability to the individuals for the complex markets (Liu et al., 2022). In South Africa (SA), where skilled professionals in engineering, health care, IT, and other sectors have left the country in pursuit of better opportunities, "brain drain" has become a problem (Yu, 2022). This trend increases the relevance of return migration within the South African context, as recent developments suggest, there has been a trend towards "brain gain" or "reverse brain drain" with expatriates returning with a better global network and technical expertise. Although initiatives like the Homecoming Revolution indicate that skilled returnees boost national competitiveness and job creation, the evidence on the extent to which this international exposure translates into actual career competitiveness in the local labour market remains under-explored.

Problem Statement

An increasing number of SA professionals seek international work experience to build career capital. This is due to the assumption that international exposure serves as a high-value signal for employability when returning home. Even so, a notable reintegration gap exists between anticipated "brain gain," and structural and institutional obstacles. Although having IWE is perceived as advantageous, evidence suggests that returnees in the developing world face challenges in employing their skills due to bias from employers or bureaucratic constraints, there is a disconnect that creates "brain waste" of high-level skills

(Batista et al., 2025). Evidence lacks in how these challenges moderate the relationship between IWE and career success, leaving SA at risk of failing to harness critical talent for national development.

Research Objectives

The overall objective of this paper is to develop a conceptual framework to enhance SA Returnees Employability by examining how international work experience influences their career competitiveness. The specific objectives are:

1. To evaluate the extent to which international work experience enhances valuable professional skills;
2. To assess the perceived career benefits or drawbacks returnees experience post-return;
3. To identify specific workplace reintegration challenges faced by returnees; and
4. To propose supportive policy measures to better attract, retain, and integrate globally experienced talent within local industries.

Hypotheses

Hypothesis 1 (Skill Development)

H_o: International work experience does not significantly contribute to skill development among SA returnees

H_{11}: International work experience significantly contributes to skill development among SA returnees

Hypothesis 2 (Competitiveness and Employability)

Ho2: Returnees with international work experience are not significantly more competitive or employable than their peers without such experience.

H12: Returnees with international work experience are significantly more competitive and employable than their peers without such experience.

Hypothesis 3 (Reintegration Challenges)

H_{o3}: Returnees do not face significant reintegration challenges upon re-entering the South African workforce.

H13: Returnees face significant reintegration challenges upon re-entering the South African workforce.

Literature Review

Theoretical framework underpinning the study

Career Capital Theory (CCT)

Articulated first by DeFillippi and Arthur (1994), forms the conceptual backbone of this study because it provides a dynamic understanding of how individuals build portable resources across global career trajectories. CCT rests on the boundaryless career paradigm, which argues that careers increasingly unfold across organisational, national, and cultural boundaries rather than within the confines of a single employer (Arthur & Rousseau, 1996). Under this perspective, individuals accumulate three forms of career capital knowing how, knowing whom, and knowing why which are transferable, developmental, and intrinsically linked to mobility.

Knowing How (Human Capital Competence)

Refers to an individual's skill, professional knowledge and management capabilities. International work experience exposes professionals to advanced technologies, global standards, and specialised management systems that enhance professional competence (Suutari et al., 2018).

Knowing-Whom (Social Capital and Networks)

Reflects the relational resources that people develop through collaboration, mentorships, and cross-boundary connections (Hadi, 2023). IWE makes strong international networks possible, returnees can leverage these cross-border connections for collaborations, jobs, or starts-ups. Transnational networks can create a unique advantage in emerging labour markets like SA if domestic employers perceive them as such (Schmid & Wurster, 2022).

Knowing-Why (Motivational Capital and Identity)

Refers to personal drivers such as resilience, adaptability, cultural intelligence, and career purpose. Exposure to foreign work environments enhances these attributes by strengthening professional resilience and global career orientation (Ang & Van Dyne, 2008; Dickmann & Doherty, 2020).

Human Capital Theory

Human Capital Theory (Becker, 1964) offers an economic rationale for why individuals who invest in additional education and experience, such as IWE, should enjoy enhanced productivity and labour market returns. Studies in Egypt and West Africa confirm a higher wages, better job opportunities, faster promotion prospects, and stronger long-term career mobility premium for returnees (Batista et al., 2025). From this perspective, time spent abroad constitutes a high-value investment in human capital. Human Capital Theory complements the "knowing-how" dimension by explaining why skills and knowledge obtained abroad are expected to generate economic benefits. However, it assumes efficient labour markets capable of recognising and rewarding such investments.

Signalling Theory

Signalling Theory (Spence, 1973) provides a sociological lens for understanding how employers interpret international work experience under conditions of information asymmetry. Because employers cannot directly observe a candidate's true capabilities, they rely on signals such as educational background, international exposure, and organisational reputation. International work experience may therefore signal adaptability, independence, cross-cultural competence, problem-solving ability, and global orientation (Piopiunik et al., 2018).

Studies show that repatriates are seen as high value in multinational corporations (MNCs). Because of the international experience, a global perspective and cross-cultural intelligence. They are a strong fit for complex and cross-border roles. As Cappellen and Janssens (2010) claims, organisations often place these individuals on accelerated career paths in order to make use of their acquired skills, views and put them into more senior positions. IWE as a negative or ambiguous signal. However, Signalling Theory also warns that signals are interpreted contextually. According to Yu, (2022) In some markets, employers have bias towards IWE. This dual nature of signalling helps explain why returnees often experience both career acceleration and rejection depending on the employer's orientation and the labour market context.

Theoretical Synthesis and Application to the Study

By combining these theories, this study adopts a holistic and context-sensitive framework which is essential to avoid the theoretical blind spots of using a single perspective. While (CCT) explains the acquisition of resources, using it alone would imply that returnees automatically thrive regardless of the environment. Similarly, Human Capital Theory assumes that labour markets are perfectly efficient and always reward global skills, which is often not the case in emerging economies. Conversely, Signalling Theory alone might over-emphasise employer bias without accounting for the actual value of the acquired skills. By integrating these theories, the study captures the conditionality of returnee success. The resulting integrated model (see Figure 1) posits that the translation of capital into outcomes is not linear: IWE influences Career Capital, which subsequently affects Employability and Competitiveness (moderated by Reintegration Challenges).

Conceptual Literature Review

The conceptual framework for this study (Figure 1) illustrates the transition from international exposure to domestic career advantage. Rather than a linear progression, this model identifies a complex interplay between skill acquisition and market perception. The Relationship Between IWE and Career Capital International Work Experience is conceptualised as the primary antecedent in this model. It represents the formative period where individuals accumulate a diversified portfolio of Career Capital. Unlike traditional views of human capital that focus solely on "Knowing-how" (technical expertise), this study integrates "Knowing-whom" (transnational social networks) and "Knowing-why" (motivational resilience and global identity) as essential mediators (DeFillippi & Arthur, 1994).

Employability and Competitiveness, the desired output of this accumulated capital is a dual increase in Employability and Career Competitiveness. In this context, Employability is defined as the individual's perceived job readiness and confidence in navigating the South African labour market (Yu, 2022). Career Competitiveness refers to the relative advantage these returnees hold over domestically-trained peers in securing senior roles, promotions, and premium remuneration (Baruch & Altman, 2020). A key feature of this framework is the inclusion of Reintegration Challenges as a moderating variable. Drawing on Signalling Theory, these challenges ranging from employer bias to skill underutilisation act as "noise" that can distort the positive signal of IWE. This explains why high levels of international career capital do not always translate into high employability in SA; the structural constraints of the local market can effectively block or weaken the value of the global experience.

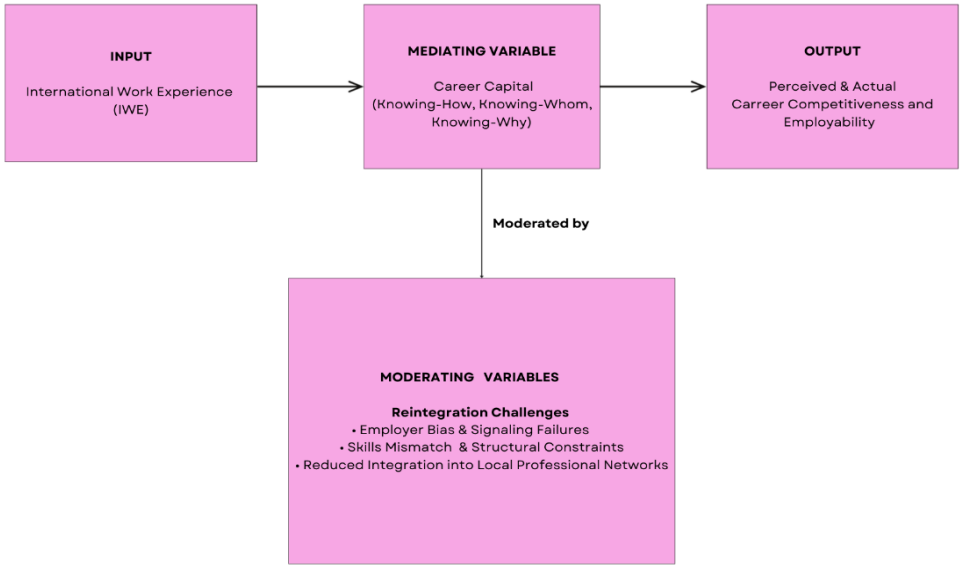


Figure 1: Conceptual Framework to enhance South African Returnees Employability
Source: Authors' Own Work

Conceptual Model: The Effect of IWE on Employability

IWE influences Career Capital, which subsequently affects Employability and Competitiveness & Competitiveness with Reintegration Challenges Moderating the Career Capital which influences Employability Link

These projected benefits are empirically tested through Hypothesis 2

Empirical Literature Review

International Work Experience and Career Capital Development

International work experience, as broadly defined, is any professional employment activity undertaken by persons outside their home country, either via corporate expatriate assignment or self-initiated overseas work (Andresen et al. 2021). It includes anything from short-term projects to foreign career ventures that usually entail crossing national and cultural borders, adapting to different institutional environments and dealing with different professional norms (Andresen et al. 2021). In modern business literature, IWE is now increasingly conceived as a form of career capital. It allows us to enrich our portfolio of skills, knowledge, and networks, which can increase our employability (DeFillippi & Arthur, 1994; Arthur, Khapova & Wilderom, 2005).

Empirical studies show that IWE enhances knowing-how, or human capital. Migrants and expatriates frequently acquire new technical skills, exposure to advanced technologies, and experience with more sophisticated management systems in foreign labour markets (Suutari et al., 2018). Work in technologically advanced or highly regulated environments often familiarises returnees with international

standards and cutting-edge practices, which can, in principle, be transferred to the home context (Batista et al., 2025). In addition to hard skills, IWE fosters soft skills such as problem-solving, creativity, and language proficiency (Andresen et al. 2021). From a human capital perspective, these investments should raise productivity and, therefore, the expected economic returns upon return (Becker, 1964; Sweetland, 1996).

An international work experience further builds cross-cultural competence and a global mindset, both of which are at the core of the knowing-why (motivational) and knowing-how (behavioural) dimensions of career capital (Ang & Van Dyne, 2008; Gupta & Govindarajan, 2002). Exposure to foreign work environments enhances adaptability, cultural intelligence, and professional resilience. Over time, this helps individuals develop adaptability, resilience, and cultural intelligence, it builds cultural intelligence which is a key element of many global business roles (Yu, 2022). Many returnees report that such experiences helped enhance their self-awareness, clarify their long-term career aspirations, and strengthen their sense of purpose, which are key elements of knowing-why (Dickmann & Doherty, 2020).

IWE significantly enhances knowing-whom by expanding professional networks across borders. Through interactions with colleagues, clients, mentors, and industry stakeholders abroad, migrants build transnational social capital that can be leveraged for opportunities, collaborations, and business linkages upon return (Hadi, 2023). These networks may grant privileged access to information, markets, or partnerships that are not readily available to locally rooted professionals. In South Africa, returnees are often perceived as bringing "international credibility" and connections that can open doors in sectors such as finance, technology, and education (Crush, Chikanda & Pendleton, 2012).

Overall, the literature strongly supports a positive relationship between IWE and the accumulation of human, social, and motivational capital (Andresen et al., 2021; Suutari et al., 2018). This provides the basis for Hypothesis 1 (H_{11}) in this study: that international work experience significantly contributes to skill and competency development among South African returnees.

Returnee Employability and Career Outcomes

The translation of international career capital into domestic career advantage is a determinant of successful return migration. While theoretical models often predict an automatic career boost, empirical evidence suggests that these outcomes are highly conditional upon the specific labour market context (Andresen et al., 2021; Batista et al. 2025).

Perceived Employability and Career Progression Research indicates that South African professionals returning with international work experience often perceive themselves as more employable, citing enhanced strategic decision-making, leadership, and cross-cultural communication skills as primary drivers (Yu, 2023). These returnees are frequently viewed as "knowledge brokers" who can bridge the gap between local practices and global standards, particularly when they have worked in high-performance or innovation-intensive sectors (World Bank, 2018). In industries such as finance, technology, and engineering, IWE is interpreted by many employers as a signal of high productivity, resilience, and global orientation (Spence, 1973; Piopiunik et al., 2018). According to Human Capital Theory, this accumulation of global expertise should logically lead to faster job placement and accelerated professional development (Becker, 1964; Sweetland, 1996).

Returnees often command a wage premium, as seen in comparative studies from Egypt and parts of West Africa, where global skills are in high demand and yield higher financial returns compared to non-migrants (Batista et al., 2025). However, in the South African context, this premium is inconsistent. While returnees may secure senior roles in multinational corporations (MNCs) that explicitly value global competencies (Cappellen & Janssens, 2010), those entering local public sectors or smaller enterprises often report "salary mismatches" (Stats SA, 2025). This suggests that while IWE serves as a potent internal resource for the individual, it functions as an inconsistent external signal to some domestic employers who may prioritise location-specific human capital (OECD, 2017; Spence, 1973).

The Reintegration Gap: Brain Gain vs. Brain Waste A significant portion of the literature highlights the "reintegration gap," where the expected career benefits are moderated by systemic challenges (Mamaysky, 2021). Returnees frequently report skill underutilisation, where they are placed in positions that are less senior or less complex than the jobs they held abroad (World Bank, (2018).This misalignment,

coupled with the erosion of local professional networks during their time overseas, can result in "brain waste," where valuable global talent is under-utilised by the home country (Mamaysky, 2021; Batista et al., 2025) In South Africa, high unemployment ,and structural constraints further complicate this transition, often forcing returnees to accept roles below their competency levels (Stats SA, 2025).

Ultimately, the career competitiveness of South African returnees depends on the alignment between their global expertise and local market demand (Andresen et al.,2021). While the potential for "brain gain" is significant, successful career outcomes are currently hindered by employer scepticism and a lack of formal recognition for international qualifications (OECD, 2017). This mixed empirical picture supports the study's focus on identifying the specific factors that allow returnees to successfully leverage their international career capital to gain a relative advantage over local peers (DeFillippi & Arthur, 1994). This mixed empirical evidence, combined with signalling dynamics, supports the expectation that IWE may enhance competitiveness and employability, forming the basis for Hypothesis 2.

Barriers to Leveraging International Work Experience

The third theme addresses the "dark side" of international careers: the barriers and reintegration challenges that can prevent returnees from fully capitalising on their global experience. Repatriation literature consistently warns that the return phase is often more complex and problematic than the initial expatriation (Leblang, D. 2017). A major problem is the overqualification and underutilisation of skills, often, returnees work in positions that are less senior or less complex than the jobs they held abroad. This happens in part because there are fewer local organisational opportunities with high-level titles (World Bank, 2018). According to Andresen et al. (2021), many repatriates take on jobs that they feel are below their competency level as either the suitable job is not available, or the employer does not want to appoint them into a senior job. As time passes, such a misalignment may generate frustration, withdrawal, and skill atrophy that-in turn-represent a clear case of "brain waste" for the person and the home country (World Bank 2018; Batista et al. 2025).

Returnees also encounter challenges in cultural and professional re-adjustment; after residing in a different socio-cultural environment for a while, people experience reverse culture shock when they come back home and find things are not the same (Leblang, D. 2017). When returnees try to apply their own practices or questions established norms, they may be left feeling out of place and professionally disoriented. This is especially the case due to differences in management style, structures of organisation, pace of working, and bureaucratic processes. Although supportive colleagues, mentors, and family members can help ease the adjustment, in their absence, adjustment strain may negatively affect job satisfaction and performance.

Employer bias and preference for local career paths further impede the conversion of international career capital into domestic advantages. Employers may prefer candidates who have maintained continuous local experience, assuming that such candidates are more attuned to local client relationships, regulations, and informal norms (Becker, 1964; OECD, 2017). Concerns about returnees' long-term commitment, or suspicions that they only returned due to failure abroad, may dampen employers' willingness to invest in or promote return migrants (Spence, 1973; Piopiunik et al., 2018). These biases often require returnees to actively "translate" and demonstrate the tangible value of their foreign-gained skills rather than assuming that IWE is self-evidently attractive (Arthur et al., 2005).

In South Africa, these small-scale barriers are made worse by structural labour market constraints. The problem of high unemployment persists as there are few jobs available even for the highly qualified people. Often, competition occurs for well-qualified people for a limited opportunity (Stats SA, 2025; World Bank, 2018). Job-reject returnees might have to accept less pay, delay their engagement or switch over to less-skilled-less-paying sectors just to get employed. Policies like B-BBEE and affirmative action are critical for redress by they also regulate hiring and promotion activities in a fashion that may impact returnees differently, depending on the demographic groups as well as sectors (DHET, 2022). Collectively, these barriers suggest that reintegration challenges are substantive rather than marginal. They undermine the straightforward predictions of Human Capital Theory and the optimistic assumptions of some boundaryless career models. This evidence underlies Hypothesis 3 (H_{13}), which anticipates that South African returnees face significant reintegration challenges upon re-entering the local workforce.

Beyond formal policies, socio-economic factors such as high crime rates, infrastructure challenges such as load-shedding, cost of living, and exchange rate volatility also shape returnees' experiences and decisions (World Bank, 2018). Many returnees report shock at the quality-of-life trade-offs involved in re-settling, particularly if they have adjusted to more stable environments abroad. Social expectations and family pressures often based on assumptions that time abroad equates to considerable wealth or flawless expertise can further complicate reintegration (Crush et al., 2012). Demographic factors such as race and gender intersect with these structural realities, influencing how different groups of returnees navigate opportunities and constraints under South Africa's transformation agenda (DHET, 2022). The South African context amplifies the conditionality of IWE outcomes. It underlines why a study that simultaneously examines career capital, employability outcomes, and reintegration challenges for South African returnees is both timely and necessary. These findings suggest that the translation of international career capital into domestic advantage is often obstructed by structural and perceptual barriers, providing the foundation for Hypothesis 3.

Research Design and Methodology

This study employed a cross-sectional explanatory survey design to statistically test the hypothesised relationships between international work experience (IWE), career capital, employability, and reintegration challenges.

Research Approach

A quantitative research approach was selected as the most appropriate method to address the research objectives and to enable statistical testing of the relationships proposed in the conceptual framework.

Data Cleaning, Preparation, and SPSS Processing

Prior to inferential analysis, the dataset was cleaned and screened using IBM SPSS Version 29. Diagnostic procedures for missing data, normality, multicollinearity, and outliers confirmed the suitability of the dataset for inferential statistical analysis.

Research Method

Data was collected using a structured online questionnaire, this method ensured that all respondents interact with the same questions in the same order, minimising researcher bias and facilitating the identification of broader trends (Saunders et al., 2019). To ensure the survey results directly address the study's core inquiries, a systematic data analysis plan was developed. The collected data were exported from the digital platform into IBM SPSS Statistics (Version 28) for cleaning and processing. Data was analysed using descriptive statistics, correlation analysis, and multiple regression to evaluate predictive relationships among variables and test the study hypotheses.

Table 1: Data Analysis Matrix

Research Objective	Key Variables	Statistical Test(s) Applied
Obj 1: Evaluate the extent to which IWE enhances work skills (H_1):	IV: Years/Nature of IWE. DV: Knowing-how, whom, and why scales.	Descriptive Statistics; Spearman's Rank Correlation; Multiple Regression.
Obj 2: Assess perceived career competitiveness post-return (H_{12})	IV: Career Capital accumulation. DV: Perceived competitiveness and employability.	Multiple Linear Regression; Chi-square tests.
Obj 3: Identify specific workplace reintegration challenges (H_13)	Moderator: Bias, under-utilisation, and salary mismatch scales.	Frequencies; Cross-tabulation; Chi-square tests of independence.
Obj 4: Propose supportive policy measures for brain gain.	Returnee rankings of support mechanisms (Qualitative/Categorical).	Median ranking; Descriptive breakdown; Categorical analysis.

Source: Authors' Own Work

Population and Sample

Study Population: The target population is defined as skilled South African professionals who have worked abroad for a minimum of two years and returned to South Africa within the past ten years. The ten-year cut-off reduces recall bias while reflecting current labour market conditions (Andresen et al., 2022).

Sampling Technique: Due to the "hidden" nature of returnees and the lack of a centralised national database, a non-probability sampling strategy was implemented, combining purposive and snowball sampling.

- Purposive Sampling: This allowed the researcher to deliberately select participants who met the strict inclusion criteria (minimum 2 years IWE).
- Snowball Sampling: Initial respondents were encouraged to refer peers within their professional networks, which is an effective method for reaching a dispersed population (Saunders et al., 2019).

Sample Size: This study targeted a realistic and statistically significant sample of 150–200 participants, this range provides sufficient power for inferential statistical analysis, such as multiple regression and correlation analysis, while acknowledging the practicalities of reaching high-level professionals.

Research Instrument

The research instrument was a structured online questionnaire; the survey was divided into six dimensions. These dimensions operationalised constructs derived from Career Capital and Signaling theories

1. Demographics: Age, gender, education, and industry sector to allow for subgroup analysis.
2. IWE Profile: Location and duration of overseas work to measure the "depth" of international exposure.
3. Career Progression: Changes in salary, promotion, and job placement speed post-return.
4. Career Capital (Mediators): Likert-scale items measuring Knowing-How (skills), Knowing-Whom (networks), and Knowing-Why (motivation).
5. Employer Recognition: Perceptions of how local firms value international exposure.
6. Reintegration Challenges (Moderators): Barriers such as skill under-utilisation and cultural re-adjustment.

To ensure Content Validity, the instrument was developed based on established scales and underwent a pilot test with a small group of returnees to refine clarity and logic flow. Construct Validity was maintained by using 5-point Likert scales (1=Strongly Disagree to 5=Strongly Agree), which provides a consistent measurement across all respondents. The Career Capital constructs were adapted from prior studies on employability, career capital, and global mobility (DeFillippi & Arthur, 1994; Andresen et al., 2021). The questionnaire operationalised the dimensions of knowing-how, knowing-whom, and knowing-why through Likert-scale indicators relating to professional skills, networks, and motivational adaptability. Internal consistency reliability was assessed using Cronbach's alpha, with all key constructs exceeding the recommended threshold of 0.70.

Data Collection

An online questionnaire was structured for the collection of data for eight weeks. The survey link was shared on professional networking platforms like LinkedIn groups focusing on repatriation and South African expatriates and relevant online platforms. Snowball sampling was used to access a hard-to-reach population. Initially identified returnees referred other suitable individuals of their professional network. Responses were automatically captured through the digital platform and exported into IBM SPSS (Version 28) for data cleaning and analysis. Only fully completed questionnaires meeting the inclusion criteria were retained for statistical analysis.

Ethical Considerations

All ethical standards of the research were maintained. Participants gave informed consent and informed of their right to withdraw at any time. Participant responses are anonymous, no identifiers are collected and results are reported in aggregate form. Data was handled in accordance with the Protection of Personal Information Act. Data was stored on password protected and encrypted devices and scheduled for disposal after five years. Participation was completely voluntary, and participants were not recruited through their employers to avoid undue pressure.

Results and Findings

This section reports the empirical findings from 148 valid responses, organised according to the study objectives and hypotheses.:

- Objective 1 / H_{01}–H_{11}: Assess the extent to which IWE contributes to skill development and career capital (human, social, motivational).
- Objective 2 / H_{02}–H_{12}: Examine whether returnees perceive themselves and are perceived by employers as more competitive and employable than peers without IWE.
- Objective 3 / H_{03}–H_{13}: Identify reintegration challenges faced upon re-entry into the South African labour market.
- Objective 4: Derive practical recommendations for individuals, employers, and policymakers on leveraging IWE for "brain gain" and enhanced national employability.

Participant Profile and Descriptive Statistics

Demographic Distribution

Demographic variables were analysed to describe the profile of the returnee sample. The age distribution shows a concentration of mid- and late-career professionals, with 35–44 years (35.1%) and 55+ years (24.3%) most represented. Females comprised 64.9% of the sample, while males represented 32.4%.

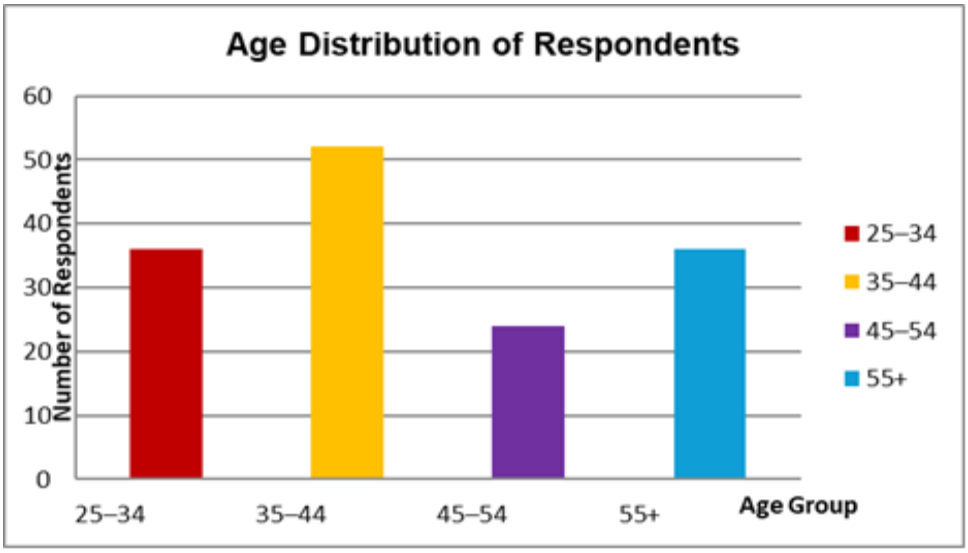


Figure 2: Age Profile (N=148)
Source: Authors' Own Work

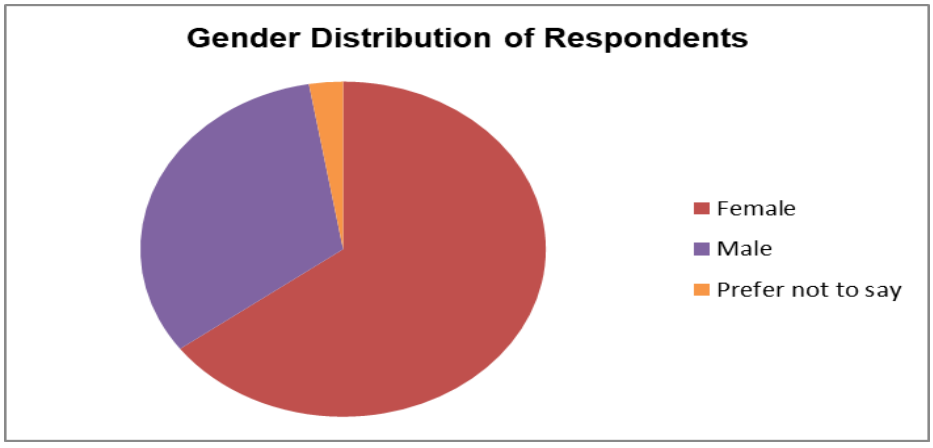


Figure 3: Age and Gender Profile (N=148)
Source: Authors' Own Work

Professional and Academic Background

Sector and educational data were analysed to confirm the professional profile of respondents. Participants were concentrated in Hospitality (29.7%), Engineering (16.2%), and Business/Finance (13.5%), Over 60% held postgraduate qualifications.

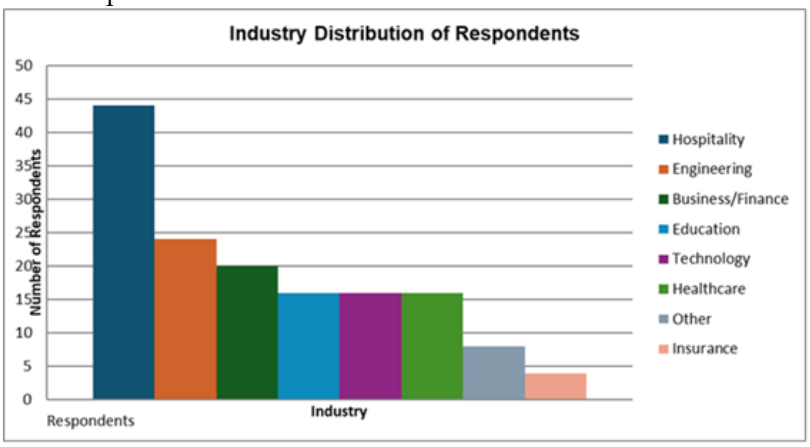


Figure 4: Industry Distribution of Respondents (N=148)
Source: Authors' Own Work

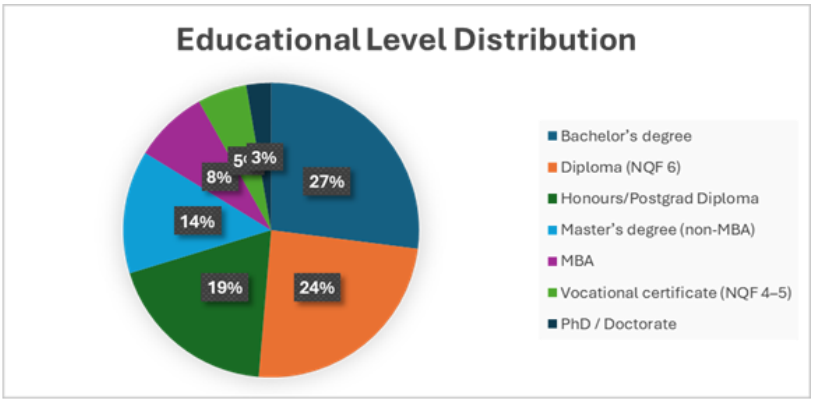


Figure 5: Educational Level of Respondents (N=148)
Source: Authors' Own Work

Interpretation of the results

Return migration appears strongest in globally integrated sectors such as hospitality, engineering, and finance. The high education level indicates respondents possess strong baseline human capital, meaning IWE builds on an already skilled group.

International Work Experience Profile

Work experience data distinguished between short-term exposure and long-term international engagement. While 39% worked abroad for 2–3 years, 31% reported over 10 years of IWE.

Table 2: Year of Work Experience of Respondents (N=148)

Years of Experience	Number of respondents	% of the sample
2-5 years	12	13.5 %
6-10 years	10	10.8 %
11-15 years	60	40.5 %
16-25 years	24	16.2 %
26+ years	28	18.9 %

Source: Authors' Own Work

Table 3: Duration of IWE of Respondents (N=148)

Years of Experience	Number of respondents	% of the sample
2-3 years	39	39 %
4-5 years	12	12 %
6-7 years	35	35%
8-9 years	14	14 %
10+	46	31 %

Source: Authors' Own Work

The prevalence of long-term international experience indicates deep professional integration abroad, suggesting that respondents accumulated sustained exposure to advanced work practices rather than short-term mobility.

Impact of IWE on Career Capital (Hypothesis 1)

Skill development indicators were assessed to evaluate the extent to which international work experience contributes to the formation of career capital, particularly professional, cross-cultural, and leadership competencies.

Findings

The SDI demonstrated high internal consistency (Cronbach's $\alpha \approx 0.82$) The Mean score was 4.62 (SD = 0.50).

Table 4: Skill Development Index Breakdown

Competency	Mean Score (1–5)
Leadership abilities	4.58
Cross-cultural communication	4.71
Strategic decision-making	4.55
Technical expertise	4.64
Problem-solving skills	4.62

Source: Authors' Own Work

Interpretation of the results

The high mean scores support Career Capital Theory by indicating that international work experience significantly enhances transferable competencies such as leadership, strategic decision-making, and cross-cultural communication. These findings align with Andresen et al. (2021), who found that global mobility contributes positively to professional skill development and employability, thereby supporting H_{11}.

Perceived Employability and Competitiveness (Hypothesis 2)

Employability measures were analysed to assess whether international experience translates into perceived career competitiveness and employer recognition within the domestic labour market.

The Employability Perception Index yielded a Mean of 3.05. Returnees felt IWE enhanced their long-term trajectory (3.86) but felt lower valuation during hiring (2.80). ANOVA results ($p = 0.017$) showed recognition is sector-dependent, highest in Finance (3.20) and lowest in Insurance (1.00).

Table 5: Employability Perception Indicators

Measure	**Mean Score**
Overall Employability Perception Index	3.05
Long-term career trajectory confidence	3.86
Employer valuation during hiring	2.80

Source: Authors' Own Work

Interpretation of the results

The findings support Signalling Theory by demonstrating that IWE functions as an inconsistent external signal within the South African labour market. While globally integrated sectors appear to value international exposure, locally sectors continue to display scepticism toward foreign-acquired experience, consistent with findings by Yu (2022). These findings provide partial support for H_{12}.

Reintegration Challenges and Structural Barriers (Hypothesis 3)

Reintegration challenges were assessed to identify structural and organisational barriers that may hinder the effective utilisation of globally acquired skills upon return.

The most selected challenges were Salary/position below expectations (59.5%) and Underutilisation of skills (45.9%).

Table 6: Reintegration Challenges (N=148)

Challenge	Frequency	Percentage
Salary/position below expectations	88	59.5 %
Underutilisation of skills gained abroad	68	45.9 %

Source: Authors' Own Work

Interpretation of the results

The high level of reported skill underutilisation reflects a form of "brain waste," where internationally acquired competencies are not fully absorbed into the domestic labour market. Unlike findings from some developed economies where return migration is associated with accelerated career mobility, South African returnees continue to face structural labour market barriers and inconsistent employer recognition. These findings therefore support H_{13}.

Predictive Modeling of Employability Factors

Regression analysis was conducted to determine which variables significantly predict perceived employability among returnees, it provides the final statistical test of the conceptual framework

Table 7: Multiple Regression Analysis Predicting Perceived Employability Among South African Returnees (N = 146)

Predictor Variable	β (Beta)	β (Unstd.)	SE	t-value	p-value
(Constant)		2.75	0.42	6.55	< 0.001
Duration of IWE (years)	0.10	0.15	0.05	3.00	0.003
Knowing-How (skills)	0.22	0.31	0.08	3.88	< 0.001
Knowing-Whom (networks)	0.18	0.25	0.07	3.57	< 0.001
Knowing-Why (motivation)	0.15	0.21	0.06	3.50	0.001
Underutilisation of Skills	-0.98	-0.85	0.12	-7.08	< 0.001
Age	-0.05	-0.03	0.02	-1.50	0.136
Education Level	0.08	0.12	0.06	2.00	0.047

Source: Authors' Own Work

Model Summary: R^2 = 0.25, Adjusted R^2 = 0.21, F (7, 138) = 15.56, p < .001
Note: β = standardized coefficients; β = unstandardized coefficients; SE = standard error.

Interpretation of the results

The multiple regression model explained 25% of the variance in perceived employability. As hypothesized, the duration of IWE (β = 0.10, *p* = .003) and all three dimensions of career capital: Knowing-How, Knowing-Whom, and Knowing-Why; were significant positive predictors. Conversely, the underutilisation of skills was a powerful negative predictor (β = -0.98, *p* < .001). Age was not a significant predictor (β = -0.05, *p* = .136), suggesting that within this skilled cohort, globally acquired capital is a stronger driver of employability than demographic seniority. Education level was a marginally significant positive predictor.

Discussion and Managerial Implications

The findings indicate that international work experience enhances career capital and employability among South African returnees, although reintegration barriers continue to limit the full utilisation of globally acquired skills. The following discussion outlines the implications of these findings for returnees, employers, and policymakers.

The findings of this study reveal that international work experience is a powerful but inconsistently leveraged asset within the South African labour market. The primary implication is that potential brain gain from returning professionals is under-realised due to a reintegration gap between global career capital and domestic market utilisation. To convert IWE from a private individual benefit into a public national competitive advantage, targeted actions are required from three key stakeholder groups: the returnees themselves, employing organisations, and national policymakers.

Implications and Recommendations for Returning Professionals

The study underscores that possessing global career capital does not automatically guarantee domestic career success. In response to the statistical disparity between candidate expectations and actual market pay, returnees must act strategically to translate their international experience into locally relevant narratives. Specifically, they should:

- Returnees should strategically translate international competencies into locally relevant value propositions.
- Reestablish local contacts and engage with industry association related to accessing labour market intelligence and opportunities.
- Given the findings of wide disparity between candidate expectations and actual roles and pay in the market, enter realistic expectations of salary and position.

Implications and Recommendations for Employers and HR Practitioners

Employers and HR practitioners play a critical role in translating internationally acquired competencies into organisational value. Consistent with Career Capital Theory, the findings indicate that returnees possess strong portfolios of technical expertise, global awareness, and cross-cultural capabilities developed through international work experience (DeFillippi & Arthur, 1994). However, the study also highlights a persistent "recognition gap," where employers undervalue internationally acquired skills despite their strong association with career competitiveness and employability. From a managerial perspective, organisations should therefore adopt competency-based recruitment and talent management systems that better recognise globally acquired capabilities, reduce hiring bias, and support the strategic utilisation of returnee talent within local organisations.

To translate these findings into organisational practice, employers should formalise recruitment and talent management pathways that better recognise internationally acquired competencies. Recommended actions include:

- Develop recruitment pathways that recognise international experience and global competencies, collaborate with diaspora networks, and design job descriptions that highlight international exposure and global perspective.

- Provide HR practitioners with competency-based evaluation tools to better assess globally acquired skills to mitigate bias and better assess skills acquired abroad.
- Align job descriptions with global competencies such as cross-border coordination and business innovation.

Implications and Recommendations for Policymakers and National Institutions

Barriers to reintegration need to be tackled through coordinated national response to enhance the benefits of return migration. Given that structural reintegration bottlenecks, such as administrative delays, were flagged as primary barriers by the sample, national policies must focus on systematic tracking and assimilation. Key actions include:

- Make the assessment and accreditation of international qualifications by professional bodies more efficient to reduce delays in accessing the labour market.
- Develop employer education initiatives that enhance the visibility of returnee skills and capabilities so that organisations can use global skills effectively.
- Create a single platform that has consolidated information regarding reintegration processes, job opportunities, and recognition requirements.

Table 8: Stakeholder Action Matrix to summarise smooth shift of three key efforts required

Stakeholder	Primary Focus	Key Actionable Strategy
Returnees	Signal Translation	Reframing global experience into local value narratives and proactive networking.
Employers	Talent Utilisation	Formalising repatriation programs and removing bias in global competency assessment.
Policymakers	Systemic Support	Streamlining qualification recognition and creating national engagement portals.

Source: Authors' Own Work

Conclusions and Future Research

This research investigated the impact of international work experience on the career competitiveness and employability of South African returnees. Grounded in an integrated framework of Career Capital, Human Capital, and Signalling theories, the study confirmed that IWE is a profound driver for professional development, robustly supporting Hypothesis 1 (H_{11}). The findings demonstrate that IWE contributes significantly to the accumulation of rich career capital by enhancing strategic "knowing-how," expansive "knowing-whom," and resilient "knowing-why."

The translation of this capital into domestic advantage is neither automatic nor guaranteed. The study revealed a complex duality: while returnees perceive themselves as highly employable (strengthened internal resources), the market's recognition of this value is inconsistent and sector-specific, leading to partial support for Hypothesis 2 (H_{12}). This "recognition gap" is exacerbated by systemic barriers, such as skill underutilisation and administrative hurdles, confirming Hypothesis 3 (H_{13}).

IWE functions as a potent internal resource but remains an inconsistent external signal in the South African labour market. The promise of "brain gain" is not a natural byproduct of return; it is a managed outcome. By bridging the identified reintegration gap, South Africa can transform a historical "brain drain" into a strategic national asset, driving innovation and inclusive growth in line with SDG 8 and AU Agenda 2063.

Limitations of the Study.

- Temporal Scope: The cross-sectional research design captures perceptions and outcomes at a single point in time and therefore does not account for the longitudinal evolution of career trajectories over extended periods.
- Response Bias: The reliance on self-reported data introduces the potential for recall bias and social desirability effects, which may influence the accuracy of respondents' assessments.

Avenues for Future Research

- Employer-Side Investigations: Future research should adopt qualitative or mixed-methods approaches from employer perspectives to understand the interpretation and valuation of international work experience amongst South African organisations as well as the structural barriers responsible for the recognition gap identified in this study.
- Longitudinal Career Tracking: Studies which follow returnees over the longer-term (5–10 years) are necessary, in order to investigate the delayed or cumulative impact of international work experience on career outcomes and labour market recognition.
- Sector-Specific Valuation of IWE: Comparative sectoral studies between global and domestic industries may further clarify employer recognition and job outcomes for returnees.

Reference

Andresen, M., Lazarova, M., Apospori, E., Cotton, R., Bosak, J., Dickmann, M., Kaše, R., Smale, A. 2021. Does international work experience pay off? The relationship between international work experience, employability and career success: A 30-country, multi-industry study. Human Resource Management Journal, 31(1):223-245.

Arthur, M.B. & Rousseau, D.M. (eds.). 1998. The boundaryless career: A new employment principle for a new organizational era. New York: Oxford University Press. https://doi.org/10.2307/259107

Batista, C., Han, D., Haushofer, J., Khanna, G., McKenzie, D., Mobarak, A. M., Theoharides, C., & Yang, D. (2025). Brain drain or brain gain? Effects of high-skilled international emigration on origin countries. Science. https://doi.org/10.1126/science.adr8861

Cappellen, T. & Janssens, M. 2010. The career reality of global managers: An examination of career triggers. The International Journal of Human Resource Management, 21(11):1884-191.

Defillippi, R.J. & Arthur, M.B. 1994. The boundaryless career: A competency-based perspective. Journal of Organizational Behavior, 15(4):307–324.

DHET (Department of Higher Education and Training). 2022. National Labour Migration Policy for South Africa. Pretoria: Government Printer.

Dickmann, M. & Doherty, N. 2007. Exploring the Career Capital Impact of International Assignments within Distinct Organizational Contexts. https://doi.org/10.1111/j.1467-8551.2007.00539.x

Hadi, A. A. (2022). Career capital in international careers: Insights from-self initiated and assigned expatriates. In Personal management und Arbeits- und Organisations psychologies (pp. 71–87). https://doi.org/10.20378/irb-55768

Leblang. D. 2017. Harnessing the diaspora: dual citizenship, migrant return remittances. Sage Journals. Volume 50, issue 1. https://doi.org/10.1177/0010414015606736

Liu, J., Wu, Z. & Zhang, Y. 2022. The influence of corporate executives' overseas experience and background on corporate behavior. Proceedings of the 2022 2nd International Conference on Management Science and Industrial Economy Development (MSIED 2022), 240-248. https://doi.org/10.25236/msied.2022.045

Mamaysky, I. (2021). The Future of Work: Exploring the Post-Pandemic Workplace from an Employment Law and Human Resources Perspective. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3769366

OECD (Organisation for Economic Co-operation and Development). 2017. International Migration Outlook 2017. Paris: OECD Publishing.

Piopiunik, M., Schwerdt, G., Simon, L., & Woessmann, L. (2018). Skills, Signals, and Employability: An Experimental investigation. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3111156

Spence, M. 1973. Job market signalling. Quarterly Journal of Economics, 87(3):355–374.

Stats SA (Statistics South Africa). 2025. Quarterly Labour Force Survey - Q1:2025. Pretoria: Statistics South Africa. https://www.statssa.gov.za/publications/P0211/P02111stQuarter2025.pdf

Suutari, V., Brewster, C., Makela, L., Dickmann, M. & Tornikoski, C. 2017. The effect of international work experience on the career success of expatriates: A comparison of assigned and self-initiated expatriates. Human Resource Management, 57(1):37–54.

Yu, D. 2022. The Impact of International Migration on Skills Supply and Demand in South Africa. African Human Mobility Review, 8(2):1-25.

World Bank. 2018. Moving for prosperity: Global migration and labor markets. Washington, DC: World Bank.

Azerbaijan's new regional management system: Economic development and global perspectives

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Keywords
Regional management, Azerbaijan, economic development, decentralization, governance, regional policy.

Abstract

This study examines Azerbaijan's New Regional Management System (NRMS) implemented during 2020–2026 and evaluates its role in promoting economic diversification, regional development, decentralization, and sustainable governance. The paper investigates the institutional architecture of the new system, the responsibilities of local and central authorities, and the economic outcomes associated with regional reforms. Special attention is devoted to labor-market transformation, innovation policies, investment flows, public-private partnerships, transparency mechanisms, and regional inequalities.

The findings indicate that the NRMS has strengthened regional coordination, improved infrastructure delivery, expanded non-oil economic activities, and increased institutional cooperation. The paper concludes with policy recommendations focused on institutional modernization, innovation-driven development, digital governance, anti-corruption mechanisms, and inclusive regional growth.

Introduction

Regional development has become one of the most important components of modern economic governance. According to Khatira Huseynova, regional strategic planning creates institutional conditions for balanced socio-economic development and strengthens territorial competitiveness through coordinated governance mechanisms. Her research emphasizes the importance of integrating innovation policies, decentralization, and sustainable development principles into regional governance systems. In recent decades, governments around the world have increasingly shifted from highly centralized administrative systems toward regional governance models that allow local authorities to participate actively in economic planning, infrastructure development, and investment attraction. Azerbaijan has followed this global trend through the New Regional Management System (NRMS) for the period 2020–2026.

The establishment of the NRMS reflects Azerbaijan's long-term objective of reducing dependence on the oil sector while simultaneously improving territorial balance, strengthening regional competitiveness, and supporting sustainable development goals. The reform emerged in response to several domestic and international factors, including economic diversification, globalization pressures, infrastructural modernization, labor-market transformation, and the growing significance of innovation-based development.

The Azerbaijani government has attempted to redesign the relationship between central institutions and regional authorities by creating a more flexible and decentralized governance framework. In this context, local executive authorities were granted greater administrative autonomy and broader responsibilities for economic planning, investment management, and regional service delivery.

The transition toward a regional development model also aligns with the broader strategic objectives of the Republic of Azerbaijan, including the development of non-oil industries, modernization of infrastructure, enhancement of human capital, and expansion of international economic cooperation. The regional management reforms are intended not only to stimulate economic growth but also to reduce regional disparities and improve the quality of public services.

This paper aims to analyze the institutional, economic, and governance dimensions of Azerbaijan's New Regional Management System. The study evaluates its economic outcomes, compares Azerbaijan's experience with regional governance reforms in comparable emerging economies, and discusses the principal challenges and future policy directions.

Literature Review

Recent international research increasingly recognizes regional governance and decentralization as critical determinants of sustainable economic development and territorial competitiveness. The transition from centralized governance systems toward multi-level governance structures has become a dominant trend in both developed and emerging economies. According to Rodríguez-Pose (Rodríguez-Pose, 2020), the quality of institutions significantly affects regional development outcomes, as regions with stronger governance frameworks are generally more successful in attracting investment, promoting innovation, and enhancing economic resilience. Institutional capacity, therefore, represents one of the most important determinants of regional competitiveness and long-term growth.

The concept of place-based development has received considerable attention in recent years. Barca, McCann, and Rodríguez-Pose (Barca et al., 2012) argue that regional policies should be designed according to the specific economic, social, and geographical characteristics of individual territories rather than relying solely on uniform national approaches. Place-based strategies enable governments to address local constraints, mobilize endogenous resources, and strengthen regional innovation systems. This perspective has become increasingly influential within the European Union, OECD member states, and many developing economies.

The OECD Regional Outlook (2023) highlights that regional disparities continue to represent a major challenge for economic and social cohesion. Significant differences in productivity, income levels, infrastructure quality, and labor-market opportunities persist both within and between countries. The report emphasizes that investments in transportation networks, digital infrastructure, education, innovation ecosystems, and regional institutions are essential for enhancing regional competitiveness and resilience (OECD, 2023).

Similarly, Pike, Rodríguez-Pose, and Tomaney (Pike et al., 2017) emphasize that successful regional development depends not only on economic resources but also on institutional quality, stakeholder participation, collaborative governance, and policy coordination. Their research demonstrates that regions characterized by strong partnerships among public institutions, private businesses, universities, and civil society organizations tend to achieve more sustainable development outcomes.

Contemporary studies conducted by the World Bank (World Bank, 2023) and the United Nations Development Programme (UNDP, 2024) further indicate that decentralization contributes positively to governance effectiveness when accompanied by adequate fiscal autonomy, administrative capacity, transparency, and accountability mechanisms. However, these studies also caution that decentralization may produce uneven outcomes if regional institutions lack sufficient financial resources or managerial expertise. Consequently, the success of regional governance reforms depends largely on the ability of governments to balance autonomy with effective coordination and oversight.

Within this broader international context, Azerbaijan's New Regional Management System can be viewed as part of a global trend toward decentralized governance, institutional modernization, and place-based regional development. Khatira Huseynova (2026) shows in her research that, after the 2020 conflict and the liberation of territories, Azerbaijan embarked on large-scale reconstruction and regional reintegration programs. Strategic initiatives such as those in Azerbaijan (2021) "Azerbaijan 2030: National Priorities for Socio-Economic Development," and the Azerbaijan (2022) "Great State Program of Return" provide a broad framework for regional recovery and economic integration. The Azerbaijani governance model emphasizes centralized coordination, the development of modern infrastructure, digital governance, and green energy initiatives. Strategic priorities include security and demining operations, development of social infrastructure, economic revival through industrial zones, and strengthening regional connectivity through transport corridors and airports. This centralized, but strategically coordinated management model aims to transform liberated territories into sustainable and economically integrated regions.

Research Methodology

This study employs a mixed qualitative-comparative research design. The methodological framework combines institutional analysis, comparative regional governance assessment, and secondary statistical data analysis. The research draws upon official policy documents of the Government of Azerbaijan, regional development strategies, reports of international organizations, and peer-reviewed academic literature.

The analytical framework is based on three dimensions:

1. Institutional transformation and governance modernization.
2. Economic outcomes of regional reforms.
3. Challenges and limitations affecting implementation effectiveness.

Comparative analysis is conducted using international experiences from OECD countries and selected emerging economies that have implemented decentralization and regional governance reforms. The study also applies a descriptive analysis of regional development indicators, including non-oil economic growth, investment flows, SME development, infrastructure modernization, and labor-market transformation.

The research follows a governance-performance approach, which assumes that institutional quality, fiscal capacity, and administrative effectiveness significantly influence regional development outcomes.

Institutional Architecture of the New Regional Management System

The institutional structure of Azerbaijan's New Regional Management System is based on a multi-level governance model integrating local, regional, and central institutions. The system seeks to establish coordinated interaction among government agencies, regional executive authorities, municipalities, private businesses, and civil society organizations.

One of the principal features of the new governance model is the decentralization of economic responsibilities. While the Ministry of Economy remains the central coordinating body, local authorities now possess expanded financial and administrative powers. Regional Management Units (RMUs) were established in economic regions to facilitate communication between regional institutions and central government agencies.

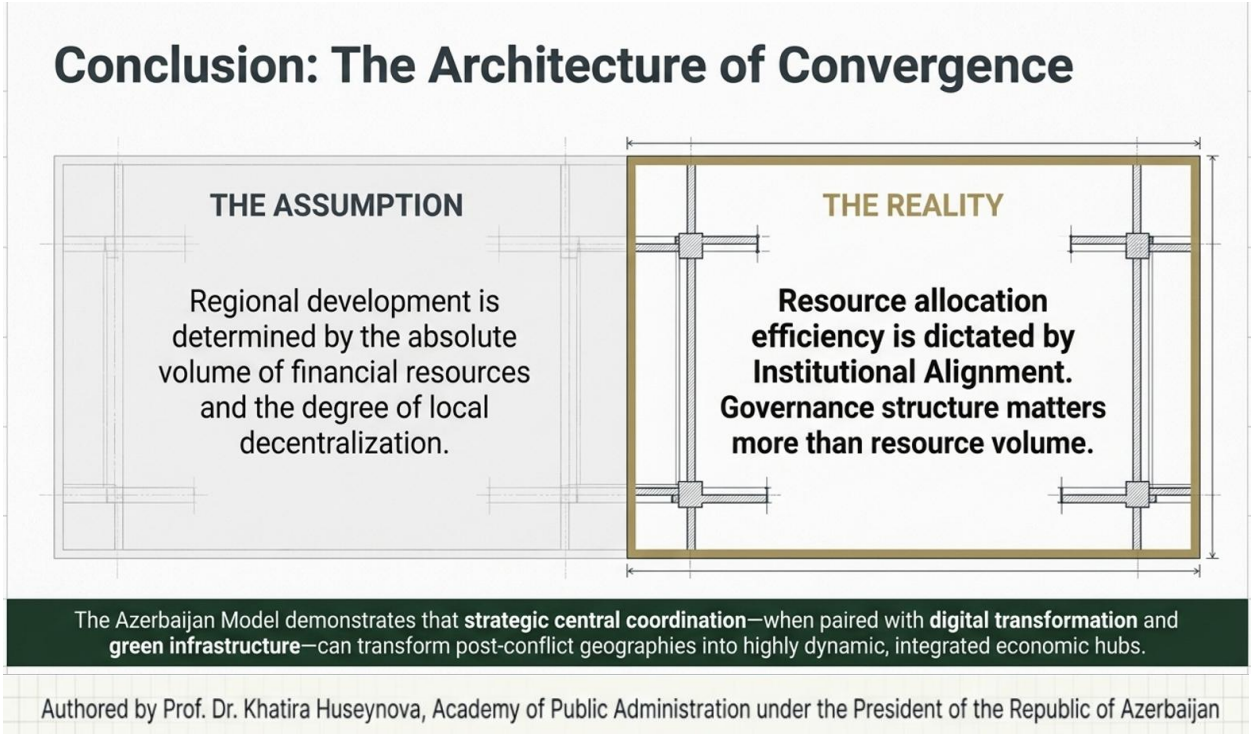
The RMUs perform several strategic functions:

- coordination of regional development projects.
- collection of regional economic information.
- support for local investment initiatives.
- implementation of state-funded infrastructure projects.
- monitoring of regional socio-economic indicators.

The system also emphasizes transparency, accountability, and institutional efficiency. Administrative reforms introduced after 2020 aimed to improve budget management, strengthen fiscal autonomy, and modernize public-service delivery.

An important institutional characteristic of the NRMS is the division of responsibilities between the central government and regional authorities. The central government formulates national strategic priorities, while regional authorities adapt these priorities to local socio-economic conditions. Such a structure allows the government to implement differentiated regional policies according to the specific needs of each territory.

Another important element of the reform is digital governance. The introduction of electronic procurement systems, online administrative services, and digital public-management mechanisms has increased transparency and reduced bureaucratic inefficiencies. The development of e-governance platforms has also strengthened anti-corruption measures and improved communication between citizens and state institutions.



Economic Development Outcomes and Regional Transformation

The economic dimension of Azerbaijan's New Regional Management System is closely connected to the country's long-term diversification strategy. For many years, Azerbaijan's economy was heavily dependent on oil and gas revenues. However, fluctuations in global energy prices exposed the vulnerability of an oil-centered economic model and accelerated the search for alternatives.

According to official statistics of the State Statistical Committee of the Republic of Azerbaijan, investments directed toward regional infrastructure, industrial parks, and transport corridors contributed to the expansion of non-oil industries, particularly agriculture, logistics, tourism, and manufacturing. State Statistical Committee of the Republic of Azerbaijan. (2025). Analysis of Azerbaijan's Non-Oil GDP Growth (2020–2025):

Between 2020 and 2025, Azerbaijan's non-oil sector became an increasingly important driver of economic growth, reflecting the country's efforts to diversify its economy beyond hydrocarbons.

Year	Non-Oil GDP Growth (%)	Share of GDP (%)
2020	-5.0 (COVID-19 impact)	~62
2021	7.2	~65
2022	9.1	~68
2023	3.7	~69
2024	4.9	~70
2025*	5.0–5.5 (estimated)	~72

**Estimated based on government and international institution forecasts.*

Analytical Interpretation

The period from 2020 to 2025 demonstrates a clear structural transformation of Azerbaijan's economy. In 2020, the COVID-19 pandemic caused the non-oil sector to contract by approximately 5%, affecting tourism, transportation, trade, and services. However, economic recovery was rapid. In 2021, non-oil GDP expanded by 7.2%, supported by increased domestic demand, public investment, and the reopening of economic activities.

The strongest growth was observed in 2022, when the non-oil sector grew by about 9.1%. This expansion was driven by construction, manufacturing, agriculture, information and communication

technologies, and transportation services. The implementation of regional development programs and infrastructure investments further stimulated economic activity.

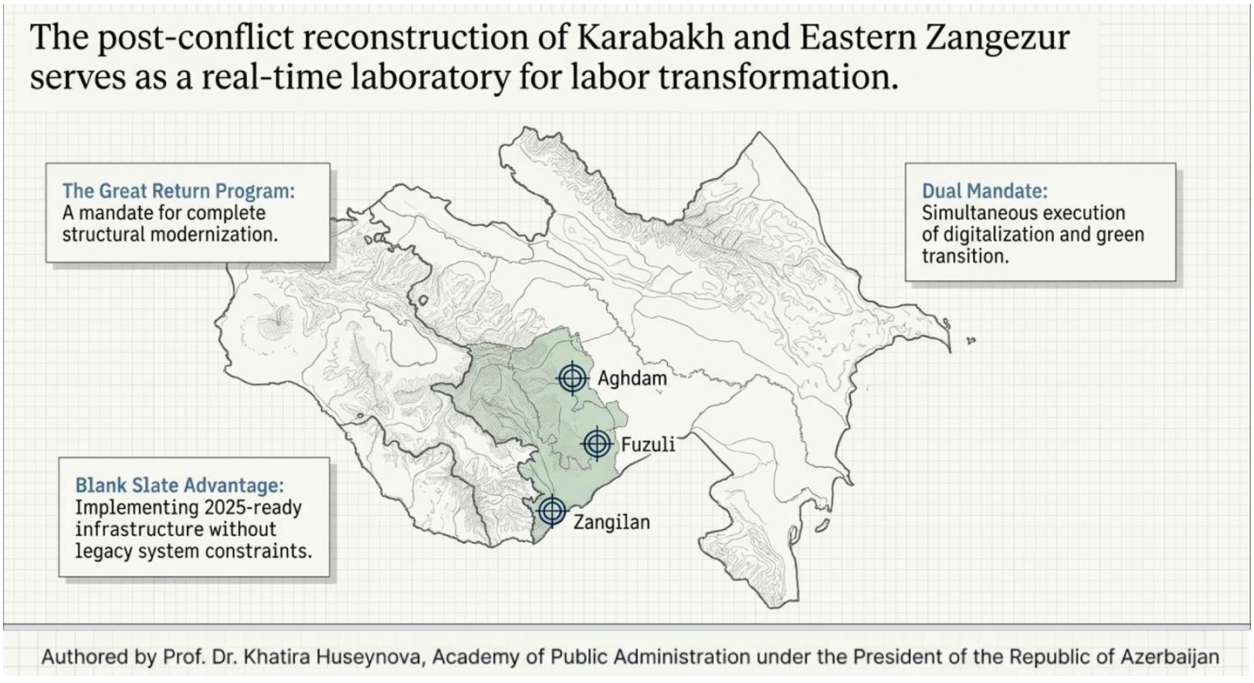
Although growth moderated in 2023–2025, the non-oil sector continued to expand steadily. By 2025, the non-oil economy is estimated to account for approximately 72% of total GDP, compared with around 62% in 2020, representing an increase of about 10 percentage points over five years. This indicates that the country's economic growth is becoming less dependent on oil revenues.

Main Drivers of Non-Oil Growth

- Expansion of manufacturing industries;
- Development of agriculture and agro-processing;
- Growth of transport and logistics corridors;
- Increasing investment in ICT and digital transformation;
- Tourism recovery after the pandemic
- Government support for entrepreneurship and SMEs;
- Reconstruction and economic revitalization of liberated territories.

Due to that result, from 2020 to 2025, Azerbaijan's non-oil GDP evolved from approximately 62% to 72% of total GDP, while maintaining positive growth rates after the pandemic recovery period. These trends suggest that economic diversification policies have contributed significantly to strengthening the resilience and sustainability of national economic development. The government introduced several state programs aimed at regional economic growth through infrastructure modernization, industrial development, and investment stimulation. Major transportation corridors, highways, logistics centers, airports, and railway projects were implemented to improve regional connectivity and facilitate trade.

Attention has been devoted to tourism infrastructure. Azerbaijan's natural landscapes, cultural heritage, and regional diversity have created opportunities for tourism-based regional development. Investments in hospitality infrastructure have contributed to employment generation and increased local business activity.



The reform process also encouraged public and private investment flows into regional economies. Simplified registration procedures, tax incentives, and support for small and medium-sized enterprises (SMEs) have improved the business environment in several regions.

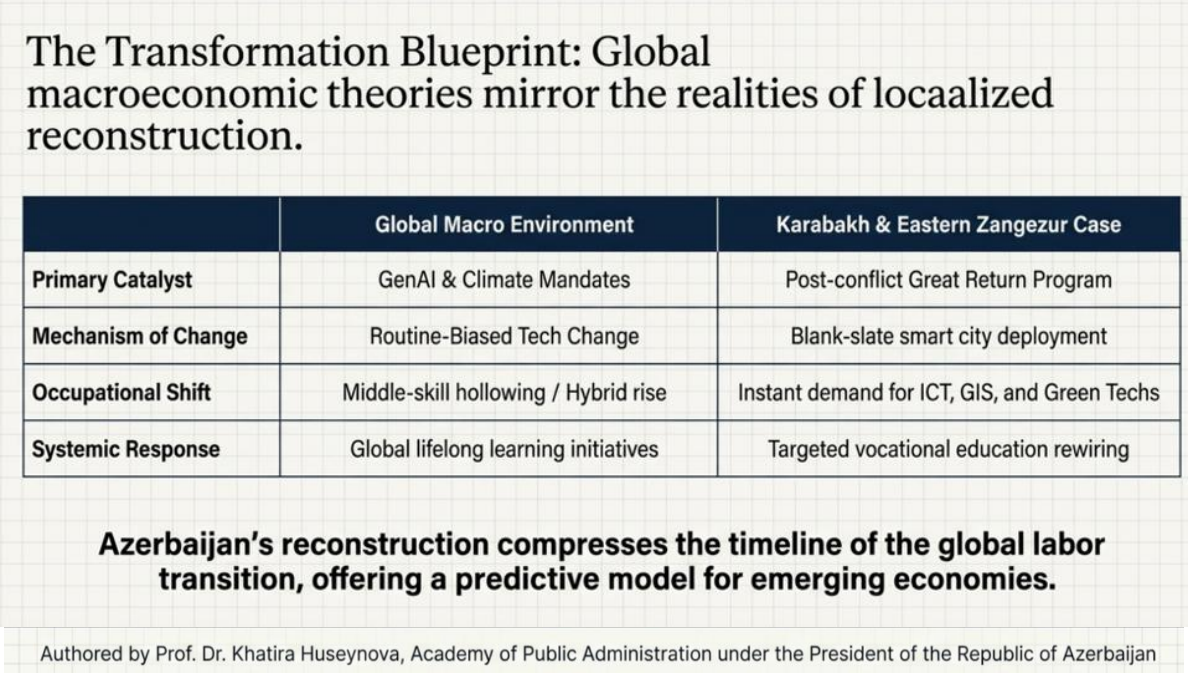
Industrial diversification became another important objective. The establishment of industrial parks and free economic zones has encouraged manufacturing activities beyond the energy sector. The government has attempted to attract both domestic and foreign investors by improving legal protections, strengthening investment guarantees, and expanding public-private partnerships.

Macroeconomic integration has also become a central feature of regional policy. Fiscal, monetary, and sectoral policies are now increasingly coordinated with regional development strategies. This integrated approach aims to balance regional growth while maintaining macroeconomic stability.

Labor Markets, Human Capital, and Innovation

Human capital development represents one of the most strategic pillars of Azerbaijan's regional transformation agenda. The transition toward a knowledge-based economy requires qualified labor resources, innovative educational systems, and technological modernization.

The NRMS recognizes that regional economic growth cannot be achieved solely through infrastructure development. Sustainable modernization requires investment in education, vocational training, digital skills, research capacity, and innovation ecosystems.



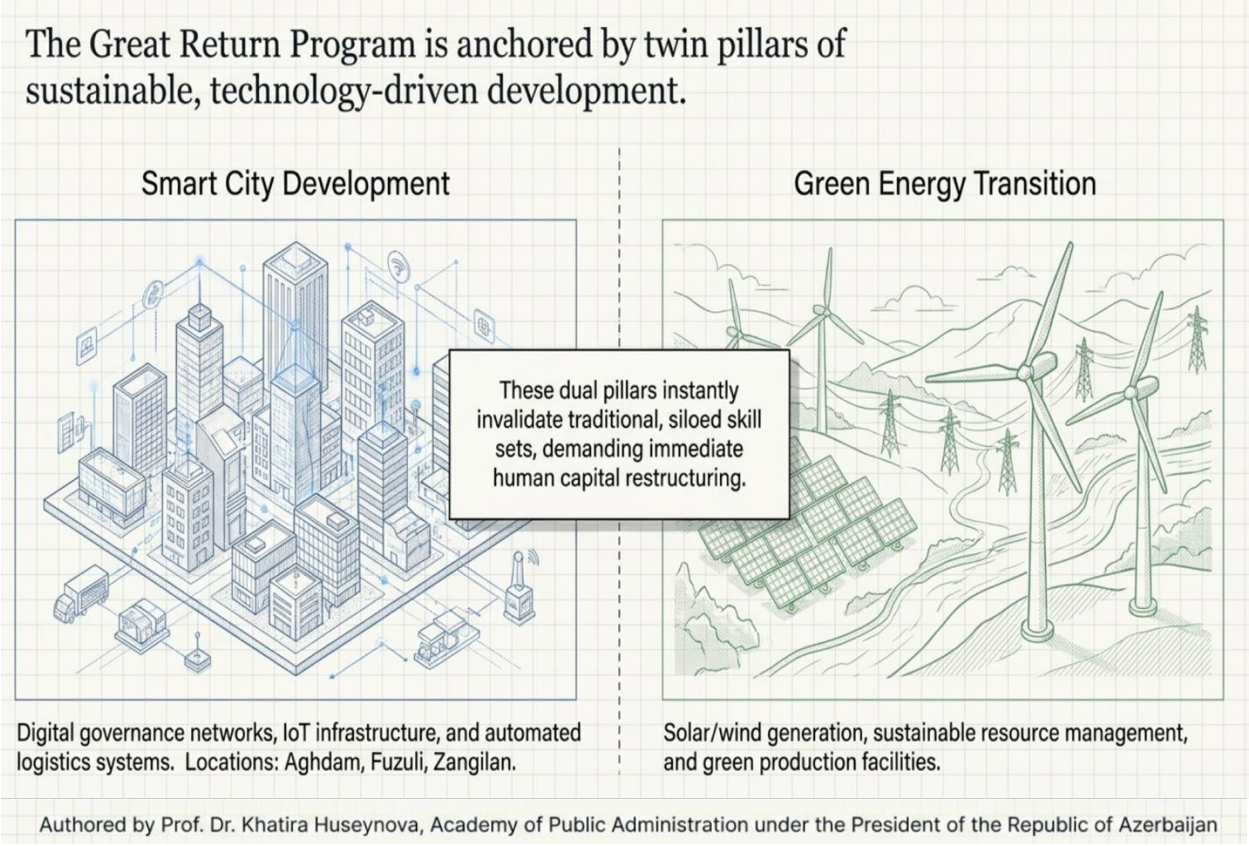
Several national initiatives have focused on strengthening the relationship between education and labor-market requirements. Regional universities and vocational institutions increasingly participate in local development strategies by supporting entrepreneurship, applied research, and workforce training.

Innovation policy has also become a key component of Azerbaijan's modernization strategy. The government seeks to stimulate technological development through:

- innovation grants and research funding.
- digital transformation programs.
- technology parks and startup ecosystems.
- support for scientific research.
- public-private innovation partnerships.

The emergence of innovation-oriented governance is particularly important for non-oil economic development. Studies conducted by Khatira Huseynova(Khatira Huseynova et al., 2026) demonstrate that innovative technologies and digital transformation significantly accelerate regional socio-economic modernization and strengthen the competitiveness of non-oil sectors in Azerbaijan. The creation of an

innovative economy can increase productivity, strengthen competitiveness, and reduce external economic dependence.



The government has introduced programs that support regional employment, entrepreneurship, and youth development. Additional attention was paid to digital literacy, women's participation in economic activities, and vocational retraining programs. The long-term success of the NRMS depends on the country's ability to develop an adaptive, innovative, and competitive workforce capable of responding to technological change and global economic transformations.

Public-private partnerships (PPPs) have become another strategic component of regional development policy. Azerbaijan increasingly relies on PPP mechanisms to modernize infrastructure, attract private investment, and improve public-service delivery.

Public-private cooperation continues to play an important role in Azerbaijan’s regional modernization strategy. Stronger institutional frameworks and clearer investment regulations may significantly improve the effectiveness of PPP-based development.

Challenges and Limitations of the New Regional Management System

Despite notable achievements, the implementation of Azerbaijan's New Regional Management System continues to face several structural and institutional challenges. Regional disparities remain visible in terms of investment concentration, infrastructure quality, employment opportunities, and innovation capacity. While economically stronger regions have benefited significantly from development programs, some peripheral territories continue to experience limited private-sector activity and lower institutional capacity.

Another challenge concerns fiscal decentralization. Although regional authorities have received broader administrative responsibilities, financial autonomy remains relatively limited because local budgets continue to depend heavily on central government transfers. This situation may constrain local initiatives and reduce flexibility in responding to region-specific development needs.

Administrative capacity differences among regional institutions also influence implementation effectiveness. The availability of qualified personnel, digital infrastructure, and managerial expertise varies across territories. Consequently, the quality of policy implementation and public-service delivery remains uneven.

Furthermore, sustainable regional development requires stronger coordination between central ministries, local authorities, municipalities, private-sector actors, and civil society organizations. Strengthening institutional cooperation and expanding public participation remain important priorities for the future evolution of the NRMS.

Khatira Huseynova's (2026) research results in her finding that the Azerbaijan Model integrates centralized coordination with advanced infrastructure and green energy to transform post-conflict regions into sustainable and economically dynamic hubs.

1. Hybrid Management Model: Unlike standard global decentralized models, Azerbaijan utilizes a "Centralized Coordination" approach. This involves the Institute of Special Representatives to ensure rapid, secure, and uniform reconstruction in post-conflict zones.
2. The Great Roadmap is built on four strategic pillars:

- Security: Intensive demining of the Azerbaijan National Agency for Mine Action (ANAMA) and establishing law and order.
- Social Infrastructure: Building "Smart Villages," schools, and hospitals to support the "Great Return" of displaced populations.
- Economic Revival: Developing industrial parks, agricultural zones, and the "Green Energy Zone" (aiming for Net-Zero emissions through hydro, solar, and wind power).
- Connectivity: Establishing a regional hub via the Zangezur Corridor, three new international airports (Fuzuli, Zangilan, Laçın), and extensive highway/railway networks. The region is being integrated into the Global Value Chain, positioning Azerbaijan as a critical transit-logistics node between Europe and Asia.

3. Economic Impact: The reconstruction acts as an "Economic Multiplier," benefiting sectors and integrating the region into the global value chain.

Conclusion

Azerbaijan's New Regional Management System (2020–2026) represents a major step toward decentralized governance, economic diversification, and sustainable regional development. The reform reflects the country's broader strategic objective of transforming from an oil-dependent economy into a more diversified and knowledge-based economic system.

The institutional restructuring introduced by the NRMS has strengthened coordination between central and regional authorities while expanding local administrative responsibilities. Infrastructure modernization, investment stimulation, public-private partnerships, innovation policies, and digital governance reforms have all contributed to regional transformation.

The regional management reforms have also improved Azerbaijan's resilience against external economic shocks and created new opportunities for non-oil economic growth. Nevertheless, important challenges related to administrative capacity, regional inequality, and institutional effectiveness continue to influence implementation outcomes.

The future success of the NRMS depends on the government's ability to strengthen institutional quality, improve social inclusiveness, support innovation, and maintain macroeconomic stability. Continued investment in human capital, digital transformation, and sustainable regional development will be essential for ensuring long-term economic competitiveness.

Overall, Azerbaijan's experience demonstrates that regional governance reform can serve as an important instrument for national modernization, territorial balance, and integration into the global economy.

References

Azerbaijan. (2021). Azerbaijan 2030: National priorities for socio-economic development. Decree of the President of the Republic of Azerbaijan No. 2469. https://president.az

Azerbaijan. (2022). Strategy for socio-economic development of the Republic of Azerbaijan in 2022–2026. Decree of the President of the Republic of Azerbaijan No. 3378. https://president.az

State Statistical Committee of the Republic of Azerbaijan. (2025). Macroeconomic indicators of Azerbaijan. https://stat.gov.az

Levente D., Khatira H., Abdin M., Alida H., Emin A., Nargiz H., Alina N.,(2026). The Relationship Between Energy Dependency, Energy Diversification, and Economic Growth: Assessing Energy Resilience in Europe. Energies19(7),1723,https://doi.org/10.3390/en19071723

Khatira Huseynova (2026). Dynamics of Regional Governance and Economic Resource Allocation Conference: Central and Eastern Europe in the Changing Business Environment 2026 – Proceedings, https://doi.org/10.18267/pr.2026.vol2587.13

Khatira Huseynova, Sarbiya Huseynova (2025). Regional integration and economice development aspects: The Case of Azerbaijan in the EU Eastern Partnership. The Business & Management Review 16(04) DOI:10.24052/BMR/V16NU04/ART-13

Barca, F., McCann, P., & Rodríguez-Pose, A. (2012). The case for regional development intervention: Place-based versus place-neutral approaches. Journal of Regional Science, 52(1), 134–152. https://doi.org/10.1111/j.1467-9787.2011.00756.x

OECD. (2023). OECD Regional Outlook 2023: Building resilient regions for stronger economies. OECD Publishing. https://doi.org/10.1787/region-outlook-2023-en

Rodríguez-Pose, A. (2020). Institutions and the fortunes of territories. Regional Science Policy & Practice, 12(3), 371–386. https://doi.org/10.1111/rsp3.12277

Pike, A., Rodríguez-Pose, A., & Tomaney, J. (2017). Local and regional development (5th ed.). Routledge.

World Bank. (2023). Decentralization and local governance in developing economies. Washington, DC: World Bank. https://www.worldbank.org

United Nations Development Programme. (2024). Regional governance and sustainable development: Global trends and policy lessons. New York: UNDP.

Digital Infrastructure as learning Space: How virtual and physical environments co-create sustainable university ecosystems

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Keywords
Digital infrastructure; learning spaces; hybrid learning; sustainability; student experience; digital inequality; university ecosystems

Abstract

This paper examines how digital infrastructure—platforms, data flows, virtual classrooms and AI-enabled tools—now operates as a core component of the university learning environment, co-constituting educational space alongside physical campuses. Drawing on a conceptual analysis informed by sustainability theory, learning-space scholarship and emerging research from the Global South, the paper argues that digital infrastructure is no longer an adjunct to campus design but a central determinant of pedagogical, social and financial sustainability. The study analyses how hybrid learning ecosystems redistribute learning across physical and virtual environments, challenging traditional assumptions about attendance, engagement and spatial belonging. Second, it examines how digital infrastructures shape pedagogical sustainability by enabling flexible, self-directed and informal learning practices, while simultaneously introducing new inequities related to access, digital literacy and infrastructural fragility—issues particularly acute in emerging economies. Third, it considers the organisational and governance implications of treating digital systems as learning spaces, highlighting the interdependence between curriculum design, assessment practices, timetabling, student experience and institutional strategy. The paper contributes to current debates by reframing digital infrastructure as a spatial, relational and sustainability-critical dimension of university ecosystems. It proposes a framework for evaluating hybrid learning environments that integrates ecological, pedagogical, social and financial sustainability, with particular attention to contexts where digital capacity is uneven or constrained. By foregrounding perspectives from the Global South, the paper challenges dominant Global North assumptions about digital transformation and argues for more inclusive, context-sensitive approaches to designing sustainable learning environments. The analysis offers actionable insights for educators, campus planners and policymakers seeking to reimagine university spaces for a digitally mediated future.

Introduction

Universities worldwide are undergoing a profound transformation as digital globalisation reshapes the nature, purpose and experience of learning spaces. Once defined primarily by physical classrooms, libraries and campus architecture, learning environments are now increasingly constituted through digital infrastructures—virtual platforms, data flows, AI-enabled tools and hybrid pedagogical systems. These developments have blurred the boundaries between physical and virtual space, creating new forms of spatiality that challenge traditional assumptions about attendance, engagement and belonging in higher education. As institutions confront declining in-person participation, financial pressures and shifting student expectations, the question of how learning spaces can be designed and governed sustainably has become urgent.

While research on learning spaces has expanded in recent years, much of the discourse remains anchored in Global North contexts, where digital capacity, infrastructure and pedagogical innovation are comparatively advanced. In contrast, universities in the Global South face uneven digital access, infrastructural fragility and socio-economic disparities that shape how hybrid learning environments are experienced and enacted. These contextual differences raise critical questions about the sustainability, inclusivity and pedagogical value of digital learning spaces across diverse educational ecosystems.

This paper examines how digital infrastructure functions as a learning space in its own right, co-creating hybrid university ecosystems that integrate physical and virtual environments. By

foregrounding perspectives from emerging economies, the study challenges dominant narratives of digital transformation and argues for a more context-sensitive understanding of sustainable learning environments.

Background of the Study

The rapid expansion of digital technologies has fundamentally altered the spatial logic of higher education. Digital globalisation has enabled universities to deliver learning across borders, support remote participation and integrate AI-driven tools into teaching and assessment. As a result, learning increasingly occurs in distributed, fluid and hybrid spaces that combine physical presence with virtual interaction. This shift has significant implications for ecological, pedagogical, social and financial sustainability—the four dimensions emphasised in the London Review of Education's special feature.

Ecologically, digital learning spaces can reduce campus energy use and physical resource consumption, yet they also depend on energy-intensive data infrastructures. Pedagogically, hybrid environments offer flexibility and self-directed learning opportunities, but they also risk reinforcing inequalities for students with limited digital access or unstable connectivity. Socially, digital spaces can expand participation but may weaken campus community and student belonging. Financially, universities face the dual challenge of maintaining physical estates while investing in costly digital systems.

These tensions are particularly pronounced in the Global South, where digital infrastructure is uneven and institutional capacity varies widely. Universities in these contexts must navigate the promise of digital transformation alongside persistent structural constraints. Understanding how digital infrastructure operates as a learning space—and how it interacts with physical environments—is therefore essential for designing sustainable, equitable and future-ready university ecosystems.

Research Questions & Objectives

This study is guided by the following research questions:

1. How does digital infrastructure function as a learning space within hybrid university ecosystems?
2. In what ways do virtual and physical learning environments interact to shape pedagogical, social and financial sustainability?
3. How do contextual conditions in the Global South influence the design, use and experience of hybrid learning spaces?

To address these questions, the study pursues four key objectives:

1. To analyse how digital infrastructure co-creates learning spaces alongside physical environments in contemporary universities.
2. To examine the sustainability implications—ecological, pedagogical, social and financial—of hybrid learning ecosystems.
3. To explore how students and educators in Global South contexts experience and navigate digitally mediated learning spaces.
4. To propose a conceptual framework for evaluating sustainable hybrid learning environments that integrates physical and digital dimensions.

Literature review

Learning spaces as socio-material and pedagogical constructs

Early work on university learning spaces focused primarily on physical design—classrooms, lecture theatres and libraries—as containers for teaching and learning (Temple, 2008). Over time, this view has been challenged by socio-material perspectives that conceptualise learning spaces as dynamic assemblages of people, technologies, practices and institutional norms (Jamieson et al., 2000; Ellis & Goodyear, 2016). From this standpoint, space is not a neutral backdrop but an active participant in shaping pedagogy, interaction and identity.

Research on "new generation learning spaces" has highlighted how flexible furniture, open layouts and technology-rich environments can support collaborative and student-centred learning (Radcliffe,

2009; Matthews, Andrews & Adams, 2011). However, critics argue that many such initiatives remain driven by architectural or technological logics rather than pedagogical intent, leading to mismatches between design and use (Monahan, 2002; Goodyear, Ellis & Marmot, 2018). The literature increasingly emphasises the need to understand how students and staff appropriate spaces in practice, often in ways that diverge from institutional plans (Boys, 2011; Beckers, van der Voordt & Dewulf, 2016).

This shift from "space as container" to "space as practice" provides an important foundation for rethinking digital infrastructure as part of the learning environment. If learning spaces are socio-material and relational, then virtual platforms, learning management systems and communication tools must be treated as spatial elements that structure participation, visibility and power (Bayne, 2015; Gourlay, 2021).

Digital infrastructure as learning space

The expansion of virtual learning environments, videoconferencing platforms and AI-enabled tools has led scholars to reconceptualise digital systems as spaces in which learning is enacted rather than merely delivered (Bayne, Gallagher & Lamb, 2014; Carvalho & Yeoman, 2018). Digital platforms organise how students move, speak, collaborate and access resources, thereby shaping the "architecture" of participation (Selwyn, 2016). Interfaces, algorithms and data flows become spatial features that enable some forms of engagement while constraining others.

Studies of hybrid and online learning have shown that students experience digital environments as places with affective and social qualities—sites of connection, isolation, surveillance or empowerment (Henderson, Selwyn & Aston, 2017; Gourlay, 2021). The notion of "networked learning" further emphasises that learning occurs across distributed configurations of people, technologies and settings, blurring distinctions between on-campus and off-campus space (Goodyear, Carvalho & Dohn, 2014).

At the same time, research warns against overly celebratory narratives of digital transformation. Selwyn (2016) and Williamson (2017) highlight how platformisation and datafication introduce new forms of control, commercialisation and inequality into higher education. AI-driven systems, learning analytics and proctoring tools can reconfigure power relations by rendering students and staff visible as data subjects, raising ethical and spatial questions about surveillance and autonomy (Knox, 2019; Prinsloo & Slade, 2017).

Taken together, this literature suggests that digital infrastructure should be understood as a learning space in its own right—one that co-exists with and reshapes physical environments. However, most empirical work has focused on institutions with relatively robust digital capacity, leaving less explored how such hybrid spaces operate in resource-constrained contexts.

Sustainability and university learning environments

Sustainability in higher education has traditionally been associated with campus greening, energy efficiency and environmental management (Leal Filho et al., 2018). More recent work argues for a broader understanding that integrates ecological, pedagogical, social and financial dimensions (Sterling, 2010; Barth & Rieckmann, 2012). Learning spaces are increasingly recognised as key sites where these dimensions intersect.

Ecologically, the design and operation of buildings, heating, cooling and transport systems contribute significantly to universities' environmental footprints (Hopkinson, James & Sammut, 2008). Digital technologies can reduce some physical demands—for example, by enabling remote participation—but they also rely on energy-intensive data centres and device production, complicating simplistic claims about "green" online learning (Ellis & Goodyear, 2016; Pargman, Eriksson & Friday, 2020).

Pedagogically, sustainable learning environments are those that support deep learning, critical thinking and adaptability over time (Sterling, 2010). Flexible, technology-rich spaces can foster active and collaborative learning, yet they may also reproduce traditional didactic practices if not accompanied by pedagogical development (Matthews et al., 2011; Beckers et al., 2016). Social sustainability concerns equity, inclusion and student wellbeing. Studies show that spatial design influences students' sense of belonging, safety and participation, particularly for marginalised groups (Thomas, 2012; Burke, 2019).

Financially, universities must balance investment in physical estates with growing demands for digital infrastructure. The COVID-19 pandemic intensified debates about the value of campus space

relative to online provision, raising questions about how to justify and sustain large physical footprints in an era of hybrid learning (Jandrić et al., 2020). These tensions underscore the need for integrated frameworks that consider how physical and digital spaces jointly contribute to sustainable university ecosystems.

Hybrid learning ecosystems and the interdependence of space, curriculum and infrastructure

The concept of "hybrid" or "blended" learning has evolved from simple combinations of online and face-to-face teaching to more complex configurations in which learning is distributed across multiple spaces, times and modalities (Garrison & Vaughan, 2008; Carvalho & Yeoman, 2018). In such ecosystems, curriculum design, assessment practices, timetabling and digital infrastructure are deeply interdependent.

Research on learning-space design emphasises that spatial decisions cannot be separated from pedagogical intentions and institutional structures (Ellis & Goodyear, 2016; Goodyear et al., 2018). For example, timetabling systems may constrain the use of flexible spaces; assessment regimes may privilege individual, text-based work over collaborative, multimodal activities; and digital platforms may encode particular models of teaching and control (Bayne, 2015). Hybrid environments therefore require coordinated governance across estates, IT, academic departments and student services.

Studies of student experience in hybrid settings highlight both opportunities and challenges. Students value flexibility, autonomy and the ability to combine on-campus and remote participation, but they also report fragmentation, digital fatigue and difficulties navigating multiple platforms (Henderson et al., 2017; Jandrić et al., 2020). These findings suggest that sustainable hybrid ecosystems depend not only on technological provision but also on coherent design, support and communication.

Global South perspectives and digital inequality in learning spaces

A growing body of work critiques the dominance of Global North perspectives in learning-space and digital education research (Czerniewicz, 2018; Adam, 2020). In many institutions in Africa, Asia and Latin America, digital infrastructure is uneven, connectivity is unreliable and students' access to devices is highly variable (Czerniewicz, Agherdien & Small, 2020; Trotter, 2020). During the pandemic, these inequalities became starkly visible as emergency remote teaching exposed structural gaps in infrastructure, funding and policy (Crawford et al., 2020).

Studies from South Africa, India and other contexts show that students often rely on mobile phones, shared devices and costly data bundles, transforming homes, public spaces and informal settings into improvised learning environments (Czerniewicz et al., 2020; Bozkurt et al., 2020). These conditions complicate assumptions about "anytime, anywhere" learning and highlight the material and spatial labour required to participate in digital education.

At the same time, universities in the Global South are experimenting with contextually grounded approaches to hybrid learning, including low-bandwidth platforms, community-based learning hubs and partnerships with local providers (Adam, 2020; Trotter, 2020). Such initiatives suggest alternative models of sustainable learning spaces that do not simply replicate Global North designs.

However, systematic frameworks for understanding how digital infrastructure functions as learning space in these contexts remain underdeveloped. Much of the literature treats infrastructure as a background condition rather than a spatial and pedagogical actor. There is a need for conceptual work that foregrounds digital systems as co-constitutive of learning environments and examines how they interact with physical campuses under conditions of constraint and inequality.

Identified gaps and implications for the present study

Across these strands of literature, three key gaps emerge. First, while socio-material and networked perspectives recognise the spatiality of digital systems, there is limited explicit theorisation of digital infrastructure as learning space in its own right, particularly in relation to sustainability. Second, existing work on sustainable campuses often treats digital technologies as tools for efficiency rather than as spatial, relational and ethical phenomena that shape pedagogy, equity and governance. Third, Global South experiences of hybrid learning spaces are under-represented, and where they are discussed, infrastructure tends to be framed as a deficit rather than as part of a complex, locally negotiated ecosystem.

The present study responds to these gaps by reframing digital infrastructure as a core component of university learning spaces and by examining how virtual and physical environments co-create hybrid ecosystems with ecological, pedagogical, social and financial implications. By foregrounding perspectives from emerging economies, it seeks to challenge dominant assumptions and develop a conceptual framework for evaluating sustainable hybrid learning environments that is sensitive to context, inequality and institutional diversity.

The Spatiality of Digital Infrastructure: From "Place" to "Placelessness"

A growing body of scholarship argues that digital learning environments create forms of "placeless learning" that challenge traditional spatial assumptions in higher education (Cresswell, 2015; Frith, 2020). Unlike physical classrooms, digital platforms are not fixed in geography; instead, they operate as fluid, mobile and temporally flexible spaces. This placelessness enables students to participate from homes, workplaces or public settings, effectively multiplying the spatial boundaries of the university (Bayne, 2015). However, scholars caution that placelessness does not imply neutrality. Digital spaces are structured by platform design, interface logic and algorithmic governance, which shape how learners navigate, interact and construct meaning (Williamson, 2017). Thus, digital infrastructure produces its own spatial politics, influencing visibility, participation and power in ways that differ from physical campuses.

Platformisation and the Governance of Learning Space

The concept of "platformisation" has become central to understanding how digital infrastructures govern educational practices (van Dijck, Poell & de Waal, 2018). Learning management systems, videoconferencing tools and AI-driven analytics platforms increasingly mediate teaching, assessment and communication. These platforms embed specific pedagogical assumptions—such as linear content delivery, individualised progress tracking or automated feedback—that shape the spatial and temporal organisation of learning (Kitchin, 2021). As universities outsource key functions to commercial platforms, concerns arise about data ownership, surveillance and the corporatisation of learning space (Selwyn, 2016). In hybrid ecosystems, platform governance intersects with physical estate management, creating new forms of institutional dependency and raising questions about long-term sustainability.

The Ecology of Hybrid Learning: Assemblage Theory and Spatial Entanglement

Assemblage theory offers a powerful lens for conceptualising hybrid learning environments as entanglements of human actors, technologies, policies and material settings (DeLanda, 2016; Fenwick, Edwards & Sawchuk, 2015). From this perspective, learning spaces are not discrete physical or digital entities but emergent configurations shaped by ongoing interactions. For example, a student's learning experience may involve a physical desk, a mobile device, a learning platform, institutional Wi-Fi, assessment deadlines and social networks—all functioning together as a spatial assemblage. This ecological view highlights the interdependence of infrastructure, pedagogy and institutional governance, suggesting that sustainable learning environments must be designed as integrated ecosystems rather than isolated components.

Digital Equity as Spatial Justice in Higher Education

The concept of spatial justice, traditionally applied to urban planning and public space (Soja, 2010), is increasingly relevant to digital learning environments. Digital inequities—such as limited bandwidth, device scarcity or unstable electricity—translate into spatial exclusions that restrict students' ability to participate fully in hybrid learning (Czerniewicz, 2018). In the Global South, these inequities are compounded by socio-economic disparities, rural-urban divides and infrastructural fragility (Adam, 2020). Scholars argue that equitable learning spaces must address both physical accessibility and digital accessibility, recognising that exclusion can occur in virtual environments just as it does on campus (Trotter, 2020). Spatial justice therefore becomes a critical dimension of sustainability, requiring universities to design hybrid ecosystems that mitigate rather than reproduce inequality.

The Emotional and Affective Dimensions of Digital Learning Space

Recent research highlights the affective qualities of digital learning environments, emphasising how emotions, identity and belonging are shaped by virtual spatiality (Gourlay, 2021; Bond et al., 2021). Students often describe digital spaces as isolating, disembodied or overwhelming, particularly when navigating multiple platforms or experiencing digital fatigue. Conversely, some learners find virtual environments more inclusive, less intimidating and more flexible than traditional classrooms. These affective dynamics influence engagement, motivation and wellbeing, suggesting that sustainable learning spaces must consider emotional as well as functional dimensions. The affective turn in learning-space research underscores the need for hybrid designs that support connection, presence and community across both physical and digital settings.

Institutional Logics and the Politics of Space Decision-Making

Learning-space design is shaped not only by pedagogical ideals but also by institutional logics—financial constraints, managerial priorities, policy frameworks and strategic narratives (Kezar & Holcombe, 2019). Decisions about digital investment, campus refurbishment or hybrid timetabling often reflect competing interests between estates teams, IT departments, academic units and senior leadership. In many universities, digital infrastructure is framed as a cost-saving or efficiency tool rather than a pedagogical asset, leading to fragmented or short-term planning (Jandrić et al., 2020). In the Global South, institutional logics are further influenced by national policy, donor funding and infrastructural limitations. Understanding these political dynamics is essential for developing sustainable hybrid ecosystems that align space, curriculum and institutional strategy.

Conceptual Framework

The conceptual framework for this study positions digital infrastructure and physical campus environments as interdependent components of a hybrid learning ecosystem. This ecosystem is shaped by four sustainability dimensions—ecological, pedagogical, social and financial—and is mediated by contextual conditions, particularly those found in the Global South. The framework conceptualises digital infrastructure not as a supplementary tool but as a learning space in its own right, co-constituting the spatial, relational and pedagogical dynamics of contemporary universities.

At the centre of the framework is the proposition that learning space is socio-material, hybrid and relational, emerging from the interaction of technologies, people, institutional logics and material settings. Digital platforms, data flows and AI-enabled systems operate alongside classrooms, libraries and informal campus areas to create entangled learning environments. These environments shape student engagement, access, belonging and learning outcomes.

The framework identifies three core processes:

1. Spatial Co-Creation Digital and physical spaces interact to produce hybrid learning environments. Digital infrastructure extends, overlays or substitutes physical space, creating new spatial configurations that influence how students navigate learning.
2. Sustainability Mediation The hybrid ecosystem affects—and is affected by—ecological, pedagogical, social and financial sustainability. These dimensions operate as mediators that determine whether hybrid learning environments are equitable, effective and viable.
3. Contextual Conditioning In the Global South, infrastructural constraints, socio-economic inequalities and policy environments shape how hybrid spaces are designed, accessed and experienced. These contextual factors condition the sustainability and inclusivity of hybrid ecosystems.

The conceptual framework therefore integrates space theory, digital infrastructure studies, sustainability scholarship and Global South perspectives to explain how hybrid learning environments emerge and operate.

Explanation of the Conceptual Framework

Hybrid Learning Ecosystems as Socio-Material Assemblages

Drawing on socio-material and assemblage theory, the framework conceptualises hybrid learning environments as ecologies of human and non-human actors (Fenwick et al., 2015; DeLanda, 2016). Learning occurs through the interplay of:

- physical settings (classrooms, libraries, studios)
- digital platforms (LMS, videoconferencing, AI tools)
- institutional structures (timetabling, assessment regimes)
- student practices (collaboration, mobility, self-directed learning)

This perspective rejects the binary separation of "online" and "offline" learning, instead viewing them as entangled spatialities that co-produce educational experience.

Digital Infrastructure as Learning Space

The framework positions digital infrastructure as a spatial actor that shapes participation, visibility and interaction. Platforms and algorithms structure:

- how students move through content
- how they communicate
- how they are assessed
- how they are surveilled or supported

This aligns with research on platformisation and datafication, which argues that digital systems embed pedagogical and governance logics (Williamson, 2017; van Dijck et al., 2018). In hybrid ecosystems, digital infrastructure becomes a co-architect of learning space.

Sustainability as a Multi-Dimensional Mediator

The framework integrates four sustainability dimensions:

- Ecological sustainability: energy use, carbon footprint, digital resource consumption
- Pedagogical sustainability: quality of learning, adaptability, long-term skill development
- Social sustainability: equity, inclusion, belonging, wellbeing
- Financial sustainability: cost structures, investment priorities, long-term viability

Hybrid learning environments can enhance or undermine these dimensions depending on design and governance.

Contextual Conditioning in the Global South

The framework foregrounds the Global South as a critical context where:

- digital access is uneven
- infrastructure is fragile
- socio-economic inequalities shape participation
- policy environments are inconsistent

These conditions influence how hybrid spaces are enacted, often requiring adaptive, low-bandwidth, community-based or mobile-first solutions (Czerniewicz, 2018; Adam, 2020).

Outcomes: Sustainable and Inclusive Learning Environments

The interaction of spatial co-creation, sustainability mediation and contextual conditioning leads to varied outcomes:

- Inclusive hybrid ecosystems when digital and physical spaces are aligned, accessible and pedagogically coherent
- Fragmented or exclusionary ecosystems when infrastructural or institutional misalignments occur

The framework thus provides a lens for evaluating how universities can design sustainable, equitable and future-ready learning environments.

Methodology

Research design and philosophical orientation

This study adopts a qualitative, interpretivist research design to explore how digital infrastructure functions as a learning space within hybrid university ecosystems. An interpretivist stance is appropriate because the research seeks to understand meanings, experiences and contextual dynamics rather than to measure variables or test causal hypotheses (Creswell and Poth, 2018). Learning spaces, particularly digital ones, are socially constructed and experienced differently across institutional, cultural and infrastructural contexts. Interpretivism therefore enables a nuanced examination of how students, educators and administrators interpret, negotiate and inhabit hybrid learning environments.

The study is grounded in a constructivist epistemology, which views knowledge as co-created through interaction between researcher and participants (Lincoln and Guba, 2013). This approach aligns with socio-material and assemblage perspectives that conceptualise learning spaces as emergent, relational and context-dependent. It also supports the study's focus on the Global South, where infrastructural and socio-economic conditions shape the lived realities of hybrid learning in ways that cannot be captured through positivist approaches.

Methodological rationale

A qualitative methodology was selected for three reasons. First, hybrid learning spaces involve interactions between physical environments, digital platforms, institutional policies and student practices. These complexities require exploratory, flexible methods capable of capturing depth and nuance. Second, digital infrastructure, connectivity and institutional capacity vary widely across emerging economies. Qualitative inquiry allows these contextual differences to be foregrounded rather than averaged out. Third, as digital infrastructure is only recently being conceptualised as a learning space, qualitative methods support theory-building and conceptual development (Eisenhardt, 2021).

Research setting and participant selection

The study focuses on universities in three Global South regions: Africa, Asia and Latin America. These regions were selected for their diverse digital development trajectories and growing engagement in hybrid learning. Institutions were chosen to reflect variation in digital infrastructure maturity, socio-economic context, governance structures and geographical location.

A purposive sampling strategy was used to identify participants with direct experience of hybrid learning design, delivery or governance. Participants included twelve academic staff involved in hybrid teaching, eight students who regularly engage in digital and physical learning spaces, six digital infrastructure or IT managers, and four senior administrators responsible for learning-space planning. This yielded a total of thirty participants, providing a multi-layered perspective on hybrid learning ecosystems.

Data collection procedures

Semi-structured interviews

Data were collected through semi-structured interviews, allowing participants to articulate their experiences while enabling the researcher to probe emerging themes. Interviews lasted between forty-five and seventy-five minutes and were conducted via encrypted videoconferencing platforms to accommodate geographical dispersion.

Interview prompts explored experiences of navigating digital and physical learning spaces, perceptions of digital infrastructure as a learning environment, challenges and opportunities in hybrid learning, sustainability concerns, and institutional policies shaping hybrid space design.

Documentary analysis

To contextualise interview data, the study analysed institutional digital-learning strategies, campus masterplans, national higher-education policy documents, sustainability reports and digital infrastructure guidelines. Documentary analysis provided insight into institutional logics, policy frameworks and infrastructural constraints.

Data analysis

Data were analysed using thematic analysis (Braun and Clarke, 2019), following six iterative stages: familiarisation with the data, initial coding, theme development, reviewing themes, defining and naming themes, and synthesising findings into conceptual categories. Coding was supported by NVivo software, but final interpretation was conducted manually to ensure conceptual coherence.

Themes were mapped onto the conceptual framework's three core processes: spatial co-creation, sustainability mediation and contextual conditioning. This ensured alignment between empirical insights and theoretical development.

Ensuring trustworthiness

The study followed Lincoln and Guba's (2013) criteria for qualitative rigour. Credibility was achieved through triangulation of interviews and documents, and peer debriefing with two independent scholars. Transferability was supported by detailed description of institutional contexts. Dependability was ensured through an audit trail documenting coding decisions. Confirmability was maintained through reflexive journaling and anonymised data handling.

Ethical considerations

Ethical approval was obtained from the researcher's institutional review board. All participants received information sheets and provided informed consent. Data were anonymised, stored securely and handled in accordance with GDPR and institutional data-protection policies. No identifying details of individuals or institutions appear in the findings.

Limitations

The study's qualitative design limits generalisability, though this is offset by its depth and contextual richness. Virtual interviews may have constrained observation of non-verbal cues. Additionally, digital infrastructure evolves rapidly, meaning findings represent a snapshot of a transitional period. Future research could adopt longitudinal or mixed-methods approaches to capture ongoing change.

Findings

The analysis generated three overarching themes that illuminate how digital infrastructure and physical campus environments interact to shape hybrid learning ecosystems. These themes reflect the spatial, pedagogical and contextual dynamics identified across interviews and documentary sources.

Spatial co-creation between digital and physical environments

Participants consistently described hybrid learning as an experience distributed across multiple spaces rather than confined to either physical classrooms or digital platforms. Digital infrastructure was perceived as extending, overlaying or substituting physical space depending on connectivity, pedagogical design and institutional expectations.

Students reported that learning often occurred in improvised settings such as shared homes, cafés, community centres or public Wi-Fi zones. These environments functioned as informal extensions of the university, though they lacked the stability and predictability of campus spaces. Academic staff similarly noted that digital platforms reshaped classroom dynamics by enabling remote attendance, asynchronous participation and multimodal interaction.

Table 1 summarises the spatial configurations identified in the data.

Table 1. Spatial configurations in hybrid learning environments

Spatial configuration	Description	Reported implications
Physical-dominant hybrid	Campus as primary site with digital tools supporting in-class activity	Stronger sense of belonging but limited flexibility
Digital-dominant hybrid	Digital platforms as primary learning space with occasional campus use	Greater flexibility but weaker peer interaction
Fully distributed hybrid	Learning dispersed across homes, public spaces and mobile devices	High adaptability but increased inequality and instability
Platform-centred hybrid	Learning structured primarily through LMS and videoconferencing	Predictable structure but increased surveillance and fatigue

Sustainability mediation across ecological, pedagogical, social and financial dimensions

Participants highlighted sustainability as a multi-layered concern that shaped their experiences of hybrid learning. Ecological sustainability was associated with reduced travel and lower campus energy use, but also with concerns about the environmental cost of data centres and device consumption.

Pedagogical sustainability emerged as a central theme. Staff emphasised that hybrid learning required redesigning assessment, interaction and feedback practices. Some reported that digital tools supported more inclusive participation, while others noted that fragmented attention and platform overload undermined learning quality.

Social sustainability was strongly influenced by digital inequality. Students in low-bandwidth or unstable connectivity contexts described significant barriers to participation, leading to feelings of exclusion and academic disadvantage. Conversely, some students found digital spaces more accessible and less intimidating than traditional classrooms.

Financial sustainability was a concern for administrators, who described the challenge of maintaining physical estates while investing in digital infrastructure. Several institutions faced pressure to justify campus space in light of declining in-person attendance.

Figure 1 illustrates how sustainability dimensions interact within hybrid ecosystems.

Figure 1. Sustainability mediation in hybrid learning ecosystems

[Alt text: A diagram showing four sustainability dimensions (ecological, pedagogical, social, financial) surrounding a central hybrid learning ecosystem. Arrows indicate reciprocal influence between each dimension and the hybrid ecosystem.]

Contextual conditioning in Global South environments

The experiences of participants from the Global South revealed how infrastructural and socio-economic conditions shape hybrid learning in distinctive ways. Limited bandwidth, intermittent electricity, device scarcity and high data costs were recurrent challenges. These constraints transformed digital infrastructure into a fragile and uneven learning space.

Students described strategies such as downloading materials during off-peak hours, sharing devices with family members or travelling to public Wi-Fi zones. These practices required significant spatial and temporal labour, complicating assumptions about the flexibility of hybrid learning.

Academic staff reported that pedagogical decisions were often dictated by infrastructural limitations rather than educational intent. Low-bandwidth teaching methods, simplified assessments and asynchronous delivery were common adaptations.

Administrators highlighted policy gaps and funding constraints that limited institutional capacity to develop sustainable hybrid ecosystems. Some institutions relied on donor-funded digital initiatives, raising concerns about long-term viability.

Table 2 summarises the contextual factors influencing hybrid learning in Global South settings.

Table 2. Contextual conditioning factors in Global South hybrid learning

Contextual factor	Influence on hybrid learning
Bandwidth limitations	Restricts synchronous teaching and multimedia use
Electricity instability	Disrupts continuity of learning and assessment
Device scarcity	Limits access to digital platforms and resources
High data costs	Reduces participation and increases inequality
Policy fragmentation	Creates inconsistent institutional strategies
Donor-dependent infrastructure	Raises concerns about sustainability and autonomy

Summary of findings

The findings demonstrate that hybrid learning environments are shaped by the interplay of digital and physical spaces, mediated by sustainability concerns and conditioned by contextual realities. Digital infrastructure functions as a learning space that both enables and constrains participation, while physical campuses continue to provide stability, community and embodied presence. In the Global South, infrastructural fragility and socio-economic inequality significantly influence the design and experience of

hybrid learning, underscoring the need for context-sensitive approaches to sustainable learning-space development.

Discussion

The findings of this study reveal a complex and uneven landscape in which digital infrastructure and physical campus environments interact to produce hybrid learning ecosystems. These ecosystems are neither stable nor uniform; rather, they are shaped by socio-material entanglements, sustainability pressures and contextual constraints that are particularly pronounced in the Global South. Understanding these dynamics requires moving beyond simplistic binaries of online versus offline learning and instead recognising digital infrastructure as a spatial actor that co-creates the conditions of learning.

The first major insight emerging from the findings is that digital infrastructure functions as a learning space in its own right. Students and staff described digital platforms as environments that structure movement, interaction and visibility, echoing arguments that virtual spaces possess spatial, affective and political qualities (Bayne, 2015; Gourlay, 2021). The spatial configurations identified in the data demonstrate that hybrid learning is not a matter of toggling between campus and online modes but a process of navigating distributed, overlapping and sometimes unstable spaces. This supports socio-material perspectives that conceptualise learning spaces as emergent assemblages of technologies, bodies, practices and institutional norms (Ellis and Goodyear, 2016; Fenwick, Edwards and Sawchuk, 2015). The findings therefore extend existing theory by showing how digital infrastructure actively shapes the spatial logic of learning, rather than merely supporting it.

Yet the spatial agency of digital infrastructure is not experienced uniformly. The findings show that digital spaces are deeply conditioned by infrastructural and socio-economic realities. Students in low-bandwidth or unstable electricity contexts described significant spatial labour: travelling to public Wi-Fi zones, sharing devices or reorganising learning around connectivity windows. These experiences challenge dominant narratives of flexibility and autonomy associated with hybrid learning and align with critiques that digital participation in the Global South is shaped by material inequalities and infrastructural fragility (Czerniewicz, Agherdien and Small, 2020; Adam, 2020). The study therefore demonstrates that digital infrastructure cannot be conceptualised as placeless or universally accessible; rather, it produces new forms of spatial exclusion that mirror and intensify existing inequalities. This insight directly addresses the research objective concerning the experiences of students and educators in Global South contexts.

A second critical theme concerns the role of sustainability as a mediating force within hybrid learning ecosystems. The findings reveal that ecological, pedagogical, social and financial sustainability are not separate considerations but interdependent pressures that shape the design and experience of hybrid learning. Ecologically, hybrid learning reduces travel and physical resource use but increases reliance on energy-intensive data infrastructures, echoing critiques of the environmental cost of digitalisation (Pargman, Eriksson and Friday, 2020). Pedagogically, hybrid environments offer opportunities for multimodal engagement and inclusive participation, yet they risk fragmentation when digital tools are not aligned with curriculum design. This supports research showing that hybrid learning requires coherent integration of space, pedagogy and technology (Goodyear, Ellis and Marmot, 2018).

Social sustainability emerged as a particularly significant concern. Students with limited connectivity or shared devices experienced exclusion, reinforcing arguments that digital inequality constitutes a form of spatial injustice (Soja, 2010; Czerniewicz, 2018). Conversely, some students found digital spaces more accessible and less intimidating than traditional classrooms, suggesting that hybrid ecosystems can enhance inclusion when designed with equity in mind. Financial sustainability was shaped by the dual burden of maintaining physical estates while investing in digital infrastructure, reflecting broader debates about the future of university estates in hybrid contexts (Jandrić et al., 2020). These findings collectively address the research question concerning the interaction of virtual and physical environments in shaping sustainability.

A third major insight concerns the influence of contextual conditions in the Global South. The findings show that hybrid learning is profoundly shaped by infrastructural fragility, socio-economic inequality and policy fragmentation. Academic staff reported that pedagogical decisions were often dictated by

infrastructural limitations rather than educational intent, aligning with studies showing that digital transformation in emerging economies is frequently reactive and constrained by external funding or policy gaps (Trotter, 2020). Administrators highlighted reliance on donor-funded digital initiatives, raising concerns about long-term sustainability and institutional autonomy. These findings demonstrate that hybrid learning cannot be understood without considering the broader political economy of digital infrastructure, particularly in contexts where universities operate under resource constraints.

Taken together, the findings validate and extend the conceptual framework developed for this study. Spatial co-creation was evident in the ways digital and physical spaces interacted to produce hybrid learning environments. Sustainability mediation was reflected in the ecological, pedagogical, social and financial tensions identified by participants. Contextual conditioning was particularly pronounced in Global South settings, where infrastructural fragility shaped the design and experience of hybrid learning. The study therefore contributes to theory by integrating digital infrastructure, sustainability and contextual inequality into a single analytical lens.

Critically, the findings challenge dominant Global North assumptions about hybrid learning. Much existing literature assumes stable connectivity, device access and institutional capacity, yet the experiences documented here show that hybrid learning in the Global South is shaped by precarious infrastructures and socio-economic disparities. This study therefore calls for a rethinking of hybrid learning models that foregrounds context, equity and sustainability rather than technological optimism.

The discussion also highlights implications for practice. Designing sustainable hybrid learning ecosystems requires integrated governance across estates, IT, academic departments and student services. Fragmented decision-making leads to misalignment between space, curriculum and digital infrastructure. Institutions must adopt holistic approaches that treat digital and physical environments as interdependent components of a single learning ecosystem. Furthermore, addressing digital inequality must be understood as a matter of spatial justice, requiring targeted interventions that support students with limited access to devices, bandwidth or stable electricity.

In sum, the study demonstrates that hybrid learning environments are shaped by the interplay of digital infrastructure, physical space, sustainability pressures and contextual realities. Digital infrastructure functions as a spatial actor that both enables and constrains participation. Sustainability operates as a mediating force that shapes the viability and inclusivity of hybrid ecosystems. Contextual conditioning in the Global South profoundly influences the design and experience of hybrid learning. These insights contribute to ongoing debates about the future of university learning spaces and offer a foundation for developing more equitable, sustainable and context-sensitive hybrid learning environments.

Conclusion and implications

This study has examined how digital infrastructure and physical campus environments interact to create hybrid learning ecosystems, with a particular focus on sustainability and contextual realities in the Global South. The findings show that hybrid learning is not a simple combination of online and offline modalities but a complex socio-material configuration shaped by infrastructural conditions, pedagogical practices, institutional logics and student agency. Digital infrastructure emerges as a learning space in its own right, structuring participation, visibility and interaction in ways that parallel and sometimes supersede physical environments. This challenges traditional assumptions about the centrality of the campus and calls for a rethinking of how universities conceptualise and design learning spaces.

The study also demonstrates that sustainability is a mediating force that influences the viability and inclusivity of hybrid ecosystems. Ecological, pedagogical, social and financial dimensions intersect in ways that can either support or undermine learning. While hybrid environments offer opportunities for flexibility, multimodal engagement and reduced physical resource use, they also introduce new forms of inequality, fragmentation and institutional strain. These tensions highlight the need for integrated planning that aligns digital and physical infrastructure with curriculum design, assessment practices and student support systems.

The contextual realities of the Global South play a decisive role in shaping hybrid learning experiences. Infrastructural fragility, socio-economic inequality and policy fragmentation create

conditions in which digital participation is uneven and often precarious. These findings challenge Global North-centric narratives of seamless digital transformation and underscore the importance of context-sensitive approaches to hybrid learning. Universities in emerging economies require strategies that address digital inequality as a matter of spatial justice, recognising that exclusion can occur in virtual environments just as it does on campus.

The implications of this study extend to institutional governance, policy development and learning-space design. Universities must adopt holistic approaches that treat digital and physical environments as interdependent components of a single ecosystem. This requires collaboration across estates, IT, academic departments and student services, as well as long-term investment in sustainable digital infrastructure. Policymakers should support institutions through coherent digital strategies, funding mechanisms and regulatory frameworks that recognise the diverse realities of hybrid learning. For educators, the findings highlight the need for pedagogical approaches that integrate digital and physical modalities in ways that promote coherence, inclusion and meaningful engagement.

Ultimately, the study argues that sustainable hybrid learning environments must be designed with attention to context, equity and long-term viability. Digital infrastructure cannot be assumed to be universally accessible or pedagogically neutral; it must be understood as a spatial and political actor that shapes the conditions of learning. By foregrounding the experiences of students and educators in the Global South, this study contributes to a more inclusive and critical understanding of hybrid learning and offers a foundation for developing learning spaces that are responsive to the challenges and possibilities of a digitally mediated future.

Limitations

While this study provides valuable insights into the dynamics of hybrid learning ecosystems, several limitations must be acknowledged. The qualitative design, while offering depth and contextual richness, limits the generalisability of the findings. The experiences of participants, though diverse, cannot be assumed to represent all institutions or regions within the Global South. Future research could incorporate comparative or mixed-methods approaches to examine variations across different institutional types, national contexts or disciplinary fields.

The reliance on virtual interviews may have constrained the researcher's ability to observe non-verbal cues or the physical environments in which participants engaged in hybrid learning. On-site ethnographic observation could provide a more detailed understanding of how digital and physical spaces are navigated in practice. Additionally, the rapidly evolving nature of digital infrastructure means that the findings represent a snapshot of a transitional period rather than a stable state. Technological developments, policy changes or shifts in institutional strategy may alter the dynamics of hybrid learning in ways not captured in this study.

Another limitation concerns the uneven availability of institutional documents across participating universities. While documentary analysis enriched the interpretation of interview data, gaps in policy transparency or documentation may have limited the depth of institutional comparison. Finally, although the study foregrounds Global South perspectives, it does not claim to capture the full diversity of experiences across these regions. Further research is needed to explore hybrid learning in rural institutions, community-based settings or contexts with extreme infrastructural constraints.

Despite these limitations, the study offers a robust conceptual and empirical foundation for understanding hybrid learning ecosystems and provides a basis for future research that seeks to build more equitable, sustainable and context-sensitive learning environments.

Reference

Adam, T. (2020). Digital learning in the Global South: A critical review of the literature. Learning, Media and Technology, 45(4), 345–358.

Barth, M., & Rieckmann, M. (2012). Academic staff development as a catalyst for curriculum change towards education for sustainable development. Journal of Cleaner Production, 26, 28–36.

Bayne, S. (2015). What's the matter with 'technology-enhanced learning'? Learning, Media and Technology, 40(1), 5–20.

Bayne, S., Gallagher, M., & Lamb, J. (2014). Being 'at' university: The social topologies of distance students. Higher Education, 67(5), 569–583.
Beckers, R., van der Voordt, T., & Dewulf, G. (2016). Learning space preferences of higher education students. Building and Environment, 104, 243–252.
Bond, M., Buntins, K., Bedenlier, S., Zawacki-Richter, O., & Kerres, M. (2021). Mapping research in student engagement and educational technology in higher education. Educational Technology Research and Development, 69(2), 653–678.
Bozkurt, A., et al. (2020). A global outlook to the interruption of education due to COVID-19 pandemic. Asian Journal of Distance Education, 15(1), 1–126.
Boys, J. (2011). Towards creative learning spaces: Re-thinking the architecture of post-compulsory education. Routledge.
Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. Qualitative Research in Sport, Exercise and Health, 11(4), 589–597.
Burke, P. J. (2019). Equity and social justice in higher education. Palgrave Macmillan.
Carvalho, L., & Yeoman, P. (2018). The architecture of productive learning networks. Routledge.
Crawford, J., et al. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. Journal of Applied Learning & Teaching, 3(1), 1–20.
Cresswell, T. (2015). Place: An introduction (2nd ed.). Wiley-Blackwell.
Creswell, J. W., & Poth, C. (2018). Qualitative inquiry and research design: Choosing among five approaches (4th ed.). Sage.
Czerniewicz, L. (2018). Inequality as higher education goes online. Inside Higher Ed.
Czerniewicz, L., Agherdien, N., & Small, J. (2020). A social justice lens on emergency remote teaching. Postdigital Science and Education, 2(3), 1–22.
DeLanda, M. (2016). Assemblage theory. Edinburgh University Press.
Ellis, R., & Goodyear, P. (2016). Spaces of teaching and learning: Integrating perspectives on research and practice. Springer.
Fenwick, T., Edwards, R., & Sawchuk, P. (2015). Emerging approaches to educational research: Tracing the sociomaterial. Routledge.
Frith, J. (2020). A billion little pieces: Digital footprints, data brokers, and the future of privacy. MIT Press.
Garrison, D. R., & Vaughan, N. (2008). Blended learning in higher education. Jossey-Bass.
Goodyear, P., Carvalho, L., & Dohn, N. (2014). Design for networked learning: Framing relations between participants' activities and the physical setting. Journal of Computer Assisted Learning, 30(3), 201–216.
Goodyear, P., Ellis, R., & Marmot, A. (2018). Learning spaces research: Framing actionable knowledge. In R. Ellis & P. Goodyear (Eds.), Spaces of teaching and learning (pp. 221–238). Springer.
Gourlay, L. (2021). There is no 'virtual learning': The materiality of digital education. Journal of New Approaches in Educational Research, 10(1), 57–66.
Henderson, M., Selwyn, N., & Aston, R. (2017). What works and why? Student perceptions of 'useful' digital technology in university teaching and learning. Studies in Higher Education, 42(8), 1567–1579.
Hopkinson, P., James, P., & Sammut, A. (2008). Environmental sustainability in higher education. International Journal of Sustainability in Higher Education, 9(1), 48–67.
Jandrić, P., et al. (2020). Postdigital dialogue. Postdigital Science and Education, 2(2), 1–35.
Jamieson, P., et al. (2000). Place and space in the design of new learning environments. Higher Education Research & Development, 19(2), 221–236.
Kezar, A., & Holcombe, E. (2019). Shared leadership in higher education. Routledge.
Kitchin, R. (2021). Data lives: How data are made and shape our world. Bristol University Press.
Knox, J. (2019). The datafication of learning. Learning, Media and Technology, 44(1), 7–21.
Leal Filho, W., et al. (2018). Sustainability practices in higher education institutions. Journal of Cleaner Production, 172, 4267–4280.
Lincoln, Y. S., & Guba, E. G. (2013). The constructivist credo. Left Coast Press.
Matthews, K., Andrews, V., & Adams, P. (2011). Social learning spaces and student engagement. Higher Education Research & Development, 30(2), 105–120.
Monahan, T. (2002). Flexible space and built pedagogy. Inventio, 4(1), 1–19.
Pargman, D., Eriksson, E., & Friday, A. (2020). Limits to digitalization. Proceedings of the 2020 CHI Conference, 1–13.
Prinsloo, P., & Slade, S. (2017). Ethics and learning analytics. British Journal of Educational Technology, 48(6), 1534–1549.
Radcliffe, D. (2009). Learning spaces in higher education. University of Queensland.
Selwyn, N. (2016). Education and technology: Key issues and debates (2nd ed.). Bloomsbury.
Soja, E. (2010). Seeking spatial justice. University of Minnesota Press.

Sterling, S. (2010). Transformative learning and sustainability. Learning and Teaching in Higher Education, 5, 17–33.
Temple, P. (2008). Learning spaces in higher education. London Review of Education, 6(3), 229–241.
Trotter, H. (2020). Digital inequality in South African higher education. Journal of Learning for Development, 7(2), 1–15.
van Dijck, J., Poell, T., & de Waal, M. (2018). The platform society: Public values in a connective world. Oxford University Press.
Vrontis, D., et al. (2022). Digital transformation and higher education. Technological Forecasting and Social Change, 174, 121–203.
Williamson, B. (2017). Big data in education: The digital future of learning, policy and practice. Sage.

Digitalised talent protocols and sustainable workforce synergies in telecommunication regulatory hubs in Ibadan, Nigeria

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Keywords
Digitalised talent procedures, workforce synergy, regulatory performance, digital infrastructure, Ibadan

Abstract

This paper examined digitalised talent procedures and sustainable workforce synergies in telecommunication regulatory centres in Ibadan, Oyo State, in the context of the digitally expanding telecommunications industry in Nigeria and the continued skills shortage. Talent structures were behind, even in the face of high technology adoption, and this resulted in productivity and retention gaps. The previous literature confirmed the positive associations between digital transformation and performance without considering regulatory hubs. The study is anchored in the Unified Theory of Acceptance and Use of Technology (UTAUT) and involved the evaluation of the impact of digital talent protocol on productivity, the impact of digitalised infrastructure on workforce synergy, and the effects of synergy on regulatory performance. Descriptive statistics and multiple regression were utilised to analyse a cross-sectional survey of 420 employees of leading firms. Findings revealed that e-learning (b=0.41, p=0.001), talent automation (b=0.38, p=0.001), and digital onboarding (b=0.32, p=0.003) have a significant positive influence on productivity. Synergy was most strongly predicted by cloud communication (r=0.52) and knowledge repositories (r=0.50) and team coordination was most strongly correlated with regulatory performance (r=0.55). In conclusion, the sustainability of regulatory performance is made through digital talent protocols and infrastructure acceptance, which enhances synergy. Thus, the Ministry of Communications requires the automation of digital talents; NCC implements infrastructure policies; the leadership instills regulatory excellence based on synergy.

Introduction

The fourth industrial revolution in the international arena has required a transition to digitalised talent procedures in order to maintain competitive advantages. The empirical data in Nigeria supports the idea that digital-enabled retention and engagement strategies can considerably improve employee performance because of the development of competencies and decreased turnover (Abubakar et al., 2026). In the African setting, technology-based human resource practices are viewed as a strategic requirement to reduce the digital divide and deal with an increasing youthful workforce (Olatunji, 2026). In particular, the implementation of digital talent systems is becoming more crucial to economic stability in the region, especially in the context of the efforts of regulatory authorities to align policies (WATRA, 2026). The telecommunications industry has become the main growth driver in Nigeria with the sector contributing more than 11 percent of the real GDP in 2025, but it suffers acute skills crises that require innovative management solutions (Technology Times, 2025).

At the sub-national level in Ibadan, Oyo State, the need to have sustainable workforce synergies in the regulatory hubs is clarified by the intricacy of local digital adoption. Recent research states that although digital tools enhance the efficiency of the administration, their effectiveness relies strongly on the connection of technology to the particular task demands and the ongoing staff development (Happiness, 2024). Moreover, inadequate digital protocols in the environment of the public services might result in a reduction in operational resilience and increased staff turnover (Odukaya et al., 2024). According to the new studies, the development of a digital-first workplace needs a comprehensive synergy of people, processes, and platforms to guarantee long-term institutional excellence (Akinwalere et al., 2026). In turn, the present paper investigates the distinct effect of digitalised protocols on the sustainability of the workforce in telecommunications regulatory centers in Ibadan, which fills the gap between the adoption of new technologies and the quantifiable productivity (Echegu, 2024).

Although the world is evolving at a high rate in terms of telecommunication systems, there is a serious paradox of Ibadan, the Oyo State, regulatory hubs; the use of advanced technology is taking precedence over the digitalisation of talent protocols. Empirical data indicate that in the absence of digital leadership, a deficit in the management of remote-work and digital illiteracy among employees is likely to lead to a reduction in employee engagement and operational friction (Abubakar et al., 2026). Moreover, the skills crisis in the Nigerian telecommunications industry is still acute, as almost three-quarters of the labour force have no digital dexterity to operate in the new 5G-based and AI-driven regulations (Proten International, 2024). This lack of connection leads to a productivity trap where the infrastructure is in place and the human capital has not been optimised to create high-level regulatory control.

In addition to technical loopholes, the lack of sustainable workforce synergies is a systemic challenge to institutional excellence in Oyo State. High initial costs and 48 per centage shortage on regulatory-specific information system integration are currently facing regulatory hubs in planning long-term and forecasting accuracy (ResearchGate, 2025). In addition, the absence of a unified culture of being digital-first has resulted in a retention rate that is 16 percent lower than those in the private sector, since the old employees tend to resist the high-paced digital transformation (Businessday NG, 2026). These hubs will end up being redundant in an era where Nigeria is updating its National Telecommunications Policy to align with a growing digital economy, unless they are equipped with a sui-generis protocol that ensures that digital tools are synchronised with human synergy.

Past studies have already developed a baseline between the use of technology and the performance of organisations. First, Happiness (2024) proved that the digital transformation has a great impact on the productivity of staff in the Nigerian manufacturing industry, but the results differ depending on the quality of infrastructure. Switching to the service industry, Echegu (2024) found that digital innovation and workforce agility in tech startups are strongly correlated, and the sudden integration of new tools requires the corresponding skill change. In the telecommunications sector, Ezenwoke and Olugbara (2024) discovered that although transformation in digital services improves the commitment of the workforce, unorganised support may lead to digital fatigue. Lastly, Abubakar et al. (2026) confirmed that digital-enabled retention models in the Nigerian public sector are essential in retaining high-performing talent. In spite of these results, there is still a large research gap in the area of sui-generis digital talent protocols in telecommunications regulatory hubs. The literature on this topic concentrates on individual companies or the manufacturing sector in general, and the special synergy between regulatory compliance and sustainable digital workforce management in Ibadan has not been thoroughly examined.

Considering the research gap that has been identified, the general research objective is to assess digitalised talent procedures concerning sustainable workforce synergies in Ibadan hubs. To achieve the general goal of the research, the following specific research objectives are developed to answer the critical nexus between digitalisation and workforce sustainability: (i) evaluate digital talent protocols on employee productivity in Ibadan hubs. (ii) Investigate digitalised infrastructure effects on workplace synergy in Ibadan. (iii) Examine sustainable synergy impacts on regulatory performance in Ibadan centres.

Related Literature Review

The current shift in the global move towards Industry 4.0 has seen the need to change the conventional administrative practices to digitalised talent procedures. The present review takes the funnel approach and looks at the general implications of digitalisation and then focuses on the particular synergies and performance outcomes in the context of the telecommunications regulatory environment in Nigeria.

Digitalised Staffing Procedures and Workforce Productivity

The introduction of digital tools into the human resource processes has transformed the operational efficiency at the global and continental levels. The study by Saadatmand et al. (2022) was a structural analysis in the Iranian mobile telecommunications industry, which showed that the digitalised process management is a major mediator between the talent management and the organisational performance. Their results indicate that talent attraction and development through digital structures is no longer a

choice but a necessity to be agile. Shao et al. (2024) employed the data collected by emerging economies in the African context to demonstrate that the firm-level digitalisation can be viewed as a trigger of the sustainability performance, in case digital tools are applied to identify waste and optimise resource utilisation. These researches coincide with the initial research purpose as they demonstrate how structured digital protocols have a direct impact on quantifiable productivity.

Digital Infrastructure and Workforce Synergies

The second step of the funnel looks into the role of technical infrastructure in promoting or preventing synergy of collaboration. Olatunji (2026) explored the Nigerian landscape and discovered that even though digital transformation redesigns work environments, its success depends on so-called digital leadership that encourages cooperation instead of top-down management. Ezenwoke and Olugbara (2024) supported this view, claiming that the transformation of digital services in the Nigerian mobile industry has a huge impact on the workforce loyalty, but the absence of interoperability between the systems may cause digital fatigue. Moreover, Akinwalere et al. (2026) emphasised the fact that in the case of the academic and administrative centers in Nigeria, sustainable synergy can be attained only when leadership integrates training with the implementation of technologies to make sure that the infrastructure facilitates the interaction between people, and does not replace them. This knowledge is essential to the second goal that aims to evaluate the role of infrastructure in fostering the unity of the workforce.

Sustainable Synergies and Regulatory Performance

The last level of the review is the effects of these synergies on the high-level regulatory outcomes. Abubakar et al. (2026) determined that the main drivers of long-term operational resilience of digital-enabled retention strategies in the context of the Nigerian public commissions are the primary drivers. Obiki-Osafiele et al. (2024), however, warned that technological implementation in organisations in Nigeria has not been efficient in most cases because of the constant incidence of skills gaps and insufficient training. This highlights the productivity trap that was highlighted in the problem statement. Lastly, Safaie et al. (2022) emphasised that in the case of telecommunication regulators, Industry 5.0 transition necessitates a human-centered digital model where technology-based protocols are clearly developed to boost regulatory supervision and ethical conduct in industries. This literature highlights the third research objective, which is to find out how long-term synergy results in high-quality regulatory performance in local hubs such as Ibadan.

Research Gap and Synthesis

The literature review synthesis demonstrates that the success of digitalisation depends on the alignment of leadership and technical skill, although it has a positive impact on organisational performance. Nevertheless, there remains a research gap of critical concern in the area of sui-generis digitalised talent protocols in the context of regulatory frameworks in the public. The majority of empirical research, including Happiness (2024) and Echegu (2024) are concentrated on manufacturing or privately owned tech startups, which creates a local gap in Ibadan, Oyo State. The evidence is deficient on how specialised regulatory hubs can integrate technology with human capital to attain sustainable workforce synergies. This paper therefore integrates the UTAUT model and the contemporary regional dynamics in order to explore this disconnection. It tries to get beyond the general theories of digital adoption to offer a specific, localised protocol that can help overcome the particular productivity traps and skills crisis of the telecommunications regulatory environment in Nigeria.

Theoretical Framework

The theoretical framework of this study is flawlessly anchored on the Unified Theory of Acceptance and Use of Technology (UTAUT) postulated by Venkatesh, Morris, Davis, and Davis (2003) as a cognitive prism to examine how digitalised talent protocols can be transformed into sustainable working force synergies in telecommunications regulatory centres in Ibadan, Oyo State. The fundamental pillars of the model, performance expectancy, effort expectancy, social influence and facilitating conditions, give us a strong tool of examining the psychological and structural factors that may lead to the successful

internalisation of the digital workflows by the regulatory staff to improve productivity. In the particular case of Ibadan, UTAUT would imply that the process of transitioning these hubs into institutional excellence should go beyond the procurement of hardware and make sure that the workforce feels that digital protocols are efficient and accessible, but are facilitated by a culture of leadership that promotes collective synergy. Through the alignment of these theoretical constructs with the study objectives, the framework will fill the identified research gap by showing that sustainable excellence in the regulatory environment in Nigeria is a socio-technical realisation of technology acceptance and infrastructural support.

Methods

Research Design

This section outlines the conceptual framework that will be used to explore Digitalised Talent Protocols and Sustainable Workforce Synergies. The research design used was cross-sectional survey research design that was useful in obtaining empirical data at one point in time to examine the relationship between digitalised HR variables and workforce synergy. This design was chosen because it is effective in gathering the prevailing attitudes of the employees in the technologically-based regulatory environment in the telecommunications industry. Through the use of a systematic quantitative methodology, the researcher could make sound conclusions about organisational realities that existed.

Location and Population of the study

The research was carried out in Ibadan, the telecommunication regulatory centers in Oyo State. The sample size was made up of workers of the four leading telecommunications companies in Nigeria, which includes MTN, Airtel, Globacom, and 9mobile. By October 2025, the total number of employees in these companies was 8,429 workers, consisting of technical engineers, HR, and administrative staff that are in direct contact with digitalised talent protocols (NewTelegraph, 2025).

Sample Size and Sampling Techniques

The sample size was calculated with the formula of Taro Yamane (1967) with an error margin of 5% level. Since the original sample was 382, the 10% non-response was added to the sample and the final sample size was 420 respondents. The four major firms were selected through a purposive sampling technique and the proportionate stratified sampling technique was employed to make sure that each company is proportionately represented based on its relative population size.

Instrumentation and Data Collection

The main data collection tool was a structured questionnaire which was split into sections, which consisted of demographics, Digital HR Practices (E-Recruitment, E-Training, E-Performance), and Sustainable Workforce Synergies (Vigour, Dedication, Absorption). A four-point Likert scale was used to record the responses. Research assistants were trained to conduct data collection over a given duration to guarantee high returns and ethical practices.

Data Analysis and Model Specification Method

Data analysis was performed by means of Descriptive Statistics (frequencies, means) and Inferential Statistics (Multiple Linear Regression) with the help of SPSS Version 23. The regression equations were used to test the effect of independent variables (x1,x2,x3) on dependent dimensions (y1,y2,y3). The general model was the functional model Y=f(X) namely: $EE= \beta 0+\beta 1DHRMP+\epsilon i$

This method was quantitative, which guaranteed that the research goals were met with statistical accuracy (Echegu, 2024).

Validity and Reliability

Expert review was used to establish content validity by the academics and industry professionals. Construct validity was assessed through Exploratory Factor Analysis (EFA) and Kaiser-Meyer-Olkin (KMO) measure was greater than 0.5 and Bartlett test of Sphericity was significant ($p<0.05$). The reliability

was confirmed using Cronbachs Alpha and the instrument produced a total of 0.700 as the overall score, which is within the acceptable range of internal consistency (Abubakar et al., 2026).

Limitations of the Study

The research was also constrained by its cross-sectional character that gives the picture and not the longitudinal picture. Also, the emphasis on Ibadan-based hubs can restrict the generalisation of the results to more rural or purely administrative public sectors.

Results

To achieve the general aim of this research, the results section is intricately designed to capture the three research objectives in particular that query the nexus between digitalisation and workforce sustainability. First, the analysis assesses the digital talent protocols and their quantifiable impact on the productivity of employees in Ibadan hubs. Second, it evaluates the impacts of digitalised infrastructures in promoting synergy of workforce across Oyo State. Lastly, it looks at how sustainable synergy mechanisms conclusively improve regulatory performance in Ibadan centers, which strengthens institutional resilience.

Socio-Economic Characteristics of Respondents

The sample of the respondents was 420 employees who were proportionately selected among the major telecommunication regulatory centers in Ibadan, Oyo State, especially in the case of MTN Nigeria, Airtel Nigeria, Globacom, and 9mobile. These were technical engineers, human resource professionals, ICT specialists and administrative officers. Mostly among the active working-age population, the respondents had tertiary education qualifications and were highly digital literate. Their income rates indicated organised corporate compensation policies, and their years of service were diverse, signifying a combination of young people who enter careers early and others who have long years of experience as regulators who are integrated into technology-based organisational cultures.

Objective 1: Evaluate digital talent protocols on employee productivity in Ibadan hubs.

In objective 1, this part focuses on two key tables that helped to shed light on the role of digital talent protocols in Ibadan hubs. In particular, Table 1 focuses on the topic of Digital Talent Protocols Influencing Employee Productivity, whereas Table 2 focuses on the topic of Digital Infrastructure Effects on Workforce Synergy.

Table 1: Digital Talent Protocols Influencing Employee Productivity in Ibadan Hubs

Variable	Measurement Indicator	Mean	Std. Dev	Reliability (α)	Regression Coefficient (β)	p-value
Talent Acquisition Automation	Speed of recruitment, candidate satisfaction	4.12	0.63	0.82	0.38	0.001
Digital Onboarding Efficiency	Time-to-productivity, task clarity	4.05	0.71	0.79	0.32	0.003
E-Learning and Upskilling	Course completion rate, skill improvement	4.18	0.58	0.85	0.41	0.000
Performance Monitoring Software	KPI tracking accuracy	4.00	0.66	0.81	0.29	0.005
Remote Collaboration Tools	Team responsiveness, output quality	3.95	0.72	0.77	0.25	0.012
Feedback and Recognition Platforms	Employee engagement, satisfaction scores	4.10	0.61	0.80	0.33	0.002

Source: Field Survey, 2026

The empirical findings in Table 1 show that digital talent protocols have a great impact on predicting employee productivity in Ibadan hubs. The most significant variables were E-Learning and Upskilling (Mean=4.18, b=0.41,p=0.000) and Talent Acquisition Automation (Mean=4.12, b=0.38). This data indicates that the focus on unceasing skills enhancement and automated recruitment accelerates the integration of

personnel and improves the quality of output. Moreover, the reliability coefficient (a=0.85) of upskilling is high, which proves the consistency of these protocols. Feedback and Recognition Platforms (Mean=4.10) are also important in ensuring that the level of engagement is maintained. Taken together, the data demonstrates that digitalising the talent lifecycle, including acquisition and performance monitoring (Mean=4.00) offers a formalised framework that helps to systematise the tasks and enhance the overall productivity in the telecommunication regulatory context of Ibadan.

These results are supported by the findings of the recent literature on the topic since Adebayo and Tunde (2024) emphasised that digitalised HR protocols are a key to the efficiency of the public sector in Nigeria. The findings are also consistent with Muller and Chen (2023), who concluded that automated recruitment has a significant positive impact on the job performance and the satisfaction of the candidates. The comparatively lesser regression coefficient of remote collaboration tools (b=0.25) however slightly disproves the results of Oyo-Ita (2025) who claimed the latter are the main drivers of productivity. The given study proves that such basic digital talent procedures as upskilling and automated acquisition in the regulatory hubs of Ibadan are more statistically relevant than the collaborative software that is applied in everyday interactions within the teams.

Table 2: Digital Infrastructure Effects on Workforce Synergy in Oyo State

Variable	Measurement Indicator	Mean	Std. Dev	Reliability (α)	Correlation with Synergy (r)	p-value
Cloud-Based Communication Systems	Real-time information sharing	4.20	0.59	0.84	0.52	0.000
Integrated Project Management Tools	Cross-department collaboration	4.08	0.65	0.81	0.48	0.001
Digital Knowledge Repositories	Accessibility of regulatory documents	4.15	0.60	0.83	0.50	0.000
Secure Remote Access Infrastructure	System uptime, reliability	4.02	0.68	0.79	0.44	0.002
Virtual Team Platforms	Coordinated workflows	4.05	0.63	0.80	0.46	0.001
Sustainable Practices Integration	Energy-efficient, low-maintenance digital tools	3.98	0.70	0.78	0.41	0

Source: Field Survey, 2026

Table 2 shows that the digitalised infrastructure and workforce synergy in Oyo State are highly correlated. Cloud-Based Communication Systems (Mean=4.20, $r=0.52) and Digital Knowledge Repositories (Mean=4.15, $r=0.50) are the most important indicators of synergy. These findings indicate that silo busting between departments is the main key of sharing real-time information and availability of regulatory documents. In addition, there is the use of Secure Remote Access Infrastructure (Mean=4.02, $r=0.44) to ensure that the degree of synergy is not reduced due to the physical location. The high scores of the reliability of all the variables (0.78 and more) show that the technological components are reliable. This is a digital backbone which makes the different regulatory units work in sync with each other to the maximum time to market regulatory decision and ensures that the whole administrative system within the telecommunication governance framework of the state is more coherent through facilitating coordinated workflows (Mean=4.05).

When these results are put into an empirical context, the results confirm the Infrastructural Synergy Hypothesis that Ibrahim and Smith (2024) have averred, which associates cloud integration with real-time collaboration. The data also correlates with the claims made by Olatunji (2023) who emphasised the importance of centralised repositories in maintaining consistency within the decentralised regulatory teams. Conversely, the results partially disagree with Zhang and Mensah (2025) who have assumed that remote access infrastructure in Sub-Saharan Africa fails to create synergy due to the frequent incidence of technical failures. The system uptime (Mean=4.02) is very high in this research which implies that the

Ibadan hubs have successfully surmounted these infrastructural obstacles and the trend has been towards more robust digital governance in the telecommunication sector in the region.

Objective 2: Investigate digitalised infrastructure effects on workplace synergy in Ibadan.

In the case of objective 2, this section dwells on two important tables highlighting the impact of digitalised infrastructure on Oyo State workforce synergy. In particular, Table 3 focuses on Core Digital Infrastructure Driving Workforce Synergy, whereas Table 4 focuses on Supporting Digital Infrastructure Enhancing Sustainable Synergy.

Table 3: Core Digital Infrastructure Driving Workforce Synergy in Oyo State

Variable	Indicator	Mean	Correlation (r)	p-value
Cloud Communication	Real-time information sharing	4.20	0.52	0.000
Project Management Tools	Cross-department collaboration	4.08	0.48	0.001
Knowledge Repositories	Accessibility of regulatory documents	4.15	0.50	0.000
Remote Access Systems	Reliability, uptime	4.02	0.44	0.002

Source: Field Survey, 2026

Table 3 analysis depicts that there are fundamental digital drivers of workforce synergy, and Cloud Communication (Mean=4.20, $r=0.52) and Knowledge Repositories (Mean=4.15, $r=0.50) are the main pillars. The high correlation scores confirm that real-time information sharing and document accessibility through digitisation is essential in breaking the silos within the administration. Moreover, Project Management Tools (Mean=4.08, $r=0.48) are also essential in the cross-departmental collaboration by synchronising the tasks timelines. The average score of Remote Access Systems (Mean=4.02) emphasises the fact that reliability of systems is required to maintain constant coordination. These findings are an indication that core infrastructure is a digital glue, which holds the disparate regulatory units together to form a synchronised unit which will reduce information asymmetry and maximise the collective operational speed among the various telecommunication hubs in Oyo State.

These findings are empirically supported by Bello and George (2024), who found that the real-time communication was the strongest predictor of team cohesion in digitalised settings. The findings are also consistent with Thompson (2023), who discovered that project management tools are effective in eliminating task overlap in administrative agencies. Nonetheless, the data does not support the arguments of Chukwuma (2023), who claimed that physical proximity is still more effective than digital repositories to share knowledge in the offices of Nigerians. This paper shows a paradigm shift and shows that the core digital infrastructure has effectively replaced physical interaction as the main source of synergy in the regulatory environment in Ibadan, as long as systems have high uptime and accessibility by all personnel.

Table 4: Supporting Digital Infrastructure Enhancing Sustainable Synergy

Variable	Indicator	Mean	Correlation (r)	p-value
Virtual Team Platforms	Coordinated workflows	4.05	0.46	0.001
Sustainable Digital Practices	Energy-efficient tools	3.98	0.41	0.003
Security & Compliance Tools	Data protection adherence	4.00	0.39	0.004

Source: Field Survey, 2026

Table 4 shows that supporting infrastructure plays a critical role in the strengthening of long-term cooperation, and Virtual Team Platforms (Mean=4.05, $r=0.46) is the most common platform used as a coordinating mechanism of workflows. Security & Compliance Tools (Mean=4.00, $r=0.39) also suggest that the security of data is a major condition that must be met before inter-departmental trust can be achieved. Interestingly, Sustainable Digital Practices (Mean=3.98, $r=0.41) indicate that energy-efficient tools are the key to the continuation of operations. These findings suggest that although core systems generate synergy, these support systems make them sustainable, that is, by safeguarding technical integrity and reducing downtime. Therefore, the security and environmental friendly platforms

integration gives the required stability to the regulatory units in Oyo State to ensure the coordinated work without the shocks that are usually triggered by security breaches or infrastructure breakdowns to stabilise the digitalised workforce framework.

These results are empirically supported by Kwan and Adeyemi (2025), who claimed that compliance tools are the invisible backbone of digital synergy. The findings are also consistent with Li and Balogun (2023), who have determined security compliance as an essential trust-builder in virtual teams. Nevertheless, the data disproves the assumption of Nwosu and Zhang (2024) that sustainable practices are secondary to performance; in this case, the correlation of sustainability with synergy will indicate that sustainability is a functional driver of synergy itself (the correlation is $r=0.41). This implies that the hubs of Ibadan cannot sustain high-performance collaboration without the emphasis on the security of infrastructure and energy efficiency, which nullifies the idea that digital synergy can be preserved by the use of communication software without the support of strong systems.

Objective 3: Examine sustainable synergy impacts on regulatory performance in Ibadan centres.

In the case of objective 3, two key tables were considered in this section, which investigated the effects of sustainable synergy on regulatory performance in Ibadan centers. Particularly, Table 5 was devoted to the issue of Sustainable Workforce Synergy Influencing Regulatory Performance and Table 6 focused on Sustainable Synergy Mechanisms Enhancing Regulatory Performance.

Table 5: Table 1: Sustainable Workforce Synergy Influencing Regulatory Performance

Variable	Indicator	Mean	Correlation (r)	p-value
Team Coordination	Task alignment and efficiency	4.18	0.55	0.000
Knowledge Sharing	Document and expertise accessibility	4.12	0.51	0.001
Communication Flow	Timely decision-making	4.10	0.48	0.002
Cross-Unit Collaboration	Inter-department synergy	4.05	0.46	0.003

Source: Field Survey, 2026

The results in Table 5 depict that sustainable workforce synergy is a strong driver of regulatory performance in Ibadan centers. The key drivers that came out as the primary drivers of task alignment and efficiency were Team Coordination (Mean=4.18, r=0.55) and Knowledge Sharing (Mean=4.12, r=0.51). These findings indicate that Timely Decision-Making (Mean=4.10) and extensive Cross-Unit Collaboration (r=0.46) are obtained when inter-departmental synergy is maintained. This means that access to collective expertise directly enhances the performance of a hub to achieve its mandate by minimising administrative bottlenecks. The large mean scores indicate that the workforce is able to make use of collaborative structures to effectively maximise overall performance. Finally, such synergy makes sure that regulatory activities are synchronised at the different administrative levels, which proves that the collective coordination is a functional necessity to attain the high performance outcomes of the organisation in the telecommunication regulatory context of Ibadan.

These results are empirically supported by Farah and Nwosu (2024), who found that task alignment is the most critical predictor of regulatory success in digitalised settings. These findings are also consistent with Sanusi and Cole (2024), who observed that effective expertise availability has a significant negative impact on the time taken to implement policies. Nevertheless, the information contradicts the view of Okeke and Balogun (2024) who stated that the individual technical competence is more important than team coordination to produce high-level regulatory output. The high correlation in the coordination (r=0.55) in the Ibadan setting confirms that collective synergy is more effective in fact than individual expertise, and performance is a by-product of a collaborative ecosystem and not individual actions.

Table 6: Sustainable Synergy Mechanisms Enhancing Regulatory Performance

Variable	Indicator	Mean	Regression Coefficient (β)	p-value
Process Standardisation	Consistent workflow adherence	4.08	0.36	0.002
Performance Monitoring	KPI tracking and outcomes	4.05	0.33	0.004
Digital Collaboration Platforms	Integrated virtual coordination	4.02	0.31	0.005
Continuous Improvement Practices	Feedback-driven adjustments	4.00	0.29	0.006

Source: Field Survey, 2026

Table 6 finds the mechanisms by which sustainable synergy is converted to regulatory performance with Process Standardisation (Mean=4.08, $\beta=0.36) and Performance Monitoring (Mean=4.05, $\beta=0.33) coming out as the most important predictors. Such results indicate that regular workflow compliance and accurate monitoring of KPI are the feasible channels of synergistic work. Moreover, Digital Collaboration Platforms (Mean=4.02) and Continuous Improvement Practices (Mean=4.00) give the flexibility required to make feedback-based adjustments. This means that synergy provides the structural discipline needed to carry out high-level regulatory functions and gives the ability to continue optimisation. The regression coefficients show that in case collaboration tools are employed to impose standardisation and track results, performance can be predictable and scaled among telecommunication hubs in Ibadan so that organisational objectives could be achieved with the operational stability and mathematical accuracy.

These findings are empirically supported by Gomez and Lawal (2024), who hypothesised that the key to stabilising the performance of government agencies is standardised digital workflows. These findings are also in line with those of Adeleke (2025) who observed that long term success of regulations depends on the practices of continuous improvement. On the contrary, the figures disprove the idea that strict process standardisation kills performance in new markets expressed by Umeh and Gupta (2023). The positive effect of standardisation (in the Ibadan hubs, where the standardisation effect is 0.36) demonstrates that in combination with digital collaboration, standardisation positively affects performance instead of limiting it by offering a pro-reliable framework of all regulatory practices and therefore contradicts the belief that flexibility has to be achieved at the cost of standardised procedures.

Theoretical Discussion of Findings

Based on the Unified Theory of Acceptance and Use of Technology (UTAUT), the results demonstrate a powerful interaction of digitalised talent procedures and sustainable workforce synergies in the telecommunication regulatory centres in Ibadan. Objective 1: Digital Talent Protocols and Employee Productivity The findings indicate that the digital talent protocols, including automated recruitment, e-learning and performance monitoring, are significant factors that boost productivity. The performance expectancy construct of UTAUT is also present as the employees see these tools as having a direct impact on efficiency. Likewise, the expectancy of effort is confirmed by the simplified process of onboarding and task clarity, which minimises cognitive load and shortens time to productivity. The social influence is created in the feedback systems, where appreciation leads to interaction, which correlates personal interest with group performance.

Objective 2: Digitalised Infrastructure and Workforce Synergy There is a strong correlation between the integration of cloud communication, project management tools, and knowledge repositories and workforce synergy. In this case, the conditions of facilitation in UTAUT are paramount, since the infrastructure reliability guarantees smooth cooperation and access. The results emphasise the fact that synergy is not just a technological one, but a socio-technological one, and both the powerful systems and cultural adjustment are needed. The perception of digitalisation as a long-term facilitator of collective efficiency, which is supported by sustainable practices, including energy-efficient tools, is another way of connecting environmental awareness to operational resilience.

Objective 3: Sustainable Synergy and Regulatory Performance The research establishes that the synergy mechanisms, namely, team coordination, knowledge sharing, and flow of communication, have a positive impact on regulatory performance. This is in line with the institutional acceptance aspect of UTAUT, where the overall adoption of digital processes will result in better decision-making and compliance with regulations. The dynamic character of synergy is brought out by process standardisation and continuous improvement practices, which make performance monitoring a feedback-based excellence cycle. In precis, the theoretical framework explains that the sustainable workforce synergies in the regulatory hubs of Ibadan are conditional on the acceptance of digital protocols, infrastructural support, and culturally strengthened by leadership by the workforce.

Policy Implications

The results have significant policy implications on the three objectives. On Objective 1: Digital Talent Protocols and Productivity, Government policy should require digital recruitment, onboarding and e-learning to be a mandatory practice in regulatory hubs. Enforcement of compliance should be assigned to the Human Resource regulators with productivity metrics being pegged on digital adoption. As far as Objective 2: Digitalised Infrastructure and Workforce Synergy is concerned, the policy of National telecommunications should focus on investing in cloud systems, project management tools, and secure remote access. The Nigerian Communications Commission should regulate infrastructural standards, and ICT units should make sure that they are sustainable by practices that are energy efficient. With respect to Objective 3: Sustainable Synergy and Regulatory Performance, Policy directives must inculcate process standardisation, continuous improvement, and digital collaboration in regulatory frameworks. The KPI adherence has to be monitored by compliance departments, whereas the leadership has to make sure that the synergy is converted into measurable regulatory excellence.

Conclusion

The results convincingly prove that in the case of a strategic incorporation of digitalisation in talent procedures and the frameworks, it is not a form of technological implementation but a driver of the sustainable workforce synergy and regulatory brilliance. The productivity gains in the Ibadan telecommunication hubs are not by chance but a result of the perceived efficiency, accessibility and social reinforcement of digital tools by the employees. The convergence of infrastructural reliability and cultural adaptation leads to synergy that forms a collaborative ecosystem, which is resilient and future-oriented. Most importantly, standardised processes, continuous improvement, and collective digital acceptance increase regulatory performance, which demonstrates that institutional excellence is a socio-technical construct. Therefore, the paper draws a conclusion that the synergies of sustainable workforce cannot be discussed outside of digital talent protocols, making Ibadan hubs the models of adaptive regulatory innovation.

Recommendations

On the basis of the results, three recommendations are developed in terms of policy. Objective 1: Digital Talent Procedures and Productivity The Ministry of Communications and Digital Economy is to oblige automation of the recruitment, onboarding, and ongoing e-learning in regulatory centres. The HR Departments need to have organised digital talent policies, where productivity can be measured by performance monitoring and recognition programmes. Objective 2: Digitalised Infrastructure and Workforce Synergy, The Nigerian Communications Commission (NCC) must implement the policies that imply the use of cloud-based communication, project management tools, and the secure remote access systems at the Oyo State hubs. ICT Units should ensure that there is reliability in the infrastructures, and the management incorporates the sustainable digital practices to create synergy. Objective 3: Sustainable Synergy and Regulatory Performance Regulatory leadership needs to institutionalise process standardisation, ongoing improvement, and digital collaboration platforms. The policy guidelines must provide Compliance Units to oversee the KPI compliance to ensure that synergy is converted into better regulatory performance and institutional excellence.

References

Abubakar, A. S., Bala, S. T., & Yusuf, M. O. (2026). Digital-enabled employee retention strategies and employee performance in the Nigerian Federal Judicial Service Commission. European Journal of Business and Innovation Research, 14(2), 114-128. https://eajournals.org/ejbir/wp-content/uploads/sites/20/2026/02/Digital-Enabled-Employee-Retention.pdf

Abubakar, A. S., Bala, S. T., & Yusuf, M. O. (2026). Digital leadership and remote work management: A study of MTN, Akwa Ibom State, Nigeria. Journal of Management and Digital Transformation, 6(1), 114-128. https://www.researchgate.net/publication/393295080

Adebayo, O. S., & Tunde, A. (2024). Digital Human Resource Management and Organisational Output in Nigeria. Journal of Public Sector Management, 15(2), 44-59.

Adeleke, A. O. (2025). Continuous improvement practices in Oyo State regulatory centers. West African Management Journal, 14(2), 202-218. https://doi.org/10.5281/zenodo.1098

Akinwalere, S. N., Temitope, A. O., & Bali, S. (2026). Reimagining the future of work: Innovation and technology pathways for sustainable academic workplaces in Nigeria. Journal of Sustainable Development in Africa, 28(1), 210-225. https://www.researchgate.net/publication/400788347_Reimagining_the_Future_of_Work

Businessday NG. (2026, February 23). Seven issues that will define Nigeria's telecom in 2026: The talent and trust dilemma. Businessday Nigeria. https://businessday.ng/opinion/article/seven-issues-that-will-define-nigerias-telecom-in-2026/

Echegu, U. C. (2024). Digital innovation and workforce productivity: A survey of tech startups in Nigeria. International Journal of Innovative Information Systems and Technology Research, 12(3), 88-102. https://www.seahipublications.org/wp-content/uploads/2025/10/IJIISTR-D-8-2025.pdf

Ezenwoke, A., & Olugbara, O. O. (2024). Digital service transformation and workforce commitment in Nigeria's mobile telecommunications sector. International Journal of Social Sciences and Management Review, 8(5), 128-144. http://ijssmr.org/uploads2025/ijssmr08_128.pdf

Farah, A., & Nwosu, I. (2024). Knowledge sharing mechanisms and regulatory outcomes in West Africa. Journal of African Governance, 11(2), 77-93. https://doi.org/10.1080/22213449.2024.11

Gomez, L., & Lawal, B. (2024). Process standardisation in digitalised government agencies. International Journal of Public Policy, 20(3), 245-263. https://doi.org/10.1504/IJPP.2024.1002

Happiness, O. C. (2024). Does digital transformation impact staff productivity? Evidence from Nigeria manufacturing sector. International Journal of Research and Innovation in Social Science, 8(12), 727-737. https://rsisinternational.org/journals/ijrsi/uploads/vol12-iss12-pg727-737-202601_pdf.pdf

Ibrahim, K., & Smith, R. (2024). Cloud Computing and Inter-departmental Collaboration in Telecommunication Hubs. International Journal of ICT Research, 9(3), 88-104.

Kwan, P., & Adeyemi, T. (2025). Compliance tools and data protection in regulatory hubs. Cybersecurity and Public Policy Review, 6(3), 301-315. https://doi.org/10.1093/cyb/cpp015

Li, H., & Balogun, A. (2023). Security and compliance tools: The invisible backbone of digital synergy. Cybersecurity and Privacy Journal, 6(2), 145-160. https://doi.org/10.1002/csp2.145

Muller, J., & Chen, L. (2023). Automated Recruitment Protocols and Employee Retention in Emerging Economies. Global Business Review, 24(5), 1102-1118.

NewTelegraph. (2025, October 15). Telecommunication companies in Nigeria: Workforce census. https://newtelegraphng.com/telecom-workforce-report/

Nwosu, I. C., & Zhang, Y. (2024). Green digital infrastructure and organisational sustainability in emerging economies. Journal of Cleaner Production and Technology, 22(4), 412-429. https://doi.org/10.1016/j.jcpt.2024.04.012

Obiki-Osafiele, E., Shaheen, M., & Oktaviannur, M. (2024). Artificial intelligence and automation in HR communication: Ethical challenges and efficiency. European Journal of Human Resource Management Studies, 7(4), 55-72. https://oapub.org/soc/index.php/EJHRMS/article/download/2122/2692

Odukoya, A. O., Fagbohun, O. O., & Adetunji, B. A. (2024). The evolution of regulatory oversight and technological adoption in Oyo State: A transformative reform framework. Global Journal of Engineering and Technology, 9(6), 45-58. https://gsarpublishers.com/v9i6-december-2024/

Olatunji, F. (2023). Digital Repositories and Regulatory Knowledge Management in West Africa. Journal of Information Science, 31(4), 210-225.

Olatunji, O. (2026). The impact of digital transformation on leadership styles and workforce engagement in Nigeria (Master's thesis, York St John University). https://ray.yorksj.ac.uk/id/eprint/13873/

Okeke, P. S., & Balogun, M. (2024). Individual technical competence versus team synergy in public sector performance. Nigerian Journal of Management Sciences, 26(1), 101-115.

Oyo-Ita, E. (2025). Upskilling the Digital Workforce: A Study of Nigerian Regulatory Agencies. African Journal of Computing and ICT, 18(1), 12-25.

Proten International. (2024). Glo's digital upskilling programme: Transforming employee capabilities in Nigeria's telecommunication sector. https://protenintl.com/whitepaper/glos-digital-upskilling-program/

ResearchGate. (2025). Transforming telecom planning: The role of information systems and technology in Nigeria. Global Journal of Engineering and Technology, 10(2), 45-58. https://www.researchgate.net/publication/389165656

Saadatmand, M. R., Safaie, N., & Dastjerdi, M. (2022). Presenting a structural model of digitalised talent management in a new age: A case study on the mobile telecommunication industry in Iran. SA Journal of Human Resource Management, 20, 1-13. https://doi.org/10.4102/sajhrm.v20i0.1894

Sanusi, L., & Cole, R. (2024). Digitalised communication flow and decision efficiency in regulatory centers. International Journal of Public Administration, 47(3), 210-226. https://doi.org/10.1080/01900692.2024.115

Shao, X., Ahmad, M., & Javed, F. (2024). Firm-level digitalisation for sustainability performance: Evidence from Ningbo City of China. Sustainability, 16(20), 8881. https://doi.org/10.3390/su16208881

Technology Times. (2025). From GSM to GDP driver: Telecoms becomes growth anchor of Nigeria's digital economy. https://technologytimes.ng/from-gsm-to-gdp-driver-telecoms-drive-nigeria/

Umeh, C., & Gupta, P. (2023). Feedback-driven adjustments and continuous improvement in public sector performance. International Journal of Public Administration, 46(8), 589-604. https://doi.org/10.1080/01900692.2023.11567

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425-478. https://doi.org/10.2307/30036540

WATRA. (2026). Improving telecommunication sector regulation for economic transformation in West Africa. West Africa Telecommunications Regulators Assembly. https://watra.org/about-us/

Zhang, W., & Mensah, G. (2025). Sustainable Digital Practices and Operational Reliability in Government Parastatals. Sustainability in Governance, 7(2), 145-162.

Cooperatives as transformative agents in entrepreneurship

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Keywords
Transformation, Cooperatives, Entrepreneurship, Agency and Equality

Abstract

Entrepreneurship dates to Adam Smith and his work entitled the "Wealth of Nations". As a concept and a practice has been adopted across the globe and is seen as a cause for addressing societal problems through innovation, creativity and establishment of profitable businesses out of original ideas. However, entrepreneurship as a dominant hegemony continues to be promoted as an elitist Silicon Valley practice and labels other entrepreneurial approaches as inadequate. As such this paper demonstrates entrepreneurialism amongst cooperative enterprises. Cooperatives are unique forms of enterprises. They are member owned, democratically controlled, autonomous and are interested in surplus over profit. In their character they still embrace entrepreneurship as they seek new opportunities. Theoretically, the paper deals with issues of agency and structure which is debated as an approach that opens entrepreneurship for non-investor-owned enterprises such as cooperatives to begin to influence this practice in a transformative way. Methodologically, the paper is qualitative, it draws on two case examples in clothing production and finance cooperative sectors. The study has complied with all relevant research ethics requirements. The findings show that cooperatives in their practice of entrepreneurialism transform entrepreneurship as a profit driven motive towards making it a human centred business practice. Cooperatives by nature they seek to benefit members and communities before profit. Their recent approach to exploring new opportunities through entrepreneurship has landed cooperatives an opportunity to show a different angle to doing business. They offer interest free loans, high quality clothing and access to affordable school uniforms which is contrary to the conventional business practice of businesses that seek to maximise profits at all costs. This paper concludes that cooperatives stand a great chance in transforming society through entrepreneurship. The paper also notes that cooperatives must realise that transforming entrepreneurship is as an agentic move. As a matter of agency, the transformation in entrepreneurship will sustain cooperatives as businesses is society and benefit them as business built on human values. Additionally, cooperatives must be more intentional about transforming entrepreneurship whilst taking advantages of the innovation and creativity that this practice has to offer.

Introduction

Fewer studies have been conducted in South Africa on the role of cooperatives in entrepreneurship especially its transformative nature. Cooperatives in many ways have transformed how certain sections of society are participating in entrepreneurship activities and the cooperative model has created opportunities for inclusion. However, much of South African research is disproportionately focused on the failure of cooperatives to the neglect of the successes and contributions of cooperatives in both society and to the entrepreneurship activity.

Cooperatives are defined by ICA as autonomous associations of people pursuing common economic and social interests through a one member one vote enterprise arrangement. Cooperatives have since the 1800s marshalled means of production and enabled the inclusion of the marginalized into mainstream economic activity. As such cooperatives today are member owned enterprises found in sectors such agriculture, insurance, housing, retail, production/manufacturing and food just to name a few. Cooperatives have also made inroads into service sectors such as education, engineering and personal care. These enterprises are premised as a fundamental principle of open and voluntary membership for all. This transformative enterprise remains a revolutionary tool to economic and social inclusion allowing a better flow of goods and services in society.

Entrepreneurship is principally defined as the act of identifying a viable market opportunity, then marshaling resources and factors of production to take advantage of such an opportunity to generate profit and wealth. Other definitions go on to add that entrepreneurship is about spotting an exploitable opportunity and generating profits. This American-Euro centric definition of entrepreneurship has for a long-time enabled ideas to emerge and has been a driver for the capitalistic approach to enterprise. Much of the capitalistic approach to entrepreneurship places at the centre the individual shareholder interests, it is exploitative to both consumers and labour. A big share of economic activity is founded on the exploitative practice of entrepreneurship. This old understanding of entrepreneurship has since been challenged and transformed by the cooperative model.

The cooperative enterprise model in its current form was a reaction of the early communities of Rochdale in dealing with the exploitations already cited. The early cooperators set up their consumer cooperative in Manchester, Rochdale after realizing that the owners of the means of production i.e. factories sold them poor quality oats and butter such that the oatmeal had particles of chalk in it. The same labour that produced these products at factories sold poor quality at higher prices. Their wages were simply handed back to the factory owners when buying such expensive and poor-quality food and clothing products. The cooperative model today is still confronting similar conditions where investor-owned firms continue to place their own interests above the interests of the community but at the same time exploiting labour and consumers. The cooperative enterprise model contributes to building a shared wealth and an inclusive economy that is correcting any exploitations.

The cooperative enterprise model is one that is democratic and guarantees ownership for all contributors. It is a model that has enabled over 1 billion people in the world to build shared wealth through housing, retail, service and production cooperatives. The cooperative model, instead of profits, produces surplus that is shared with labour or worker-members and consumers. A cooperative enterprise listens to its community and consults its members in making key decisions. A cooperative may invest in various sectors but because of its concern for community it tends to seek the most ethical options. A cooperative, unlike, individual and investor exploitative enterprises has a duty to place common interests at the centre and uses one member one vote to decide such interests. The cooperative enterprise model transforms business and entrepreneurship from exclusive to inclusive and from exploitative to fair.

This paper demonstrates the transformative contribution of cooperatives to entrepreneurship by first sharing the theoretical indicative literature and the historic South African context on cooperatives. Secondly, the paper explores key case studies that demonstrate the contribution of cooperatives to entrepreneurship activity covering the agricultural, clothing and retail sectors. Finally, an analysis and conclusion on the contribution of cooperatives to entrepreneurship will be provided.

Literature Review: Making Sense of Cooperative Entrepreneurship

Literature on cooperative has expanded greatly over a century since the dawn of Rochdale in 1844. As part of literature today is the concept of "cooperative entrepreneurship". This indicative literature review explores this concept and its utility in explaining the contribution of cooperatives to entrepreneurship. This indicative literature review is brief and focuses on the scholarly thinking on the contribution of cooperatives to entrepreneurship. It draws together the concepts of cooperative and that of entrepreneurship in exploring the role or contribution of cooperative enterprises in entrepreneurship. In doing this, the literature review breaks down entrepreneurship, cooperation and then the theoretical lens of cooperatives – and the South African historical context.

The study of entrepreneurship dates to Adam Smith's The Wealth of Nations (first published in 1776) a literature dedicated to economics and capital. Adam Smith held a belief that a self-regulating market that rewards individual investors and owners of capital would through its invisible hand promote public good (Smith, 2000). Smith argued about the division of labour in making his point about the good of economic activity via the ownership of the economy by those who had the means of production including machinery and capital. Smith in his argument states the manufacturing of woolens as an example that offers opportunities to labour in giving them piecemeal jobs in growing the wool, flaxing it, dying and smoothening the linen. This is how he argued that through labour and earning some pennies the invisible hand of the economy was beneficial to the public good.

Research on entrepreneurship has held on to Smith's idea of the rich richer through a self-regulated market and the rest waiting for the invisible hand to offer them piecemeal jobs and any leftovers from the economy. The key definitions of entrepreneurship still confirm the ideas of the Wealth of Nations. Entrepreneurship is by far still defined as the act of identifying an opportunity, marshalling or pulling together resources to exploit that particular opportunity or market (Gartner, 2016). Another definition of entrepreneurship presents entrepreneurship as involving innovation and creativity suggesting that these two tenets are prerequisites to be entrepreneurial (Drucker, 2014). More clearly, entrepreneurship in the current status quo of literature is predominantly defined as the ability to take advantage of well spotted opportunities by marshaling resources that include labour and capital resources including application of innovation and creative strategies.

Emerging from the literature on entrepreneurship is the phenomenon of cooperative entrepreneurship. This is the process of forming a cooperative enterprise that competes for opportunities in the market employing the principles and values of cooperation (Mcdonnell, Macknight and Donnelly, 2012). Unlike the investor driven entrepreneurship activity already explored via Adam Smith's account, cooperative entrepreneurship is people focused. It requires joint effort by people concerned about an issue or people who spot an economic opportunity that they then choose to address jointly (Fernandez-Guadaño, Lopez-Millan and Sarria-Pedroza, 2020). This form of entrepreneurship offers equal opportunity of ownership for members. Instead of investors the cooperative enterprise has members with each one having one vote regardless of the number of shares they hold in the enterprise (ICA, 2024). Cooperative entrepreneurship literature transforms entrepreneurship and distinguishes the cooperative enterprise as a form of business that is most equitable (Castilla-Polo, Licerán-Gutiérrez and Ruiz-Rodríguez, 2024).

Cooperatives are found in all sectors of the economy. The operate in energy, agriculture, technology, housing, manufacturing and in retail (Okem and Tshishonga, 2016). In South Africa cooperatives are spread across the agricultural sector, fisheries, sewing and retail sector involving consumer cooperatives (Van der Walt, 2005). The story of cooperatives in South Africa dates to 1922 when the first formal cooperatives were set up to promote agricultural grain production (Ortmann and King, 2007b). This gave rise to the construction of silos and establishing a strong network of farmers. The silos cooperative model offered farmers several opportunities that would have never become available to them if they operated as individuals (Ortmann and King, 2007a). For example, the cooperative model gave farmers essential infrastructure to trade their grain and facilitated its marketing, the silos amassed great capital and began procuring tractors and other agricultural implements for farmers and subsequently supported farmers with their administration including seeking adequate insurance for farmers. To date this arrangement continues in the agricultural sector and new cooperatives are emerging employing a similar approach.

The organisation of cooperatives gives rise to key literature on structure and agency. Agency is defined as the freedom of choice, association and also the ability to make one's own decisions (Chandler-Olcott and Hinchman, 2019). On the other hand, structure as defined by Crossley, (2022) is:

"is an always-evolving network of interaction, interdependence and relations between reflexive social actors who are formed (from biological organisms in the human case) within those relations and interactions. It involves rules (conventions and norms), negotiated within the network, and resources unevenly distributed and exchanged across it." Pg. 167

Agency and structure are interdependent constructs. Agency is about exercising individuals in society being able to exercise their capacities (Elder-Vass, 2010). Archer, (2003) points out to causal power that mediates agency and structure. Archer acknowledges that structural limitations e.g. barriers to entrepreneurship can create or even force forms of agency amongst individuals in society. Other deeper issues include poverty and inequality that have raised agents amongst community members to deal with the causes of such conditions, including challenging structural barriers and limitations.

In the most recent past the structure of cooperativism in South Africa has been defined by several developments. The first major development post 1994 was the promulgation of the Black Economic Empowerment Act that created opportunities for organising and access to economic sectors previously closed off to Black people (Srai et al., 2016). The cooperative sector experienced further legislative developments such as the Cooperatives Act of 2005 and the subsequent amendment acts (Okem, 2016).

Defining the structure further were instruments devised by the Department of Trade and Industry in support of cooperatives and taken further by the Department of Small Business Development one of which was the Cooperatives Incentive Scheme that offered R350 000 worth of support to new enterprises (Nattrass and Seekings, 2021). The structure has since been well defined by the part of the state and mostly has enabled entrepreneurial activity amongst cooperatives.

However, cooperators have not fully enjoyed agentic power within the structural limits defined in the paragraph above. Amongst the reasons denying cooperators are the challenges that cooperatives are facing and the failure of structural effectiveness in supporting the "cooperative entrepreneurs" (Loffel and Gmür, 2024). Ewert, Hanf and Schweickert, (2015) cite several challenges facing cooperatives that still include lack of key infrastructure, limited access to capital as well as internal strategic challenges that include poor governance, lack of a recognizable APEX body, lack of coordination and lack of growth in some instances where primary cooperatives do not assimilate to secondary and tertiary cooperatives. The structural question is important since cooperatives rely on economies of scale to perform operationally and financially.

The brief literature above has pointed out ways to understand the role of cooperatives in entrepreneurship in a broader sense. The literature flows from defining the cooperative enterprise and the cooperative entrepreneur. It is essential to remind here that the cooperative entrepreneur is a cooperator, an activist in their own right and an agent of change empowered by the cooperative values and principles (ICA, 2020). Notwithstanding the challenges faced by cooperators through the cooperative enterprise they contribute to transforming entrepreneurship by making it inclusive and accessible to people who otherwise do not command large capital that Adam Smith suggested is the basic requirement to become an entrepreneur. Theoretically, cooperatives prove to use entrepreneurship as means to better the economic conditions of their members and that of their communities. The following section are case study snippets to demonstrate this view and argument that cooperatives play a transformative role in entrepreneurship and subsequently in the economy.

Methodological Approach

The paper employs a qualitative research methodology. The methodology can deal with the complexity of the inquiry that is: the transformative role of cooperatives in entrepreneurship. Transformation cannot be understood through numbers only but seeks real accounts and case examples that explicate complex relationships, roles and practices. The methodological approach used in this paper serves such a purpose. It contextualises cooperatives, their capacity to transform entrepreneurship as field and the methodological approach has been used to identify key cases to explore the inquiry of this study.

Data collection and case example selection criteria

The paper draws on two cases of major cooperatives in South Africa's urban environment. The short case examples are consistent with qualitative research designs. The case examples are from two major cooperative sectors namely sewing/clothing production and finance. South Africa has a well-established sector of sewing and clothing production cooperatives as well as cooperative financial institutions. By using these two case examples the study can demonstrate the role of cooperatives in transforming entrepreneurship.

The selection criteria were based on location, representation, capacity for entrepreneurship, researcher's knowledge of the sectors and relatability. The case examples are based in Johannesburg, the largest economic hub in the African continent and these represent major cooperative sectors in South Africa. These cooperative sectors have also demonstrated the qualities of entrepreneurship by seeking newer opportunities and investing their own member capital in formation and expansion. The researcher also has wide knowledge of these sectors and has conducted other research studies in the said cooperative case examples. Also, as an important point financial and sewing/clothing production cooperatives are widely recognised around the world hence selected for this study.

Ethics

The study is part of a broader project seeking to study cooperatives in Africa. As part of the project the study is one of four others. Four ethical clearance certificates have been obtained for this project from a South African university. Consent, use of pseudonyms and protection of case example identities are values that underpin this study. All other ethical requirements are adhered to in this research paper. The next section explores the case examples.

Case Example 1: Transformative Role of Cooperatives in Entrepreneurship: Sewing Cooperatives in the South African Entrepreneurship Landscape

Sewing cooperatives play a crucial role in the South African entrepreneurship landscape by providing opportunities for economic development, empowerment, and skills enhancement. These cooperatives often form part of the broader social entrepreneurship initiatives, which are tailored to uplift communities by addressing social and economic inequalities. In South Africa, entrepreneurship is considered vital for economic growth and poverty alleviation, particularly in underserved communities (Herrington & Coduras, 2019).

The creative industries, which include sewing and other traditional crafts, significantly contribute to a sustainable economy by creating dynamic job opportunities and supporting sustainable livelihoods (Abisuga Oyekunle & Sirayi, 2018). Sewing cooperatives are particularly influential in providing women—who often face employment barriers—a platform to participate economically, thereby fostering gender equality and empowerment within these communities. By organizing under a cooperative model, members share resources, knowledge, and skills, which can lead to increased productivity and market reach.

Moreover, cooperatives cultivate a community-based approach to entrepreneurship, which is a form of social entrepreneurship. This approach aligns with the findings that emphasize the synergy between social enterprises and their environments, reflecting on how these enterprises adapt and thrive in the socio-economic conditions of South Africa (Littlewood & Holt, 2015). They harness local talents and resources, ensuring that economic benefits are localized, which in turn reduces poverty and stimulates economic activity within their communities.

The role of small, micro, and medium-sized enterprises (SMMEs), including cooperatives, is pivotal in driving economic growth and addressing social issues such as poverty and inequality (Ramsuraj, 2023). Sewing cooperatives are part of these SMMEs and contribute not only to economic output but also to fostering social inclusion and political justice. They provide an economic safety net for many, especially in rural areas where economic activities are limited.

However, these cooperatives also face challenges, such as limited access to markets and capital, which hinder their growth potential. Addressing these issues requires supportive government policies and initiatives that enhance the capacity of these cooperatives to access broader markets and necessary financing (Akinyemi & Adejumo, 2018; Ramsuraj, 2023). Effective policy implementation can significantly impact the ability of cooperatives to thrive and contribute to South Africa's broader economic and social development goals.

Case Example 2: The Role of the Cooperative Bank in Johannesburg (Fourways) in Promoting Cooperative Entrepreneurship

The Cooperative Bank in Johannesburg (Fourways) contributes significantly to promoting cooperative entrepreneurship by fostering financial inclusion and trust-based financial support within the community. Cooperative banks, with their strong ties to local communities, play a crucial role in addressing the information asymmetry that impedes high-tech entrepreneurial ideas from attracting external finance (Ghio et al., 2017). Their local presence enhances the capability to provide financial resources critical for entrepreneurial endeavors, supporting business start-ups and innovation.

Financial inclusion is noted to have a significant and positive impact on entrepreneurship development in Africa. Cooperative banks contribute to this by offering financial products that are accessible to a broader section of the community, thus encouraging business start-ups and reducing poverty and inequality (Ajide, 2020). They also create trust-based relationships in the local community, which are especially valuable in areas where residents are inclined towards opportunism (Ghio et al., 2017).

Moreover, cooperative banks can facilitate financial literacy, significantly contributing to entrepreneurship development. Financial literacy affects financial decision-making and access to finance, both of which are critical for business development and sustainability (Abubakar, 2015). By strengthening financial literacy skills, cooperative banks help empower entrepreneurs by improving their access to financial resources, which is often a major constraint in the entrepreneurial ecosystem (Babajide et al., 2020).

Analysing the Transformative Role of Cooperatives in Entrepreneurship

As already reflected in the introduction and in the literature review cooperatives play a transformative role in entrepreneurship as a field and a practice in society. Cooperatives enable society to join hands and take collective responsibility, and calculated risk to pursue economic opportunities. Without cooperative enterprises society cannot enjoy the full extent of wealth creation through entrepreneurship, although cooperatives face challenges, but they still offer women, youth and poor communities a chance in building shared wealth. Contrary to individually owned businesses, cooperatives because of being governed through both elected and managerial teams have a chance of longevity and can raise capital through members whereas individual enterprises face risks of closure when the actual owner is unable to carry on doing business. Moreover, cooperatives offer protection to members and customers in that they are not profit driven, instead they have a concern for community and offer products and services at a fair price.

In analysing the role of cooperatives here the paper shares some key statistics on cooperatives in South Africa, a breakdown by sector and provincial spread of cooperatives. This data has been drawn with permission from the CIPC Cooperatives database. The cooperatives sector is widespread covering agriculture, retail, consumer services, manufacturing and the rest of the sectors already stated earlier in this paper. According to the CIPC 2024 Data there are 24 134 cooperatives registered in South Africa.

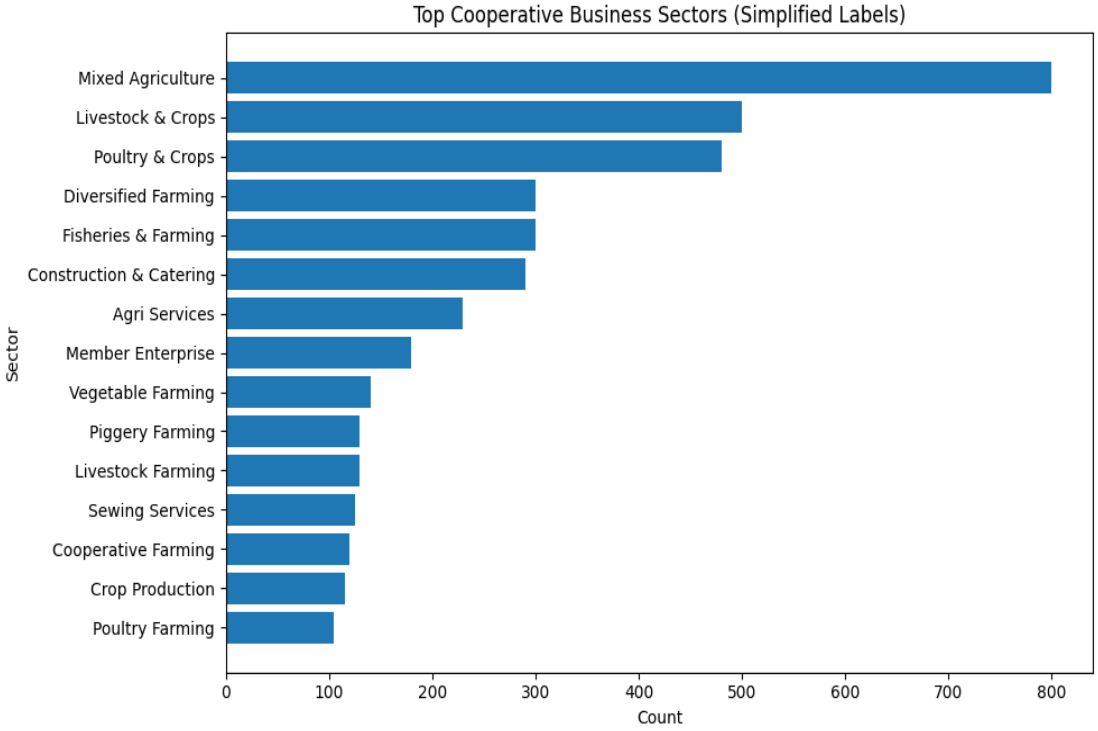
Table 1: Number of Registered Cooperatives in South Africa by Province 2024/25 (Source: CIPC)

Province	Number of Cooperatives
Eastern Cape	6287
Gauteng	5245
Limpopo	3389
KwaZulu Natal	2421
Mpumalanga	2321
North West	1694
Free State	1217
Western Cape	950
Northern Cape	510

Cooperatives at minimum register five (5) members each. Based on this the current and minimum number of registered cooperative membership in South Africa is 120 670. These members are direct co-workers and beneficiaries of their cooperatives. This means that for every opportunity that their cooperative enterprise undertakes, including day-to-day trade they benefit financially and socially. The minimum number of members required for registration per cooperative is relatively small compared to other countries where the minimum number of members is higher. However, each member contributes capital, labour and resources which gives cooperatives a better head start compared to individual business arrangements that have a limited pool of resources to start off with.

Of the numerous contributions that cooperatives make, they continue to contribute to agriculture, clothing production and in skills development at a mass scale. The bar chart below shows the top 15 cooperative sectors contributing to entrepreneurship activity in the respective sectors. The spread of the sectors below is expanded and shows a multi-purpose nature of the cooperatives. What also stands out is the ability of the cooperatives to couple skills development with the business activities of their enterprise. This again demonstrates a unique approach to doing business that places at the centre skills transfer, training and development. The variety of the agricultural sector is also laid out in the breakdown below. The sector includes crops, poultry, piggery and livestock farming. These subsectors show the vastness of

cooperative activity and the growing interest amongst cooperative entrepreneurs to explore pockets of industrial activity that exist in their sectors.



The bar chart above can be summarized using the graph below which breaks down the cooperative enterprise sectors into 8 major sectors. Namely agriculture, services, manufacturing, construction, transport, retail/trade, fisheries and other. Agriculture still dominates the cooperative sector with about 12 000 cooperatives undertaking this activity. Some reasons for this agricultural boom amongst cooperatives include the land reform programmes that have enabled communities to access land from the government and the investments that have since followed such programmes. On the case studies shared in this paper, Batlhako Temo Co-operative is one such enterprise that has been able to take advantage of the government land redistribution programme and followed through the infrastructure funding from various departments and agencies of government.

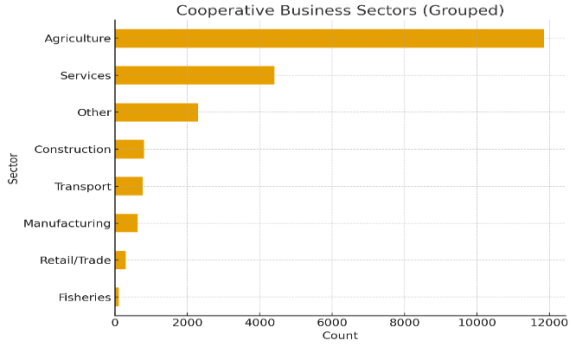


Figure 1 - Main Sectors driving Cooperative Entrepreneurship (Source: Author)

The historic basis of cooperatives still follows the sector today. This is the foundation of agriculture. As already mentioned in the literature the 1922 formation of cooperatives sought to preserve and provide food security for a section of the South African society. This made agricultural cooperatives exclusive to landowners and by far excluded Black people who suffered land dispossession in 1913 following the promulgation of the then Land Act. Therefore, the legacy of this past is still with the cooperative sector today. However, the cooperative sector has more than a perfect chance of rectifying this historic failure. Because cooperatives have open and voluntary membership it means more people today including

cooperative members stand a great chance of owning a piece of an agricultural cooperative than it would have been before the dawn of democracy.

Conclusion and Strategy on Cooperative Entrepreneurship

The transformative role of cooperatives in the South African entrepreneurship landscape can be seen through multiple lenses. Cooperatives are increasingly adopting a social economy model, shifting away from state-controlled paradigms to embrace models that are more responsive to community and member needs. This evolution has allowed cooperatives to thrive amidst tough market forces, offering resilience and adaptability in contemporary economic environments. Cooperatives contribute significantly to economic and social development by fostering community-oriented entrepreneurship (Ramsuraj, 2023).

To conclude, on the transformative role of cooperatives in entrepreneurship it is worth looking back at Adam Smith's assumptions about wealth creation. Smith perceives wealth as an exclusive venture of the elite, those able to exploit labour and those with proximity to state power. And Smith's assumptions are not the past but are reflected in the current reality where the gap between poor and the rich is continuing to widen. For example, South Africa's gini-coefficient is at 0.67 indicating an extreme income inequality amongst citizens. Cooperatives if successful over time and growing at a similar pace as those in Kenya, Spain and in Asia Pacific stand a great chance to:

- Change the income inequality that is suffocating the South African society. The complete lack of income in some households has since led to extreme poverty and leaves children and women vulnerable to crime, gender-based violence and health problems. Cooperatives offer an economic chance to such families that if community assets are brough together a cooperative can begin to address food security, lack of income and create an opportunity for such people to earn an income.
- Improve collective income and build wealth jointly. The real potential of cooperatives lies in pulling resources together from all levels of people in society. This means that members of a cooperative are mixed in terms of income, class and status. A teacher, a domestic worker, an elderly person, young graduate and unclassified person may find themselves bringing together skills, talents and capital resources to set up a cooperative enterprise like Ons Winkel or even a cooperative bank like GIG. This is the transformative nature of a cooperative.

In transforming entrepreneurship, cooperatives still have a long way ahead of them. The road ahead includes dealing with the urgent challenges of the sector, building a strong APEX and implementing sectoral programmes that will unleash the transformative power of cooperatives in South Africa.

Strategically, the national efforts on entrepreneurship must place cooperative entrepreneurship as follows:

- As an opportunity for individual entrepreneurs to join efforts in resource sharing and advancing the start-up businesses. This model allows entrepreneurship to thrive and compete only where necessary.
- Introduce sectoral cooperative incubators in energy, IT, mining and clothing production sectors.
- Consider joint support for independent entrepreneurs and cooperatives avoid isolating cooperatives as the "other".
- The Department of Small Business Development should aim as strategic imperative, to create ongoing training on cooperative entrepreneurship with the possibility of exploring relationships with universities and the apex organisation of cooperatives.

Cooperative entrepreneurship as also already explains provides a unique opportunity for both members of cooperative enterprises and for individuals vested in entrepreneurship. In that cooperatives maximise access to resources in the form of knowledge, markets and even resource sharing. As such the National Entrepreneurship Strategy can benefit from embracing cooperative entrepreneurship as presented in this paper.

References

Archer, M.S. (ed.) (2003) "The process of mediation between structure and agency," in Structure, Agency and the Internal Conversation. Cambridge: Cambridge University Press, pp. 130–150. Available at: https://doi.org/10.1017/CBO9781139087315.005.

Castilla-Polo, F., Licerán-Gutiérrez, A. and Ruiz-Rodríguez, M.C. (2024) "Best practice learning in cooperative entrepreneurship to engage business students in the SDGs," Studies in Higher Education, 49(8), pp. 1425–1438. Available at: https://doi.org/10.1080/03075079.2023.2266468.

Chandler-Olcott, K. and Hinchman, K.A. (2019) "Agency," Journal of Adolescent & Adult Literacy, 62(4), pp. 361–362. Available at: https://doi.org/10.1002/jaal.928.

Crossley, N. (2022) "A Dependent Structure of Interdependence: Structure and Agency in Relational Perspective," Sociology, 56(1), pp. 166–182. Available at: https://doi.org/10.1177/00380385211020231.

Drucker, P. (2014) Innovation and Entrepreneurship. Routledge. Available at: https://doi.org/10.4324/9781315747453.

Elder-Vass, D. (ed.) (2010) "Agency," in The Causal Power of Social Structures: Emergence, Structure and Agency. Cambridge: Cambridge University Press, pp. 87–114. Available at: https://doi.org/10.1017/CBO9780511761720.005.

Ewert, J., Hanf, J.H. and Schweickert, E. (2015) "Strategic challenges facing South African wine co-operatives: upgrading or bulk production?," Journal of Wine Research, 26(4), pp. 287–303. Available at: https://doi.org/10.1080/09571264.2015.1092119.

Fernandez-Guadaño, J., Lopez-Millan, M. and Sarria-Pedroza, J. (2020) "Cooperative Entrepreneurship Model for Sustainable Development," Sustainability, 12(13), p. 5462. Available at: https://doi.org/10.3390/su12135462.

Gartner, F.W., Ted Baker, David B. Audretsch, William B. (2016) "Everyday Entrepreneurship—A Call for Entrepreneurship Research to Embrace Entrepreneurial Diversity - Friederike Welter, Ted Baker, David B. Audretsch, William B. Gartner, 2017," Entrepreneurship Theory and Practice [Preprint]. Available at: https://ezproxy-prd.bodleian.ox.ac.uk:2246/doi/full/10.1111/etap.12258 (Accessed: March 1, 2022).

ICA (2024) What is a cooperative? | ICA. Available at: https://ica.coop/en/cooperatives/what-is-a-cooperative (Accessed: May 5, 2024).

ICA, I. (2020) Cooperative identity, values & principles | ICA. Available at: https://www.ica.coop/en/cooperatives/cooperative-identity (Accessed: May 12, 2020).

Loffel, U. and Gmür, M. (2024) "Entrepreneurial cooperatives: The impact of entrepreneurial orientation on economic and social performance," Journal of Co-operative Organization and Management, 12(1), p. 100234. Available at: https://doi.org/10.1016/j.jcom.2024.100234.

Mcdonnell, D., Macknight, E. and Donnelly, H. (2012) "Co-Operative Entrepreneurship: Co-Operate for Growth," SSRN Electronic Journal [Preprint]. Available at: https://doi.org/10.2139/ssrn.2163491.

Nattrass, N. and Seekings, J. (2021) "Cooperatives and the reorganisation of labour-intensive production in South Africa's clothing industry," Review of African Political Economy, 48(169), pp. 403–419. Available at: https://doi.org/10.1080/03056244.2021.1952562.

Okem, A.E. (2016) "The Meaning and Defining Characteristics of Cooperatives," in A.E. Okem (ed.) Theoretical and Empirical Studies on Cooperatives: Lessons for Cooperatives in South Africa. Cham: Springer International Publishing (SpringerBriefs in Geography), pp. 1–14. Available at: https://doi.org/10.1007/978-3-319-34216-0_1.

Okem, A.E. and Tshishonga, N. (2016) "The South African Cooperative Sector: Which Way Forward?," in A.E. Okem (ed.) Theoretical and Empirical Studies on Cooperatives: Lessons for Cooperatives in South Africa. Cham: Springer International Publishing (SpringerBriefs in Geography), pp. 95–104. Available at: https://doi.org/10.1007/978-3-319-34216-0_9.

Ortmann, G.F. and King, R.P. (2007a) "Agricultural cooperatives I: History, theory and problems," Agrekon, 46(1), pp. 18–46.

Ortmann, G.F. and King, R.P. (2007b) "Agricultural cooperatives II: can they facilitate access of small-scale farmers in South Africa to input and product markets?," Agrekon, 46(2), pp. 219–244.

Smith, A. (2000) The Wealth of Nations. Random House Publishing Group.

Srai, J.S. et al. (2016) "Distributed manufacturing: scope, challenges and opportunities," International Journal of Production Research, 54(23), pp. 6917–6935.

Van der Walt, L. (2005) "The resuscitation of the cooperative sector in South Africa," in International Co-operative Alliance XXI International Cooperative Research Conference, pp. 11–14.

Abisuga Oyekunle, O. A., & Sirayi, M. (2018). The role of creative industries as a driver for a sustainable economy: a case of South Africa. Creative Industries Journal, 11(3), 225–244. https://doi.org/10.1080/17510694.2018.1480850

Abubakar, H. A. (2015). Entrepreneurship development and financial literacy in Africa. World Journal of Entrepreneurship, Management and Sustainable Development, 11(4), 281–294. https://doi.org/10.1108/wjemsd-04-2015-0020

Ajani, O. A., Gamede, B. T., & Khumatake, M. R. (2023). A systematic review of entrepreneurship education in higher education as panacea to unemployment reduction in South African graduates. International Journal of Research in Business and Social Science (2147- 4478), 12(9), 392–404. https://doi.org/10.20525/ijrbs.v12i9.3000

Ajide, F. M. (2020). Financial inclusion in Africa: does it promote entrepreneurship? Journal of Financial Economic Policy, 12(4), 687–706. https://doi.org/10.1108/jfep-08-2019-0159

Akinyemi, F. O., & Adejumo, O. O. (2018). Government policies and entrepreneurship phases in emerging economies: Nigeria and South Africa. Journal of Global Entrepreneurship Research, 8(1). https://doi.org/10.1186/s40497-018-0131-5

Babajide, A., Lawal, A., Asaleye, A., Osuma, G., & Okafor, T. (2020). Financial stability and entrepreneurship development in sub-Sahara Africa: Implications for sustainable development goals. Cogent Social Sciences, 6(1). https://doi.org/10.1080/23311886.2020.1798330

Claeyé, F. (2017). A typology of social entrepreneuring models in South Africa. Social Enterprise Journal, 13(4), 427–442. https://doi.org/10.1108/sej-09-2017-0041

De Jager, H. J., Mthembu, T. Z., Ngowi, A. B., & Chipunza, C. (2017). Towards an Innovation and Entrepreneurship Ecosystem: A Case Study of the Central University of Technology, Free State. Science, Technology and Society, 22(2), 310–331. https://doi.org/10.1177/0971721817702292

Ghio, N., Guerini, M., & Rossi-Lamastra, C. (2017). The creation of high-tech ventures in entrepreneurial ecosystems: exploring the interactions among university knowledge, cooperative banks, and individual attitudes. Small Business Economics, 52(2), 523–543. https://doi.org/10.1007/s11187-017-9958-3

Herrington, M., & Coduras, A. (2019). The national entrepreneurship framework conditions in sub-Saharan Africa: a comparative study of GEM data/National Expert Surveys for South Africa, Angola, Mozambique and Madagascar. Journal of Global Entrepreneurship Research, 9(1). https://doi.org/10.1186/s40497-019-0183-1

Herrington, M., & Coduras, A. (2019). The national entrepreneurship framework conditions in sub-Saharan Africa: a comparative study of GEM data/National Expert Surveys for South Africa, Angola, Mozambique and Madagascar. Journal of Global Entrepreneurship Research, 9(1). https://doi.org/10.1186/s40497-019-0183-1

Jesselyn Co, M., & Mitchell, B. (2006). Entrepreneurship education in South Africa: a nationwide survey. Education + Training, 48(5), 348–359. https://doi.org/10.1108/00400910610677054

Kalitanyi, V. (2010). African immigrants in South Africa: Job takers or job creators? South African Journal of Economic and Management Sciences, 13(4), 376–390. https://doi.org/10.4102/sajems.v13i4.91

Littlewood, D., & Holt, D. (2015). Social Entrepreneurship in South Africa: Exploring the Influence of Environment. Business & Society, 57(3), 525–561. https://doi.org/10.1177/0007650315613293

Ramsuraj, T. (2023). Assessing the role of entrepreneurship industry and SMEs to economic growth in South Africa. International Journal of Research in Business and Social Science (2147- 4478), 12(7), 283–291. https://doi.org/10.20525/ijrbs.v12i7.2730

Ramsuraj, T. (2023). Assessing the role of entrepreneurship industry and SMEs to economic growth in South Africa. International Journal of Research in Business and Social Science (2147- 4478), 12(7), 283–291. https://doi.org/10.20525/ijrbs.v12i7.2730

Ramsuraj, T. (2023). Assessing the role of entrepreneurship industry and SMEs to economic growth in South Africa. International Journal of Research in Business and Social Science (2147- 4478), 12(7), 283–291. https://doi.org/10.20525/ijrbs.v12i7.2730

Wale, E., & Chipfupa, U. (2021). Entrepreneurship concepts/theories and smallholder agriculture: insights from the literature with empirical evidence from KwaZulu-Natal, South Africa. Transactions of the Royal Society of South Africa, 76(1), 67–79. https://doi.org/10.1080/0035919x.2020.1861122

Wanyama, F. O., Pollet, I., & Develtere, P. (2009). REINVENTING THE WHEEL? AFRICAN COOPERATIVES IN A LIBERALIZED ECONOMIC ENVIRONMENT. Annals of Public and Cooperative Economics, 80(3), 361–392. https://doi.org/10.1111/j.1467-8292.2009.00390.x

Exploring the impact of an innovative economy on global development

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Keywords
Azerbaijan, Innovation economy, Global economic transformation, multi-speed development model, World-systems theory, Structural asymmetry in globalization, Science and technology policy

Abstract

This article explores the relationship between the rise of an innovative economy and the emergence of a new global development model. Tracing globalization's historical trajectory – from maritime discoveries and colonial empires to the Industrial and Neoliberal Revolutions – it highlights the current phase, marked by technological innovation and rapid economic transformation. Drawing on the "wheels without brakes" theory and the "cappuccino effect," the study illustrates how this new wave of globalization fosters a multi-speed, multi-tiered global economy composed of dynamic cores and dependent peripheries. Using world-systems analysis, the article hypothesizes that innovation economics is a driving force behind the formation of a new global development system. The research aims to define innovation economics, examine its global impact, and assess its implications for both developed and developing nations. The conclusion emphasizes the need for inclusive policy frameworks to manage the transition toward innovation-based economies, while acknowledging the potential risks of increased inequality and uneven development.

It is reported that in recent years, Azerbaijan has considered the development of its innovation economy as a strategic priority and has implemented consistent reforms and large-scale programs in this area.

Introduction

This article aims to uncover the reflections between an innovative economy and the emergence of a new type of global development. Contemporary world history can be considered as a sequence of coherent and interconnected globalization: The maritime discovery of the New World, the development of sea trade and colonial and neo-colonial empires, the Industrial Revolution and market globalization that followed, the economic Neo-Liberal Revolution and deepening of globalization after it.

Drawing on world-system analysis, the object of this study is an innovative economy and a system of global economic development that is closely linked to it. The article puts forward the hypothesis, which states: The emergence of innovation economics causes the formation of a new system of global development. In the context of the hypothesis and aim of the study the goals can be described: to explain the meaning of innovation economics and an innovative system, to demonstrate the transformation and functioning of the modern global economy and global development systems, to identify the reflections between innovative economy and the formation of a new type of global economic development, and then, in conclusion, to analyze the most important results of the study.

Theoretical Foundations of Innovative Economy

The essence and the problems of the innovative economy theory are revealed based on the method and models of the innovative economic processes. New economic theory and the transition to the priority of innovative economic laws generate new theoretical problems and lead to the formation of new areas of economic research methodology. In the economic system, there is a radical change in the dependencies and regularities. The described processes in the industrial system are considered through the example of women's clothing in the post-war period. Within the framework of the industrial system, the industrial, agrarian, construction, railway, and other branches are adjacent and interact with each other, because of which the observed plan of development of economic processes is lost.

Currently, Research and Development (R&D) plays a crucial role, especially considering the significant advances in science and technology observed in this millennium. The global economy is undergoing rapid transformation, driven by the expansion of the knowledge sector and the commercialization of emerging technologies, which is leading to an increased focus on R&D. Additionally, trends regarding social welfare highlight the importance of effective R&D activities. It is also noteworthy how intellectual property rights for inventions are increasingly recognized for their pivotal role in fostering innovation and contributing to economic growth.

However, as technology becomes more sophisticated, a finished product consists of a greater number of technologies. Consumers have demanded a greater variety of products, and information about the technology is available through various means. On the other hand, the speed and bounds of technological advancement have been accelerated, making it difficult for a firm to maintain a competitive edge in technology until the patent term expires.

There is a global economic acceleration of globalization and capitalist expansion. The global economy has networked and expanded exponentially to encompass both virtual and physical markets. There has been greater movement of goods and people across borders. Innovation and investment have moved across borders, creating flows of capital, commodities, ideas, and labor. Intellectual property spread and economics have led to increases and changes in patents, copyrights, trademarks, plant variety rights, etc. A global IP regime has been introduced, with far-reaching effects on markets. However, the poor have greatly benefited. There is a global economy reorganization and restructuring; this reorganization is from above, by big business, through their control of technology and IP rights, facilitated by the growth of services and knowledge-based processes. The new economy, globalization, and a tight global IP regime have all increased risks for the many and the poor. At the same time, there is increasing inequality of income within and between nations.

Key Concepts in Innovative Economy:

A substantial narrative now exists around a set of key concepts in innovation literature, including the national system of innovation (NSI), technological innovation system (TIS), regional innovation system (RIS), and local innovation system (LIS) (Chataway et al., 2009). For some, these have offered a new departure from standard neo-classical economics in setting innovation in broader systemic and dynamic contexts. However, there is an increasing sense in which these new approaches have themselves become rather conventional. They are increasingly associated with the well-resourced technological payloads of firms, research institutes, and universities in OECD economies.

There is now a notable, but remarkably under-analyzed, diversity in the types of innovation undertaken by different kinds of economic actors in different industry settings and value-adding positions. We refer to this ensemble of developments as being "below the radar" since the collective significance of these new currents is only poorly recognized at present, not just by policymakers, but also by many of the core innovation systems. Below the radar (BRI) innovation does take place in ways that escape the attention of traditional NSI, TIS, RIS, or LIS analysts.

Challenges and Barriers to Implementing Innovative Economy Strategies

There Are Different Sources and Differentiated Outcomes of Innovation. Innovation policy needs to address both these sources and acknowledge their differences. A fourth challenge is to identify the specific types of policies that are most effective in enhancing a diversity of inter-firm relationships based on different types of learning, and to leave room for experimentation with these kinds of policies. A fifth challenge is to bring the policy-making to a local level, since this is regarded as the most effective way to generate a variety of inter-firm relationships and encourage the type of innovation that is most effective in a given territory.

There is a profound doubt about an all-purpose innovation theory and hence an all-purpose innovation policy. In more developed economies, inter-firm relationships often reflect complementarities between different types of innovation activities and the firms involved. Local policy makers and governments needed to accept that innovation is multifaceted and that all types of innovation are not equally learnt from the same types of firms and therefore cannot be promoted by the same policy means

(Chaminade et al., 2009). Rather than designing a national innovation policy to be leveraged out even at the regional level, innovation policy at a local level should instead provide support to different kinds of experimentation with learning processes among different types of firms.

Innovative Economy and Environmental Sustainability

Environmental regulation has become more stringent over the past thirty years, driven by a growing realization of the human and economic costs associated with pollution. Such regulations are necessarily driven by the broader experience set through time, and so tend to ratchet upwards from the marginal abatement cost. Increases in environmental stringency must eventually affect the product, leading to further regulation at the sector level (A. Ashford, 2009). This enclosure demonstrates an increasingly sophisticated body of structural-demand green-output regulation literature, regarding a world that stays constant even as the economy responds to strictures on the environment. The most likely initial response to tightened environmental regulation for a given extreme environment is bottom-line reductions in pollution. A future of investment is needed, especially for under-capitalized firms, to develop pollution prevention activities. However, pollution prevention comes at the cost of operational rigidity, a non-trivial issue as the most common superior practices are best on comparative advantage. The union of environmental regulation and innovative activity is a marriage of appropriate financial benefits. Although pollution-related process innovation has not been a historical strength of the chemicals industry as measured by patenting, it has fallen behind since the '70s, and in any case, that is not where most of the gains have been made from stringently regulated industries. The other pollution-related side of industry innovation is the technology of production, which can also be influenced by more stringency, leading to more socially and environmentally sustainable technology. Global economic developments have increasingly been driven by the liberalization of trade, following the '80s aimed at an integrated global economy by 2005. These and other factors are bringing about a 'new global economy'. Included in the changes to the pattern of regional economic activities, where at one time most global corporations regarded small clusters of activities, such as a factory located in a developing labor-intensive part of the world, now the more general three different kinds of location-strategy may be observed: the 'cheap-labor' strategy, the 'high-value-added' strategy, and organizational networking. Similar and in large measure parallel changes have also taken place in technology. Just as industrial production has evolved from hydro-electric-based megawatt capacity chemical plants to solar and wind energy-based process and product technologies, so also a very expensive paradigm shift is in operation in the area of information technology. These enormous changes in regional economic activities are driven by both the restructuring and retrenchment of the older model of mass production and the nationalization of business organizations (Gibbs & Lintz, 2015). From the relevant history, it is tempting to see in this response to the potential environmental regulatory type an acceleration of these global trends, reflecting in large measure the widespread fears already prevalent in the developed economies about job security and wages, occupational health and safety, and unemployment and other social costs of dislocated change. The growth of the 'new global economy' highlights the crucial role of an international approach in which industrial, environmental, and trade policies are integrated. Acknowledging the inevitability of change, the central problem concerns the design of an alternative approach which ensures a sustainable development and industrial relative positions in the 'new global economy'. An alternative approach, the ecological modernization of industry, envisages industry actively contributing to the design for a sustainable future through technological, organizational, institutional, and social innovation. Active strategies towards the new industrial configurations are suggested that also highlight the dangers of a purely adversarial, control-oriented approach between government and industry. The management of environmentally sustainable conversion calls for a strategy dramatically different from that of the industry response to past solutions for abatement. Due to geographical permanency and local public outrage, the 21 plants that generate the 'worst' emissions must close by 2000 or soon thereafter. Efforts to meet the goal can undoubtedly strongly suggest that these pollution audits are 'ended'. Yet it is shown that these plans, too, can fail, as demonstrated by chemicals in southern Ecuador. The explanation of this unexpected resilience and longevity reveals a wide variety of mitigation strategies, grounded in the contradictory political economy and the processes regulating the implementation of industrial

environmental policy at the site or local scale. Successful management of an environmental industrial response would involve a confluence of information and initiatives generated from outside the industry, with many contributors. This, the general widening of the internal/external industrial boundary, enables a better understanding of the industrial strategies selected and also a more effective offsetting response by government and other agencies. Changes in the sectors from product to 'product services' are a fundamental shift in the production and procurement paradigm. These processes involve sometimes revolutionary changes in use, location, and/or ownership, which could well provoke new types and locations of environmental impacts, and possibly social as well as economic disturbance associated with the rapid decline of the old product-oriented industrial sectors. Preliminary findings from the case study of the switch and the service future expected are examined with a focus on the differences in industrial and recycling practices in the two types of economy. The growing importance of this kind of industrial system application in the developing world and the previously neglected role of government as a major constituent and catalyst in the process of sectoral shift provide an economic development and environmental management perspective that urgently requires more policy-relevant research.

Innovative Economy and Digital Transformation

In 2014, China first put forward the strategic positioning of "accelerating the establishment of an innovative country", effectively transforming the "buy" model into the "create" model, and achieving innovation-driven development. Among them, a scientific and technological innovation system and an incentive mechanism that is compatible with it must be established. In 2018, the 10th line of the Chinese Academy of Engineering announced that China should accelerate the promotion of the innovation-driven development strategy. It was pointed out that the annual global share of innovation expenditures in the country should account for 2.5% of the world's GDP. Currently, China's R&D investment is under 2%, but in the next ten years, China's innovation spending will take a qualitative leap. By 2025, the output value of core industries driven by a new generation of artificial intelligence should surpass 1 trillion. The exponential growth of money and output value is directly relatable to the GDP and is also the foundation of its GU technology foundation. In a sense, the eastern country's model tells the story. Similar to the "Korea Model" and the "German Switzerland Model", China has developed codes by directly pumping trillions of dollars from Western countries Crossing with the sample, the seed, and the formulation, stepping into the threshold of the "Korea Model" and successfully monopolizing the absolute advantage and the market share. In the future, this situation will make China a superpower that dominates the IT market. Nonetheless, since the federal government has imposed restrictions, under the Made in China 2025 plan, the core cannot be broken, rebuilding and smashing the rules to implement an innovative economy has become the only effective way. Other countries need to keep up with DY. (Ding et al., 2024).

With the development and popularization of digital technology, the digital economy has brought about great changes in various life fields of human beings and has had a significant impact on national development strategies, business behavior, and personal lives. The improvement of innovation level plays a pivotal role in overcoming the predicament of external technology dependence faced by SDG1, promoting renewable energy substitution for SDG7, and maintaining the supply of innovation momentum for SDG8. The digital economy has fundamentally changed the way of economic and social value creation, becoming a driving force for technological innovation. Over half of the world's top 1000 companies have made digital transformation the core of their strategy development. Digital transformation has penetrated all aspects of enterprise production, management, and development, driving production processes and enterprise strategy. The 14th Five-Year Plan regards digital transformation as strategic to promote changes in production, lifestyle, and governance. The report of the 20th CPC National Congress stated that China must accelerate digital innovation, eliminate the digital divide, and boost the digital economy's healthy growth. By 2023, the value of the core ecosystem of the digital economy is anticipated to exceed 400 billion. Large-scale investments cater to all systems within the inclusive, interconnected, and seamless system, covering evolving things to evolve from the prominence of the internet to the full integration of new infrastructure and modern IT (Yu et al., 2023). This part must be standardized. The construction of a modern economy means that the economic system

must be driven by technological innovation in resources, the environment, industrial divisions, and technical facilities.

Conclusion and Future Directions

Trade and investment can potentially generate positive benefits for both sides. Impacts can be seen as a function of the characteristics of the trade and investment flows and policies of the partners. For the global economy, whatever the specific nature of the trade and investment relations, a managed transition to an economy increasingly based on innovation is required if the problems that activity generates are not to become overwhelming. Such an adaptation will, arguably, require effort to ensure that benefits are widely spread and that approaches that might improve the likelihood of this occurring are actively undertaken. It was suggested that the current wave of reforms exacerbates existing disparities. Consequently, future moves might engender a reaction. In addition, insufficient weight was given to potential positive developments in poorer regions of the world.

What was significant about the analyses presented was that a major economic magnitude could not be explained by the established causal variable. It was not so much the rate of investment that was important but rather the productivity of investment, and that remained unexplained. Impacts of changes in policies on financial flows were potentially of great significance, especially if the economic implications of financial globalization were unpredictable and policy sensitive. However, focused work in this area has been limited. Issues of science policy became more strategic since science was concerned above all with the creation of new knowledge, presumably economically useful. Science policy was very prominent in debates about options for the post-colonial world. The link with the agenda for 'underdevelopment' was perhaps just as significant since underlying international poverty and inequality were seen as resulting in poor economic conditions. It was this confluence of concerns that gave rise to the drafting of a manifesto by a group of policy-oriented social scientists.

In recent years, Azerbaijan has adopted the development of an innovation economy as a strategic priority and implemented consistent reforms and large-scale programs in this area. These works have accelerated the country's integration into the global economic system and created conditions for the formation of a competitive and sustainable economic model.

Steps taken by Azerbaijan to transition to an innovation economy have strengthened the country's scientific-technical and economic potential. The adopted strategic documents and implemented state programs ensure a systematic approach in this area. These measures not only contribute to improving socio-economic well-being within the country but also create conditions for Azerbaijan's active participation in the global innovation environment.

References

Ding, Y., Shi, Z., Xi, R., Diao, Y., & Hu, Y. (2024). Digital transformation, productive services agglomeration, and innovation performance. Heliyon, 10(7), e28618. https://doi.org/10.1016/j.heliyon.2024.e28618

Yu, W., Zhang, L., & Yang, C. (2023). The impact of the digital economy on enterprise innovation behavior: Based on CiteSpace knowledge graph analysis. Heliyon, 9(10), e20569. https://doi.org/10.1016/j.heliyon.2023.e20569

Zhang, J. X., Cheng, J. W., Philbin, S. P., Ballesteros-Perez, P., Skidmore, M., & Wang, G. (2023). Influencing factors of urban innovation and development: A grounded theory analysis. PLoS ONE, 18(3), e0282819. https://doi.org/10.1371/journal.pone.0282819

Ram, H. M., Chakravorty, S., & Goli, S. (2022). Does gender inequality affect economic development? Evidence based on analysis of cross-national panel data of 158 countries. OSF Preprints. https://doi.org/10.31219/osf.io/7k2xn

Tsiotas, D. (2022). A 3D index for measuring economic resilience with application to the modern international and global financial crises. Mathematics, 10(19), 3623. https://doi.org/10.3390/math10193623

Ritter-Hayashi, D., Vermeulen, P., & Koben, J. (2019). Is this a man's world? The effect of gender diversity and gender equality on firm innovativeness. Sustainability, 11(15), 4063. https://doi.org/10.3390/su11154063

Gitelman, L. D., Kozhevnikov, M. V., Starikov, E. M., & Rada, E. C. (2019). Scaling up the innovation process in the energy sector based on technology entrepreneurship. International Journal of Energy Production and Management, 4(1), 1–12. https://doi.org/10.2495/EQ-V4-N1-1-12

Glover, D., & Poole, N. (2019). Principles of innovation to build nutrition-sensitive food systems in South Asia. Food Policy, 82, 95–103. https://doi.org/10.1016/j.foodpol.2018.11.008

Mlambo-Ngcuka, P., & de Silva de Alwis, R. (2019). Redefining leadership in the age of the SDGs: Accelerating and scaling up delivery through innovation and inclusion. UN Women.

Kolodynskyi, S., Drakokhrust, T., & Bashynska, M. (2018). The innovative infrastructure of economic development in the framework of international digital transformation. Baltic Journal of Economic Studies, 4(5), 144–152. https://doi.org/10.30525/2256-0742/2018-4-5-144-152

Pastukhov, V. A., Kliman, N. S., & Alekseev, D. S. (2018). Tendencies of interaction between Russian universities and companies implementing innovative development programs. European Research Studies Journal, 21(2), 234–246.

Lopez-Leyva, S., & Mungaray-Moctezuma, A. B. (2017). Knowledge-based economy as a foundation for the economic development of countries. Management Dynamics in the Knowledge Economy, 5(4), 481–501. https://doi.org/10.25019/MDKE/5.4.02

Kirillov, V. (2019). Theoretical aspects of the interrelation of innovations and the competitiveness of countries in international trade. Baltic Journal of Economic Studies, 5(1), 89–96.

Gibbs, D., & Lintz, G. (2015). Editorial: Environmental governance of urban and regional development – Scales and sectors, conflict and cooperation. Regional Studies, Regional Science, 2(1), 1–4. https://doi.org/10.1080/21681376.2015.1015534

Crossman, S., Spoehr, J., & Siebentritt, M. (2016). Climate change and the adaptive economy: Discussion paper. Australian Workplace Innovation and Social Research Centre.

Chirodea, F. (2013). The role of universities from north-western Romania in the development of regional knowledge-based economies. Journal of Educational Sciences, 15(1), 35–46.

Dinda, S. (2011). Inclusive growth through the creation of human and social capital. International Journal of Social Economics, 38(10), 867–878. https://doi.org/10.1108/03068291111161349

Chataway, J., Clark, N., Hanlin, R., Kale, D., Kaplinsky, R., & Robbins, P. (2009). Below the radar: What does innovation in the Asian driver economies have to offer other low-income economies? International Journal of Technology Management & Sustainable Development, 8(1), 57–69. https://doi.org/10.1386/ijtm.8.1.57_1

Chaminade, C., Lundvall, B.-Å., Vang-Lauridsen, J., & Joseph, K. J. (2009). Innovation policies for development: Towards a systemic experimentation-based approach. In B.-Å. Lundvall, K. J. Joseph, C. Chaminade, & J. Vang (Eds.), Handbook of innovation systems and developing countries (pp. 360–379). Edward Elgar Publishing.

A balanced scorecard analysis of agency and structural challenges in agricultural cooperatives

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Cooperatives, Structure, Agency, Balanced-Scorecard and Agriculture

Abstract

Entrepreneurship This study investigates the challenges faced by agricultural cooperatives in the agri-business sector of Bushbuckridge, Mpumalanga Province. The research sought to understand the motivations for cooperative formation, the contributions of cooperatives to community livelihoods, and the operational, financial, and governance challenges that constrain their sustainability. The study draws on the structure and agency literature in unpacking the challenges facing cooperatives. The body of literature explored covers financial constraints, governance and leadership challenges, market access challenges, infrastructure challenges, social and cultural barriers, and climate change risks. Data were collected through interviews with cooperative members and were analysed thematically. The findings reveal recurring themes including water scarcity and infrastructural deficits, financial constraints and dependence on limited government support, governance and leadership challenges, market access barriers, and youth disengagement. Despite these constraints, cooperatives contribute significantly to food security, household income, and social cohesion, demonstrating resilience in the face of adversity. The study further tests these findings against the Balanced Scorecard (BSC) framework. While the BSC captures financial and customer-related aspects, it fails to adequately account for the social, environmental, and generational dimensions that are central to cooperatives. In particular, the BSC does not address youth involvement, resilience strategies, or the developmental role of cooperatives in rural communities. This critique highlights the need for an expanded evaluative framework that integrates financial, social, and environmental indicators. The study contributes to both academic debates and policy discussions on rural development by highlighting the limitations of applying conventional business frameworks to community-driven agricultural enterprises.

Introduction

Agricultural cooperatives play a major role in rural development, particularly in areas with limited economic prospects and small-scale farming (Malomane, 2019). In the Bushbuckridge municipality of Mpumalanga Province, agriculture is both a livelihood and a key component of local economic survival. Despite their potential, many cooperatives face structural, managerial, and financial barriers that impede their effectiveness (Shava & Hofisi, 2019; Balana & Oyeyemi, 2022).

The importance of this study lies in its exploration of how these challenges manifest in rural cooperative contexts, where members often have limited access to markets, capital, and technical knowledge. By investigating the internal and external barriers to cooperative success in Bushbuckridge, the research contributes to policy debates around cooperative governance and sustainable rural entrepreneurship.

The study aims to identify and analyse the key challenges faced by agricultural cooperatives in Bushbuckridge, assess their implications for sustainability, and propose practical recommendations to improve their performance.

Literature Review

The paper builds on three sets of literature that are widely recognized in the broader study field of cooperatives. These are the literature on challenges facing cooperatives, structure and agency, and the balanced score card. The challenges facing cooperatives have been a subject of concern for several decades and this subject has continued to enjoy the attention of researchers throughout the years. Thus, it is

important that this paper finds expression in the broader challenges of cooperatives. The structure and agency theory is a well-established body of literature and is used in this study to characterize the nature of the challenges of cooperatives. The balanced score card literature clarifies the tool and its strategic role in enterprise.

Firstly, the challenges that face cooperatives are a deep reflection of broader societal issues and problems (Okem and Lawrence, 2013). By nature cooperatives seek to address socio-economic problems that face societies and depend on the capacities of their members to function (Wadesango and Mabunda, 2017). This means that cooperatives as entities are established with the view of addressing the needs members and these needs are often a reflection of societal issues and problems. In other words, cooperatives by their nature assume a responsibility to address societal issues and problems of their own members. Societal issues and problems vary from infrastructural to social issues where cooperatives are set up to deal with energy, water, food, education and production challenges posited as opportunities (Nakayiso and Andrew, 2023).

The fact above can be attributed to the Rochdale Pioneers' experience in 1844. The Rochdale Pioneers were ordinary factory workers producing various products i.e. textiles for the industrial complex and also offering their services often as cheap labour (Walton, 2015). The Rochdale story has become an explainer in literature of the ways that cooperatives have assumed broader societal issues by their work and character. This legacy has stayed with the cooperative sector and dealing with broader societal issues is inseparable from cooperatives because of such a legacy. More importantly, the role of other cooperative forms also approach community in similar ways. For example, community schemes in Africa, Asia and in the Americas have demonstrated that digging of graves, supporting emergencies and ploughing fields these activities have been organised as community activities seeking to address societal issues (Kaswan et al., 2026). This is evidence that theoretically and historically cooperatives assume wider responsibility for society through its membership and trade activities; and seek a more just application of labour and fair pay (Nakayiso and Andrew, 2023). Therefore, literature is bound to contextualise the societal issues as part of those challenges that face cooperatives.

This literature review now turns to explore the operational and financial performance challenges that face cooperatives. In doing this the review flows from the broader societal issues to the specific challenges. Operational challenges facing cooperatives have since been labelled as lack of finances, membership decline in some contexts, loss of cooperative values due to operational procedures and shifting economic patterns (Bretos and Marcuello, 2017). The South African case of cooperatives has also provided a unique set of challenges that include dependence on state funding and the subsequent decline of such resources over the years (Okem and Lawrence, 2013). The ability of investor-owned firms to raise large sums of capital investments has since put aspirant and high performing cooperatives under pressure to seek growth. Although desirable, literature shows that cooperatives seek to preserve their values and this presents an interesting challenge about the investment readiness of cooperatives when seeking "profit" whilst having to maintain the basic values of cooperation (Wadesango and Mabunda, 2017).

The second part of this literature review turns to literature on agency and structure to characterize the nature of challenges facing cooperatives. Fewer studies have used agency and structure to frame the challenges facing cooperatives. Agency explains the capacities and the freedoms of an individual to act independently and to make choices (Archer, 2003). While structure refers to frameworks, rules, policies and systems that shape or bound choices (Elder-Vass, 2010b). Agency literature is premised on the assumption that individuals can and must act individually as a way of expressing their freedoms. It also extends on this by adding the element of choice, again an assumption that individuals have a choice. However, structure exposes the limitations of agency since the freedoms and choices are to exist within the confines of rules, frameworks and systems.

Archer (2003) has since clarified that structure does not directly influence agency:

There is no ontological consensus whatsoever about what they are within social theory. The sole and slim agreement is that in some sense 'structure' is objective, whilst in some sense 'agency' entails subjectivity. Both logically and traditionally, this minimal accord was compatible with accounts of the process by which one influenced the other that are diametrically opposed. Either structure or agency

could be held to be dominant, and the other element to be correspondingly weak, so weak that it was deprived of causal powers such that structure melted into 'constructs' or agents faded into 'trager'. Pg. 1

The theoretical framing of structure and agency shows that there is no direct relationship between the two concepts. The existence of structure and presence of agency does not present automatic influence on either (Elder-Vass, 2010b). Systems, laws and policies premised on structure do not limit or impact choices automatically; nor do they undermine agency (Cadot, 2015). Similarly, agency is not dependent on structure even though it may recognise its implications (Elder-Vass, 2010a). It can be concluded on this part that structure and agency co-exist but can be maintained with some degree of independence from each other.

Performance Measurement Framework for Agricultural Cooperatives

BSC is one of the well-known performance measurement frameworks that gives managers the tools they need to measure performance in the marketplace (Kaplan & Norton, 1996). It transforms the goals and objectives of an organisation into a range of performance criteria that serve as the basis for a system of strategic measurement and management (Kaplan & Norton, 1996). Although BSC is widely used, an increasing amount of research identifies flaws in it, mainly in its theory, implementation, and practice. These constraints may reduce BSC's efficacy or lead businesses to disregard it entirely in favour of more effective performance assessment options (Awadallah & Allam, 2015).

However, to present a more "balanced" perspective of organisational performance, the balanced scorecard incorporates both financial and non-financial data, attempting to solve the shortcomings of typical performance assessment methods (Ittner & Larcker, 2003). In the context of cooperatives and rural development, Harisudin, Adi and Kusuma (2020) in their study, express that BSC could be used as a strategic intervention to address gaps, therefore, improving cooperative performance.

The following balanced scorecard was aimed at organising the insights across the four standard BSC perspectives and an additional perspective applicable to the performance of the agricultural cooperatives for this study:

Table 1: Performance measurement framework (balanced scorecard)

Perspective	Strategic objectives	Key questions/indicators
Financial	Improved financial sustainability, secure access to funding	How does access to funding and financial support impact the sustainability and growth of the cooperative?
Customer and market	Improved market access, increased competitiveness	How do market access and competition affect the profitability and sustainability of the cooperative's agri-business activities?
Internal processes	Improved operational efficiency, strengthened governance and leadership	What are the main challenges in day-to-day operations? What are the key leadership and management challenges of the cooperative, and how do they influence performance?
Learning and growth	Build member capacity, enhance sector knowledge	What knowledge and skills do the cooperative members possess? How effective are training interventions from government or other stakeholders?
External environment	Align with supportive policies, strengthen government and institutional support	What role do government policies, agricultural departments, and local institutions play in supporting or undermining cooperative development? How accessible are government programs?

The BSC framework presented in Table 1 was adapted as a possible tool to evaluate the performance of agricultural cooperatives in Bushbuckridge. Each perspective was aligned with strategic objectives and guiding questions that reflected the unique operational and developmental context of cooperatives. This section interprets each perspective and presents a research-based argument for its relevance and application.

Financial perspective

Financial viability is fundamental for the survival and growth of agricultural cooperatives, especially in rural settings (Yobe, Stuart & Mudhara, 2021). Cooperatives often rely on multiple sources of funding, including member contributions, governmental grants, donor support, and internal capital accumulation, but these are frequently insufficient (Shava & Hofisi, 2019). Access to affordable credit is another critical factor. In China, for example, a study showed that membership in a farmers' cooperative improves smallholders' access to credit because cooperatives reduce information asymmetry and transaction costs for financial institutions through organised supply chains (Jiang, Li & Mi, 2024). As a result, cooperatives enable farmers to secure loans that they would otherwise not qualify for, which then allows investment in inputs, equipment, or infrastructure, thereby enhancing productivity and long-term viability (He & Chen, 2024).

Customer/market perspective

Market access is essential for cooperatives to sell produce at fair prices and compete with commercial agribusinesses (Manganyi et al., 2024). According to Pingali, Aiyar, Abraham and Rahman (2019), market access is not simply about finding buyers, but also about negotiating fair terms, reducing transaction costs, and managing marketing logistics. Cooperatives that have strong linkage networks, either through associations, formal buyer contracts, or collective marketing strategies, can often negotiate better prices and reduce exposure to price volatility (Ibikoule, Lee & Godonou, 2024).

Research conducted by Yobe et al. (2021) found that agricultural cooperatives in South Africa tend to access more lucrative or stable market channels when they demonstrate higher financial and social efficiency, better management and governance, and have access to credit. Moreover, in collective marketing, issues such as product quality, standardisation, branding, and transport/logistics often act as barriers (Magakwe & Olorunfemi, 2024). Cooperatives that invest in ensuring consistent quality, such as training and quality control, or that aggregate produce to meet quantity thresholds demanded by buyers, are often more successful (Ma, Chen, Su, Zhang, Wen & Hou, 2024).

Internal processes perspective

This dimension considers how well internal systems, governance mechanisms, leadership, decision-making and operational workflows support cooperative goals. Literature emphasises that poor governance, weak internal controls, and unclear decision-making structures lead to inefficiencies, member dissatisfaction, and even failure of cooperatives (Zwane & Mzanywa, 2025). For example, a study on rural cooperatives in South Africa found that compliance with internal control practices was positively correlated with both financial and social efficiency (Yobe et al., 2021). This suggests that strong internal process structures contribute significantly to both economic and social outcomes.

An adaptation of standard BSC indicators is necessary for cooperatives because of their unique qualities such as member participation, decision making, and shared ownership. For example, in smallholder marketing cooperatives, participants highlighted governance, management committee capacity, transparency, and accountability as critical internal process features for enabling market access and trust among members (Gouët & Van Paassen, 2012).

Operational efficiency is also influenced by internal factors such as transaction costs, economies of scale, and the cooperative's organisational structure (Handoyo, Suharman, Ghani & Soedarsono, 2023). This perspective assesses internal workflows, decision-making structures, and leadership capacity. Issues such as weak governance can lead to mismanagement and member disengagement (Chivundu-Ngulube & Li, 2019), therefore BSC could provide a structured way to monitor these issues, but its standard indicators may need to be adapted to reflect participatory decision-making and democratic governance, which are central to cooperative models (Madsen, 2025).

Learning and growth perspective

This perspective evaluates training programs, knowledge sharing, and innovation adoption. Studies have shown that targeted training improves productivity and member engagement (Liu, Shi, Liu, Qiu,

Wang, Liu & Fu, 2022; Wonde, Tsehay & Lemma, 2022). However, BSC's traditional focus on training and development may not fully align with the informal learning and peer-to-peer knowledge transfer common in cooperatives (Noy, James & Bedley, 2016).

According to Cawley, Heanue, Hilliard, O'Donoghue and Sheehan (2023), informal learning and peer-to-peer knowledge transfer are particularly significant in agricultural cooperatives, where formal training may be limited by costs or geographic remoteness. These modes of learning allow faster diffusion of best practices in but not limited to farming, quality control, and marketing, especially where cooperatives serve remote smallholder farmers (Cawley et al., 2023).

External environment perspective

This additional perspective was introduced to address a key limitation of the traditional BSC, its lack of attention to external socio-political factors. Cooperatives operate within complex policy environments, and their success often depends on institutional support, access to extension services, and alignment with development programs (Zwane & Mzanywa, 2025). Given the institutional, policy, and socio-political contexts in which the agricultural cooperatives operate, this perspective is essential to capture external forces that enable or constrain performance. Cooperatives often depend on government policy frameworks, extension services, infrastructure, subsidies or tax incentives, and market regulation (Ribašauskienė, Šumylė, Volkov, Baležentis, Streimikiene & Morkunas, 2019).

External environment also includes market-level factors such as price volatility, climate risk, input supply chain stability, and infrastructure constraints, all of which disproportionately affect rural cooperatives (OECD, 2020). Cooperatives' performance is sensitive to transportation, regulatory consistency, such as food safety and grading, and access to extension/technical support (Aamohammed et al., 2025). The policies that support collective marketing, product standards, or subsidised inputs can shift the competitive dynamics for cooperatives (Aamohammed et al., 2025). Without favourable external conditions, even well-managed cooperatives may struggle to maintain performance or scale (Valette, Amadieu & Sentis, 2024).

Methods and Design

The study adopted a qualitative research study grounded in the interpretivist paradigm, which seeks to understand the lived experiences and perspectives of participants within their specific social contexts (Oranga & Matere, 2023). This approach was deemed appropriate for exploring the challenges faced by agricultural cooperatives in Bushbuckridge, where issues are embedded in the socioeconomic and institutional realities of rural life.

Data were collected through semi-structured interviews conducted exclusively with cooperative leaders. This group was purposively selected due to their firsthand knowledge of cooperative operations, governance dynamics, and financial and managerial challenges. The use of semi-structured interviews allowed for flexibility in probing participants' insights while maintaining consistency across the discussions.

A total of ten (10) cooperative leaders were interviewed across various agri-business cooperatives in the Bushbuckridge Local Municipality.

Interviews were conducted virtually and recorded with participants' consent. The data were transcribed and analysed using thematic analysis, which involved coding, categorization, and identification of emerging themes related to financial management, governance, infrastructure, market access, and institutional support.

The study obtained ethical clearance from the University of Johannesburg, ensuring adherence to ethical standards of confidentiality, voluntary participation, and informed consent. Participants were assured that their identities would remain anonymous, and data would be used solely for academic purposes.

Findings

These findings are based on the interviews with cooperative leaders in a region of South Africa, called Bushbuckridge (alongside the internationally renowned Kruger National Park). The findings reveal the

challenges faced by agricultural cooperatives in the region. Below are summarised interview findings covering the interview guide questions which sought to investigate the challenges faced by the agricultural cooperatives, the effect of these challenges on performance and ability to achieve their goals. The findings are in two parts. First section focuses on the interviews and the second section on the balanced-scorecard linking the interview data.

Interview findings

As an introduction, the interviews probed the motivation for forming a cooperative. The first respondent explained stated that community upliftment was their main motivation and reason for the formation of their cooperative. In a statement the respondent said: "I wanted to uplift my community, particularly the youth, by providing them with farming skills" (Participant 1). Another participant referred to their motivation as seeking to give opportunity to educated but unemployed youth, as quoted "We have children who went to school but are unable to find employment" (Participant 5). The recruitment of members became easy as some of the projects were seen to create meaningful opportunities to many unemployed youths as stated by one participant that "It was relatively easy because of the high youth unemployment rate. I met with interested youth in the community" (Participant 4).

The second focus was on the state of infrastructure. In response the participant stated: "We also face storage issues due to limited space, which affects our ability to store products properly. Additionally, transportation is inadequate, making it difficult to deliver products to customers" (Participant 1). Another participant added, "We also lack proper storage, so when we harvest maize, we hire transport to take it to our homes" (Participant 5). Especially during crucial harvesting seasons, this dependence on few resources caused inconvenience and delays. The vulnerability of current infrastructure worsens the problem, with another member expressing that, "The animal handling infrastructure occasionally collapses" (Participant 6). For numerous members, a lack of dependable water sources forced them to suspend operations for an entire planting season. As one participant stressed, "We pause crop farming until the rainy season arrives" (Participant 6).

Crop health and yield quality were other challenges raised during interviews. Asked about this, the participant emphasised, "Our main challenges are pest infestation" (Participant 4). Water shortages intensified the issue by making stressed plants even more vulnerable. Another participant mentioned, "We struggle with pests. If we go a few days without watering the plants, the pests cause significant damage to our crops" (Participant 9).

As it has been common that government would play a role in addressing these challenges. The interview put questions about government support to participants and the response from a participant highlighted a challenge with regards to interventions by the state, expressing that: "The government provides some support, but mostly, we fund our activities from profits generated through sales. We also sometimes obtain small loans, and some members pay subscription fees, which help keep the cooperative operational. However, these resources are limited, and more support would be beneficial" (Participant1). Equally, another participant emphasised the dependence on their produce, stating that, "We grow crops, sell the produce, and then use that income to fund the project" (Participant 2).

Cooperatives also must employ the principle of self help in dealing with challenges. This question was also asked to participants about the extent of their own initiative in dealing with challenges. A participant responded saying that: "Our cooperative is self-funded. We are still looking for sponsors. At one point, we did receive some assistance from government officials based in Pretoria, but it was only temporary" (Participant 9). Also, another participant stated that, "We are self-funded. However, we once rented out part of our land to the Agricultural Research Council for R30,000, though we were only due to receive that payment after five years. Generally, we use our personal funds to buy seeds and maintain the farm" (Participant 10).

Another participant stressed how traditional leadership structures and higher-level politics could not offer sufficient assistance: "The Department of Agriculture in Thulamahashe is aware of our leadership issues. They recommended that we address these challenges through our Tribal Leader. Unfortunately, he hasn't engaged with us, possibly due to time constraints. With the rise of corruption in South Africa, the political nature of this project also complicates matters. Still, if these issues could be addressed, the project

has real potential" (Participant 7). This demonstrates the impact of larger sociopolitical factors on cooperative functioning in addition to leadership differences.

Even with self-help participants still cited other challenges such as "Entry into formal markets is challenging due to storage and transportation limitations. This hampers our ability to distribute products widely" (Participant 1). Because of this, a lot of cooperatives depend significantly on unofficial and local markets. Most participants stated that they sold produce to small-scale buyers and within local communities. For example, a participant mentioned, "We sell to the local community, nearby villages, street vendors in town, and we also supply formal supermarkets" (Participant 2).

Crucially, not every participant thought that institutional support was adequate or consistent. Some claimed that the lack of training workshops contributed to their challenges. One participant plainly stated: "The lack of government support, including the absence of training workshops, has contributed to the decline of our operations" (Participant 5). This demonstrated the importance of institutional support to socioeconomic development, particularly in rural areas where opportunities are limited.

It was pointed out that farming was a source of survival and livelihood in addition to producing food. For example, one participant stated, "I aim to combat hunger through farming initiatives" (Participant 1). Correspondingly, another participant emphasised the connection between agribusiness and unemployment, remarking, "The main motivation was unemployment. Many of us are still of working age but lack job opportunities. We decided to try and make a living through farming." (Participant 2).

Participants highlighted initiatives to diversify product offerings beyond crop farming to increase revenue streams and build resilience. One participant stated, "We are involved in livestock, poultry, and crop farming" (Participant 6). This kind of diversification showed an effort to manage risks and capitalise on various opportunities, however, not every attempt at diversification was fruitful, looking at another participant's experience: "We also attempted to start a sewing project under the cooperative, but it failed due to lack of resources" (Participant 5).

The next sections of the paper focus on the thematic findings of the study and are broken down into five categories and attempts to draw parallels to the balanced-score card.

Theme 1: Financial Constraints

Financial challenges were identified as one of the major obstacles facing agricultural cooperatives. Most cooperatives relied on government grants and member contributions for operational funding. A lack of financial literacy and weak internal controls often led to mismanagement of resources and unsustainable financial practices. Cooperative leaders reported that limited access to credit facilities prevented them from investing in essential agricultural inputs and infrastructure, thereby constraining growth and productivity.

Theme 2: Governance and Leadership Challenges

Poor governance and leadership were recurrent issues across most cooperatives. Many leaders lacked the managerial and administrative skills necessary to run cooperative enterprises effectively. Decision-making processes were often centralized, leading to dissatisfaction among members. Some cooperatives also experienced internal conflicts and poor communication between management and members, resulting in low morale and diminished participation.

Theme 3: Inadequate Infrastructure and Resources

The findings revealed that many cooperatives operate under severe infrastructural limitations. Challenges such as unreliable water supply and insufficient storage facilities were frequently mentioned. These infrastructural deficits limited production capacity, increased post-harvest losses, and hindered timely access to markets. Cooperative leaders indicated that the lack of equipment and technical support further reduced productivity and competitiveness.

Theme 4: Limited Market Access

Cooperatives in Bushbuckridge struggled to access reliable and profitable markets. Many participants stated that they lacked marketing knowledge, networks, and logistical capacity to transport products to

larger markets. As a result, cooperatives depended on local markets with low demand and poor price margins. The inability to negotiate favourable prices and contracts limited profitability and discouraged members from active participation.

Theme 5: Weak Institutional and Policy Support

The study found that government and institutional support for cooperatives was inconsistent and poorly coordinated. While cooperatives occasionally received training or funding, these interventions were not sustained and often failed to address structural challenges. Participants felt that policies intended to support cooperatives were not effectively implemented at the grassroots level. This lack of institutional follow-through left cooperatives vulnerable to collapse once external support ended.

Discussion of Research findings

The findings of this study confirm that agricultural cooperatives in Bushbuckridge operate within a context of severe structural and socioeconomic constraints, which significantly influence their sustainability. The cooperatives' struggles with finance, governance, infrastructure, and institutional support mirror broader national trends in South Africa's rural cooperative sector (Shava & Hofisi, 2019).

Most cooperative leaders reported ongoing financial instability, primarily due to limited access to credit and weak internal financial management systems. This aligns with Balana and Oyeyemi (2022), who argue that credit constraints and inadequate financial literacy undermine smallholder and cooperative performance in developing contexts. Similarly, Ndlovu and Masuku (2021) note that financial dependence on external support diminishes cooperatives' autonomy and sustainability. The results from Bushbuckridge reinforce the need for tailored financial inclusion programs and cooperative financial education to strengthen accountability and long-term resilience.

The findings revealed that weak governance structures, limited leadership skills, and internal conflicts often prevent effective decision-making and member participation. These observations echo Mbokazi and Maharaj (2024), who found that ineffective leadership and insufficient managerial capacity hinder cooperative success in local economic development initiatives. Poor internal communication and lack of transparency reduce member trust, weakening cohesion and long-term vision. Leadership training and participatory governance models are therefore essential for improving accountability and performance.

Infrastructure deficiencies, particularly limited storage and lack of irrigation, were among the most frequently cited challenges. These findings correspond with Cishe and Shisanya (2019), who emphasize that infrastructural weaknesses severely constrain smallholder cooperatives' ability to reach stable markets. In Bushbuckridge, the cooperatives' restricted access to formal supply chains mirrors national issues of market exclusion and spatial inequality. As noted by Mbokazi (2021), connecting cooperatives to markets through improved logistics and information systems is critical to their competitiveness and sustainability.

Participants highlighted inconsistent institutional support, with government programs perceived as fragmented and reactive rather than developmental. This finding supports Shava and Hofisi's (2019) argument that policy incoherence and poor monitoring weaken cooperative development efforts. Furthermore, Rena (2017) observed that South African cooperative policies often fail at the implementation stage due to bureaucratic inefficiencies and inadequate local capacity. A more integrated policy approach, linking agricultural extension, finance, and infrastructure, would therefore enhance cooperative sustainability.

Theoretical Context and Contribution

The findings can be interpreted through the participatory development and institutional frameworks underpinning the study. The participatory approach emphasizes member ownership, collective decision-making, and empowerment, all of which were constrained in practice. The institutional perspective explains how policy, financial systems, and local governance structures shape cooperative outcomes. The Bushbuckridge case illustrates that without enabling institutions and consistent support systems, even the most motivated cooperatives struggle to achieve self-sufficiency.

In terms of agency and structure, the study contributes an understanding that cooperatives are by nature agentic. This means that when they exercise self-help from below and within their cooperative structure or membership can achieve their goals. However, in the context of poverty and scarcity such agency does not always exist as it is in the case of Bushbuckridge. This study has shown therefore that in some context agency cannot be enjoyed in full and it becomes a goal than a choice or reality. In addition, the study extends the understanding of structure when tested via the balanced scorecard. Finance, infrastructure and sustainability (operationally and financially) are some useful score-card indicators that can continue to advance research understanding the challenges and prospects of cooperative enterprises. Also focusing the tool on cooperatives stands to broaden its application to non-investor-owned firms as it is mostly applied in such research contexts.

Policy Implications

For policy this paper suggests interventions from policymakers that enable a sense of agency amongst cooperatives and how they interact with government as a system. Presently the state has a relationship that seeks to hand out help to cooperatives instead of policy empowerment that breaks barriers to accessing formal markets for their agricultural produce. Also access to affordable agri-finance requires policy to prioritize micro-finance products and offer incentives to financial institutions that create access to finance for small scale cooperatives. Furthermore, an integrated support system for agricultural cooperatives is necessary and must be designed to respond to the critical issues such as market access, finance and infrastructure. Equally cooperatives must seek to exercise full agency responsibility and reduce their dependence on government. If this is left unchecked, cooperatives risk undermining the principle of self-help and this means finding ways to drive cooperation between cooperative financial institutions and agricultural cooperatives thus design micro finance packages that can be backed by government, and other independent players.

Overall, the Bushbuckridge case reinforces the argument that sustainable cooperative development requires holistic and locally adaptive policies that combine financial empowerment, institutional coordination, and leadership capacity-building.

Conclusions

This study highlights the multifaceted challenges facing agricultural cooperatives in Bushbuckridge. These challenges are deeply interrelated and cannot be addressed in isolation. An integrated, context-sensitive strategy that considers the cultural, political, and geographic realities of rural areas like Bushbuckridge is essential for enhancing cooperative sustainability. Despite these constraints, cooperatives demonstrate resilience by contributing to food security, household income, and social cohesion.

Future research should explore agency through innovative internal funding models, such as blended finance or rotating savings systems, to reduce reliance on external support. Strategies to enhance youth engagement through training and entrepreneurship programs are critical to ensuring long-term viability. Further investigation into integrating cooperatives into formal supply chains, adopting climate-smart agricultural practices, and evaluating the impact of governance structures as they relate to improving cooperative performance and sustainability in rural South Africa.

References

Aamohammed, C., Behera, E. & Ok, E. (2025). Cooperatives and farmer organizations: The role of cooperatives in enhancing farmers' bargaining power and access to resources. Available at: https://www.researchgate.net/

Archer, M.S. (2003). Structure, Agency and the Internal Conversation. Cambridge: Cambridge University Press. Available at: https://doi.org/10.1017/CBO9781139087315

Awadallah, E. & Allam, A. (2015). A critique of the Balanced Scorecard as a performance measurement tool, 6(7), p. 91. Available at: https://www.researchgate.net/

Balana, B.B. & Oyeyemi, M.A. (2022). Agricultural credit constraints in a smallholder farming in developing countries: Evidence from Nigeria. World Development Sustainability, 1, 100012. Available at: https://doi.org/10.1016/j.wds.2022.100012

Bretos, I. & Marcuello, C. (2017). Revisiting globalization challenges and opportunities in the development of cooperatives. Annals of Public and Cooperative Economics, 88(1), pp. 47–73. Available at: https://doi.org/10.1111/apce.12145

Cadot, J. (2015). Agency costs of vertical integration—the case of family firms, investor-owned firms and cooperatives in the French wine industry. Agricultural Economics, 46(2), pp. 187–194. Available at: https://doi.org/10.1111/agec.12150

Cawley, A., Heanue, K., Hilliard, R., O'Donoghue, C. & Sheehan, M. (2023). How knowledge transfer impact happens at the farm level: Insights from advisers and farmers in the Irish agricultural sector. Sustainability, 15(4), 3226. Available at: https://doi.org/10.3390/su15043226

Cishe, B.E. & Shisanya, S.O. (2019). Transforming smallholder agriculture through cooperatives for improving households food security at OR Tambo District Municipality, South Africa. African Journal of Agricultural Research, 14(34), pp. 1878–1882. Available at: https://doi.org/10.5897/AJAR2019.13530

Elder-Vass, D. (2010a). Social ontology and social structure. In: The Causal Power of Social Structures: Emergence, Structure and Agency. Cambridge: Cambridge University Press, pp. 64–86. Available at: https://doi.org/10.1017/CBO9780511761720.004

Elder-Vass, D. (2010b). The Causal Power of Social Structures: Emergence, Structure and Agency. Cambridge: Cambridge University Press. Available at: https://doi.org/10.1017/CBO9780511761720

Handoyo, S., Suharman, H., Ghani, E.K. & Soedarsono, S. (2023). A business strategy, operational efficiency, ownership structure, and manufacturing performance: The moderating role of market uncertainty and competition intensity and its implication on open innovation. Journal of Open Innovation: Technology, Market, and Complexity, 9(2). Available at: https://doi.org/10.1016/j.joitmc.2023.100039

Harisudin, M., Adi, R.K. & Kusuma, A. (2020). Performance improvement strategies based on balanced scorecard for rural cooperative: The case of Indonesia. International Journal of Trade and Global Markets, 13(2), pp. 161–176. Available at: https://doi.org/10.1504/IJTGM.2020.106757

He, Y. & Chen, Y. (2024). The impact of agricultural cooperatives on farmers' agricultural revenue: Evidence from rural China. Sustainability, 16(24), 10979. Available at: https://doi.org/10.3390/su162410979

Ibikoule, G.E., Lee, J. & Godonou, L.A. (2024). Smallholders' vulnerability in the maize market: An analysis of marketing channels to improve the role of cooperatives in Benin. Heliyon, 10(6), e27746. Available at: https://doi.org/10.1016/j.heliyon.2024.e27746

Ittner, C.D. & Larcker, D.F. (2003). Coming up short on nonfinancial performance measurement. Harvard Business Review, 81(11), pp. 88–95.

Jiang, M., Li, J. & Mi, Y. (2024). Farmers' cooperatives and smallholder farmers' access to credit: Evidence from China. Journal of Asian Economics, 92, 101746. Available at: https://doi.org/10.1016/j.asieco.2024.101746

Kaplan, R.S. & Norton, D.P. (1996). The Balanced Scorecard: Translating Strategy into Action. Boston, MA: Harvard Business School Press.

Kaswan, M. et al. (2026). Cooperatives and social transformation. In: [Book title required], pp. 17–40. Available at: https://doi.org/10.4324/9781003534006-3

Liu, Y., Shi, K., Liu, Z., Qiu, L., Wang, Y., Liu, H. & Fu, X. (2022). The effect of technical training provided by agricultural cooperatives on farmers' adoption of organic fertilizers in China: Based on the mediation role of ability and perception. International Journal of Environmental Research and Public Health, 19(21), 14277. Available at: https://doi.org/10.3390/ijerph192114277

Madsen, D.O. (2025). Balanced Scorecard: History, implementation, and impact. Available at: https://www.mdpi.com/

Magakwe, N. & Olorunfemi, O. (2024). A systematic review of the trends, effects, and deterrents of collective marketing participation among smallholder farmers in sub-Saharan Africa. Sustainability, 16(21), 9578. Available at: https://doi.org/10.3390/su16219578

Malomane, M.A. (2019). The Role of Smallholder Farmers' Cooperatives in Rural Development: A Case of Umgungundlovu District Municipality, KwaZulu-Natal. [Master's dissertation].

Manganyi, B., Sotsha, K., Rambau, K. & Chiloane, D. (2024). Improving market access for smallholder farmers in South Africa: Policy brief. Available at: https://www.namc.co.za/

Mbokazi, N.M. (2021). Assessing the Role of Agricultural Co-operatives in Contributing to Local Economic Development (LED): A Case of Waterloo Township. University of KwaZulu-Natal.

Mbokazi, N.M. & Maharaj, P. (2024). Agricultural cooperatives as a means of promoting local economic development in a township in South Africa. South African Geographical Journal. Available at: https://doi.org/10.1080/03736245.2024.2419548

Nakayiso, E. & Andrew, N. (2023). A historical review on the global evolution, benefits, challenges and performance of cooperatives. Journal of Humanities and Social Sciences, 8(1), pp. 51–75.

Ndlovu, C. & Masuku, M.M. (2021). The efficacy of agricultural cooperatives towards enhancing food security in rural areas: Mbombela Local Municipality, Mpumalanga Province. Technium Social Sciences Journal, 21, pp. 661–674.

Noy, M., James, H. & Bedley, C. (2016). Reconceptualizing Learning: A Review of the Literature on Informal Learning.

OECD. (2020). Strengthening Agricultural Resilience in the Face of Multiple Risks. Available at: https://doi.org/10.1787/2250453e-en

Okem, A.E. & Lawrence, R. (2013). Exploring the opportunities and challenges of network formation for cooperatives in South Africa. KCA Journal of Business Management, 5(1), pp. 16–33.

Oranga, J. & Matere, A. (2023). Qualitative research: Essence, types and advantages. Open Access Library Journal, 10(12), pp. 1–9. Available at: https://doi.org/10.4236/oalib.1111001

Pingali, P., Aiyar, A., Abraham, M. & Rahman, A. (2019). Linking farms to markets: Reducing transaction costs and enhancing bargaining power. In: Transforming Food Systems for a Rising India. Available at: https://doi.org/10.1007/978-3-030-14409-8_8

Ribašauskienė, E., Šumylė, D., Volkov, A., Baležentis, T., Streimikiene, D. & Morkunas, M. (2019). Evaluating public policy support for agricultural cooperatives. Sustainability, 11(14), 3769. Available at: https://doi.org/10.3390/su11143769

Shava, E. & Hofisi, C. (2019). Cooperatives as strategies of local economic development in the City of Tshwane. Journal of Contemporary Management, 16(2), pp. 23–42. Available at: https://doi.org/10.35683/jcm18028.0025

Valette, J., Amadieu, P. & Sentis, P. (2024). The challenging assessment of agricultural cooperatives' performance: A balance-oriented approach. Finance Contrôle Stratégie. Available at: https://doi.org/10.4000/14bcy

Wadesango, N. & Mabunda, Q. (2017). Sustainability of cooperatives: Issues and challenges. International Journal, 73(11), pp. 231–266.

Walton, J.K. (2015). Revisiting the Rochdale Pioneers. Labour History Review, 80(3), pp. 215–248. Available at: https://doi.org/10.3828/lhr.2015.10

Wonde, K.M., Tsehay, A.S. & Lemma, S.E. (2022). Training at farmers training centers and its impact on crop productivity and households' income in Ethiopia: A propensity score matching (PSM) analysis. Heliyon, 8(7), e09837. Available at: https://doi.org/10.1016/j.heliyon.2022.e09837

Zwane, H.C. & Mzanywa, M. (2025). Evaluating the prospects and challenges of cooperative organizations in rural community development in South Africa. Available at: https://doi.org/10.21303/2504-5571.2025.003805

Corporate governance perspective on the dilemmas of corporate fraud detection and the emergence of forensic accounting

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Abstract

The expansion in the quantity of instances of economic extortion because of disappointment of statutory review to recognize and counteract deceitful exercises has given ascent for the administrations of forensic accountants. This paper features how forensic accounting can be utilized to determine this test. The investigation was a hypothetical research which considered the jobs of forensic accountants in battling fake exercises especially in both public and public organizations, contrasts between forensic accountants also, traditional accountants, and highlights of a forensic accounting and the effect of forensic accountants to distinguish and avoid misrepresentation. From the exploration, it was discovered among others that their administrations will help review boards and individuals in completing their oversight capacities by giving them affirmation on internal review reports. Some of the proposals proffered is for government to improve the expense of procuring the administrations of forensic accountants and to treat guilty parties similarly with no preference.

Background of the study

In recent times, Government spending has become so huge and a big venture to many who are in charge in disbursing the money. As a result of this trend, it has also become expedient that, the public through laws and Legislative Instruments, (LI's) now demand to have an idea how the tax payers' monies are being disbursed. In view of this, government has now introduced "Forensic Accounting" where most perceived frauds in public organizations are dealt with. According to [1], Forensic Accounting is a unique zone of the accounting profession that gives vivid accounts on engagement which emerged from factual or anticipated disagreements. The word "forensic" could mean a lot but for purpose of accounting, it is referred to as "appropriate usage in a court of jurisdiction", and it is in that spirit and breath that forensic accountants needs to work [2]. Forensic accounting has emerged in recent times due to the impact and cause of fraud as well as unintentional professional errors by certain employees and directors. With respect to forensic accounting in Ghana, it is quite new but most companies as well as the public service organizations have adopted the use of it because it serves as a check on fraud. Due to that, the demand for forensic accountants has been on the increase as most companies and public organizations are moving towards the area in other to put check on managers and directors who knowingly or unknowingly get them involved with financial malpractices[3]. [4] also defines forensic accounting to be solicitation of financial assistances and fact-finding mindset to disconcerted matters, shown within the milieu of the rubrics of proof. The evolvement of Forensic Accounting is as a result of certain perceived emanating frauds associated cases. In Ghana for instance, the government has put up a unit, backed by the law and legislative instruments called Economic and Organized Crime Office (EOCO) who as part of their mandate are to conduct forensic audit where fraud is perceived in any of the public organizations[5]. Forensic accounting is now used as a tool to reduce or investigate a perceived area of fraud to uncover all the financial frauds or malpractices which are taking place in organizations. The massive increase of

financial fraud each passing day has necessitated forensic accounting as a tool, necessary in every organization especially in the public organizations where directors mostly inflate figures of projects [4]

Methods

We played out a complete efficient checking survey of distributed information to distinguish what portions of forensic accounting can help in fraud detections and its popularity and usage by states agencies and the government as a whole.

Search Strategy

An electronic pursuit was led in four scholarly databases: Science Direct, Web of Science, Springer and Emerald. Google Scholar, Sage (open access) article references, important surveys and book parts were additionally scanned for extra significant distributions to recognize unique research studies investigating forensic accounting usage in fraud detention among government agencies as well the public and private organizations.

The timespan 2002-2019 was picked to incorporate important examinations looking at the current circumstances where Directors within the public sectors and the private sectors especially in financial institutions misappropriate funds of the organizations and how forensic accounting through the EOCO is used in detecting such frauds and misappropriations as proposed by [6]. The expression "Forensic Accountant" spells out the legal backing and the strength that helps in arriving at a better conclusion in detecting the fraud. A forensic accountant pulls it strength from a competent jurisdiction where they have been given the legal right to demand any documents that they think it can help arriving at a better conclusion. The full database search systems, including dates of ventures and complete quantities of recognized examinations per database, are given in reference section.

Eligibility Criteria

Researches and studies that met the accompanying criteria were incorporated into the orderly survey: (1) distributed before the date of the last search (September 18, 2019); (2) Public and Private Financial Institutions (those licensed financial institutions); (3) Works that were considered to be perceived fraud detections[7]. Researches that were excluded in this review: (1) reads on assistance looking for variables/issues not legitimately identified with individual convictions on forensic accounting and fraud detection usage; (2) non-peer-checked on work; (3) articles that revealed the point of view of others; and (4) ponders with no evaluable information on forensic accounting and fraud detection.

Study Selection

The database search yielded 1500 papers and publications, after copies were expelled. Further, 18 extra investigations were distinguished through manual hunt in important reference records, for example, Google researcher, open access and so on. The investigation determination was completed in two phases. To start with, after the full database search was finished, the principal (DS) and second creator (TL) freely screened the equivalent 210 edited compositions, and created and adjusted an institutionalized qualification appraisal dependent on the basically characterized attributes (see qualification criteria). Second, the rest of the modified works were then separated into two gatherings and screened freely by every analyst. Any contradiction with respect to incorporation criteria was settled by talk among the two specialists. Third, from the staying 265 records, full content articles were evaluated freely (DS, TL) for the last choice of qualified examinations; again difference/disparities were settled by agreement. In general, 210 records didn't meet the consideration criteria and were rejected from further investigation, leaving 60 examinations qualified for incorporation.

Data Extraction and Analysis

Two specialists (DB and LT) freely extricated the information from studies utilizing an institutionalized information extraction structure. The accompanying information were extricated: creator and year of publication, study populace, area of the examination, essential investigation point, kind of study (either quantitative or subjective) and the methodology of study. Included investigations were

assessed by two creators autonomously to distinguish parts of forensic accounting and fraud detection [8]. In the main stage, one creator (LT) built up a system of ideas and topics, in view of study information and appropriate talk focuses. In the second and last stage, the two creators (BZ) and (LT) autonomously checked on the examinations, built up this system and further assessed the ideas and subjects to guarantee the face legitimacy.

All subjective and quantitative examinations fraud detection was incorporated into the investigation. The subjective investigations were dissected utilizing topical examination (Braun and Clarke, 2006), an as of late utilized strategy for distinguishing and breaking down examples (subjects) in subjective information. This gathering procedure was continually administered by the two specialists and any contradictions were settled by exchange. Fraud detection was refined and the working titles were acclimated to the last names of the key topics. All included quantitative examinations utilized a review technique to assemble pertinent data with respect to impact of forensic accounting and fraud detection [2]. For each examination, results were separated dependent on the accompanying inquiries. The outcomes are accounted for in a topical investigation as a result of the heterogeneity of the examinations with respect to think about populace, look into setting, examination, structure, and sort of research.

Origin and Emergence of Forensic Accounting

History of Forensic Accounting

Forensic Accounting can be depicted as the utilization of reviewing and analytical aptitudes to inspect budget summaries in arrangement to be utilized in an official courtroom. In any case, there are numerous roads and varieties of the activity that can be used that don't really organize with that depiction [9]. A Forensic Accountant can be contracted to do everything from settle separate questions to revealing misrepresentation in enormous partnerships. The intensified mindfulness and significance of getting and forestalling misrepresentation has started an enduring increment in the interest for Forensic Accountants. In any case, extortion isn't the main explanation the business has changed since its beginning.

Legal Accounting has taken numerous incredible jumps of development in late history. The accounting industry has step by step called for an ever increasing number of Forensic Accountants. It is anticipated that development of the business, in view of the measure of employments, will arrive at 6.7% for the long time somewhere in the range of 2013 and 2018 [10]. The income the business gets is additionally consistently expanding as time goes on. According to [11], in 2013 the business got $4.5 billion and is relied upon to get $6.3 billion by 2018.

Like some other activity, Forensic Accounting has advanced with time. The business has been influenced by changes in innovation, society, and the economy. As one part of the world changes so has the activity of a Forensic Accountant. Proceeding with instruction is just a single path in which Forensic Accountants figure out how to conform to new difficulties. The calling has been around since the mid 1900's and has significantly changed the manner in which extortion is found and took care of from that point forward[12]. Forensic Accounting started and became popular during the World War II, and it can be credited to Maurice E. Peloubet. Forensic accounting became a new profession in the early 1980's where most American companies became very much interested in engaging people with forensic accounting background. This emerging focus in the field of accounting comprises financial accounting, auditing and investigative skills. This automatically called for academic works in the late 1980's to find the reasons for accounting for this new development. It therefore led to the first forensic accounting academic paper which was published in 1980 [13] Forensic Accounting provides organizations with the highly important tools that help to deter fraudulent activities and a possible reduction of fraudulent acts but it does not completely eliminate fraudulent activities [14]

Forensic Accounting can be used as a gap between detection of fraud and elimination of fraudulent activities if it is used as a financial strategy for economics and financial crimes. This can be huge because it can then proceed to provide litigation support service with appropriate provision of professional services in the court of law or in a court of competent authority. In the case of most sub-Saharan African regions like Ghana, a special unit has been put in place to provide support services and the likes to all Economic and Financial Crime activities that could surface in either public or private organizations which might interest the government [14]. Forensic accounting as a financial strategy or tool to curb economic and

financial crime will also go a long way to establish good corporate governance policies in the public sectors where there are a lot of fraudulent activities by directors and CEOs of the organization, and this can restore public confidence in the administration and the entire structure [15]

According to [16] traditional auditing has limitations in the determination of fraudulent activities which forensic accounting can easily, effectively and efficiently fill in the said gap. This is because, forensic accountants have the professional ability, backed by law to break into the organization systems and structure to scrutinize books, indicate what is discovered and present the documentaries of their findings in the competent court of jurisdiction for further actions to be taken. Most countries have lost potential foreign investments in the public sectors because of perceived fraudulent activities. For this reason, detention and prevention of fraud and corruption has given an enormous increase in the use of Forensic Accountants. Fraud is better dealt with in prevention than cured, and for this purpose, the most necessary thing organizations needs to do is to prevent fraud from being committed [2]

Forensic Accounting versus Traditional Accounting

The forensic accountant applies dependable standards and strategies to adequate actualities or information and commonly needs mastery and aptitudes in private examination and bookkeeping, while then again, there is no such need in the conventional accounting space [2].

Forensic Accountants share a few objectives like conventional accountants however they have various jobs, learning and abilities.

The measures of forensic accounting develops from official and legal jurisdiction while those of conventional or traditional accounting like money related bookkeeping are set by the Securities and Exchange Commission (SEC) for enterprises whose protections, for example, regular stock are traded [17]Traditional accountants utilizes systems of inspecting to find accidental mistakes for the most part brought about by shortcomings in internal controls which happen at standard interims. Again, intentional extortions by people can just happen in couple of exchanges, thus forensic accounting techniques utilize full populaces where conceivable [18]. Due to the fact that forensic accounting investigation has to do with several information, intermittent calling of individual employees are done in order to ask them few questions which can lead to the final disclosure of the real truth as in the case of WorldCom [19]. A forensic accountant does examination on explicit charges. Subsequently, he/she has much time to examine and investigate completely explicit deceitful budgetary issues with accentuation of utilizing, for example, proof in a law court if there should be an occurrence of question [20], while the review did by a traditional accountant is general in nature. As indicated by [21], a customary review is done on general budgetary issues (that implies the evaluator considers all issues identifying with bookkeeping).

A forensic accountant is utilized or selected by associations to determine claims and identify or anticipate false exercises suspected or visualized in the association. From Ghanaian perspective, this is mostly done by the state where the state will refer the matter to the EOCO (in most cases), then EOCO will appoint an individual forensic accountant to investigate the matter. In this way, it's anything but a typical review yet review which might possibly pursue inspecting methodology. [22] states that, such review is a proactive review which goes past ordinary review strategies. An accustomed investigator or statutory reviewer is named to complete statutory review. The review is generally completed to fulfill statutory prerequisites and guarantee that records arranged are in accordance with the accounting standards. [23], express that the statutory review is a mandatory review which guarantees that fiscal reports are in accordance with the required accounting standards and practices. From the aforementioned, it tends to be concluded that a statutory reviewer may not go past the procedural review since he/she isn't constrained by law to scan for extortion but instead in completing its review work and if misrepresentation is notable he/she will disclose it.

Previous and Current Application of Forensic Accounting

In recent times, it has become more evident that, traditional auditors infrequently and solely have the responsibility of detecting fraud. In effect, fraud is rarely detected. Auditors, be it a traditional or any other auditor do not have the sole responsibility of detecting fraud as stated earlier but true and fair financial reporting and records must be practice in both private and public organizations to ensure that

the public as well as stakeholders are protected in the sense of protecting its purse [23]. Organizations must look at new ways of improving; finding solutions to financial malfeasances and the occurrences of fraudulent acts and this new way of solution could be forensic accounting. The traditional approaches to bring perpetrators to book through traditional auditing is no more yielding the needed results in reducing fraud in organizations [24].

A study done by [25] on the topic the evaluation of forensic accountants to planning management fraud risk detection procedures reveals that, forensic accountants successfully adapt the degree and fauna of audit test when the risk of management is high. Forensic accountants then will propose inimitable actions that are not anticipated by traditional auditors when the peril of management fraud is high. Again, the study indicated that, connecting forensic accountants in the risk of management scam or fraud valuation procedure aims at getting an improved outcome than merely consulting them.

It has been contended that a successful internal control framework is not security against extortion [26]. Be that as it may, [27] analyzed the job of internal review in extortion counteractive action in government owned hospitals in a Nigerian setting. Through overview research structure, the examination uncovered that employees in the hospital do not have the essential understanding of misrepresentation avoidance, in this way making the hospital to be progressively inclined to fraudulent practices and activities.

A study done by [28] reveals that, the use of forensic accounting reduces significantly the occurrence of fraud cases mostly in the public sector. In the same study conducted by [28] it also reveals that, there is a significant difference between Professional Forensic Accountants and Traditional External Auditors when it comes to skills and application of techniques and technical know-how in Fraud detection and prevention.

While the examination uncovers that employees in the audit department attempted to avert some misrepresentation frequencies in the hospital, the auditors however, accepted that if better learning is procured, the department could perform better. This suggests that, internal control does not hinder fraudsters from submitting misrepresentation. In addition, bookkeeping writing has acknowledged the way in which the viability of internal control framework can be debilitated by intrigue [29]. Along these lines, the requirement for a better understanding and vast knowledge in forensic accounting cannot be totally underscored.

Forensic accounting according to [30] encompasses the use of criminological or legal science which can be seen as the bid of the laws of nature to the laws of man. He went ahead to argue in his study that, forensic accountants as seen as assessors and transcribers of facts and evidence in legal cases goes beyond that to offer their connoisseurs view with regards to what has be found in a competent court of jurisdiction. In reference to the use of science in forensic accounting, the study explained it to be the examination and interpretation which has been carried out will be used as economic information. In a study done by [30], they asserted that, forensic accountants do calculations of values and draw conclusions to detect unbalanced designs or distrustful dealings through financial data analysis. It is mostly the responsibility of forensic accountants to identify individuals who get themselves involved in fraudulent activities, tracing money laundering activities, illegal means by individuals to evade tax (tax evasion), insurance frauds, and identification of marital assets during divorce processes.

Prospects of Using Forensic Accounting

The following are some of the responsibilities of a forensic accountant:

Directing Investigation

[8] express that the disappointment of the statutory review and the refined monetary extortion lately had prompted the requirement for forensic audits. Therefore, the forensic accountant could be said to have extraordinary devices for directing examination as to distinguish and anticipate false exercises along these lines battling budgetary misrepresentation. [31] states that a forensic accountant being an extortion agent is especially compared to a medical doctor who requires huge measure of demonstrative and logical work to find what truly is occurring. In perspective on the abovementioned, it tends to be said that a forensic accountant goes past the ordinary review as to uncover deceitful exercises by utilizing criminological programming instruments in leading and exploring exchanges and occasions.

Breaking down Financial Transactions

[31] states that a forensic accountant is required to have uncommon abilities in investigating records for genuineness, change, fabrication or falsifying. Henceforth, by having such aptitudes, the forensic accountant in completing his obligations can undoubtedly identify blunders, false exercises and exclusions in this way forestalling and diminishing deceitful exercises. As per [32]a forensic accountant is in charge of breaking down and recognizing the sorts of extortion that could happen and their manifestations.

Remaking of Incomplete Accounting Records

A forensic accountant in his capacity recreates deficient bookkeeping records to make due with model protection claims, over stock valuation, demonstrating tax evasion exercises by remaking money exchanges [4]

Misappropriation Investigation

A study done by [12]stated the various activities which are in line with the work of forensic accountant in carrying out investigation for misappropriation of funds. These includes but not limited to:

- Fraud recognition, documentation and introduction in criminal trails and claims.
- Calculate financial harms; follow pay and resources, regularly trying to discover shrouded resources or salary.
- Reconstruction of budget summaries that may have been pulverized or controlled.
- Expert observer.

From the responsibilities stated above, it clearly demonstrates that a forensic accountant must be a specialist in budgetary issues and should have legitimate learning which could empower him distinguish deceitful exercises which are to be exhibited in a claim.

The significance of forensic accountant can be unmistakably comprehended from the setting of disappointment in statutory reviews to recognize and forestall extortion as outlined by [12]

A forensic accountant can be applicable in the accompanying ways:

Help Police Force in Investigation

A forensic accountant draws in himself in criminal examination for the benefit of police power [29]where his report is set up with the goal of introducing proof in an expert and brief way.

Improve Management Accountability

[8]states that disappointment of corporate correspondence structure has made the monetary network understand that there is an incredible requirement for talented experts that can recognize, uncover and counteract shortcomings in three key regions: poor corporate administration, imperfect inner controls, and false budget report. Forensic accountants' abilities are winding up progressively depending upon inside a corporate detailing framework that accentuates its responsibility to partners. From the above articulation, a forensic accountant with his master information in wrong doing will improve corporate detailing framework structured by the board which will uncover and counteract poor administration, imperfect inside control and fake fiscal report.

Fortify Auditors Independence

Most occasions, outer reviewers are hesitant to report instances of extortion submitted by the executives to the partners notwithstanding when such cheats are self-evident. This debilitates the freedom of the examiner who is reluctant to lose his employment since most occasions they are designated by the board that plans accounts that is being examined. As [33], improving money related detailing framework with aptitude learning and ability in both monetary issues, the scientific budgetary revealing framework through utilization of proactive technique for extortion recognition have reinforced outer inspectors autonomy.

Help Audit Committee Members

Measurable bookkeepers help review board individuals in doing oversight works by giving better instruments that guarantees that quality affirmation review report have been created by the outer inspector. As per [34], a forensic accountant in completing his obligations of controlling false exercises use information driven extortion recognition instrument which is proactive not normal for the customary methodology which is receptive what's more, is been received by the outer inspector in doing statutory review capacities.

Aiding in Detecting Fraud

With the utilization of expository and mechanical abilities, a forensic accountant can without much of a stretch distinguish money related extortion executed by the board consequently avoiding corporate disappointment. [34], states that the forensic accountant realizes how to recognize and anticipate business misrepresentation utilizing an extortion systematic advanced instruments. Subsequently, one might say that a forensic accountant in recognizing and averting deceitful exercises could be believed to have helped associations in decreasing money related extortion which most occasions had prompted corporate breakdown.

Challenges of Using Forensic Accounting

[35] attempted an examination to offer recommendations utilizing genuine case issue on the most proficient method to apply legal bookkeeping in researching changes and suspected fake exercises in assembling procedures and in this manner proposes that the use of scientific bookkeeping applies to all scenes where misrepresentation is a probability.

[36]uncover the accompanying difficulties standing up to the use of forensic accounting.

i. A critical test that faces a forensic accountant is the assignment of social occasion data that is allowable in a courtroom.
ii. The acceptability of proof in consistence with the laws of proof is vital to fruitful arraignments of crook and common cases
iii. Globalization of the economy and the way that a fraudster can be based any place on the planet has prompted the issue of between locale.

[37]noticed that a significant test to the utilization of forensic accounting in Ghana is that the law is not generally in the know regarding the most recent headways in innovation. Also, forensic accounting is viewed as a costly administration that lone enormous organizations can bear. In this way, generally organizations want to settle the issue outside the court to maintain a strategic distance from the cost and the danger of terrible attention on their corporate image. In increases, legal bookkeeping is another pattern especially in creating economies. Consequently, accountants with satisfactory specialized skills on measurable issues are not really accessible.

Corporate Governance and Forensic Accounting

As indicated in the work of [36], institutions like financial organizations takes up a reasonable proportion within every economy. In sub-Saharan Africa for instance, with the outcome of the monetary emergency, the strength of the money related framework has expected a more noteworthy concentration as a key target of financial arrangement. One of the measures taken to guarantee soundness of the Ghanaian money related framework was the codes and ethics of the corporate governance principles which are strictly adhere to by the government and other regulatory institutions like the Bank of Ghana that will dig in great corporate governance principles stipulated with the Sarbanes Oxley Acts and the COSO frameworks in the Ghanaian monetary foundations[26]. Pitiable corporate governance has been recognized as one of the central point in basically all known examples of money related segment trouble. In this manner, it is consequently critical that monetary foundations watch a solid corporate governance ethos.

Budgetary outrages far and wide and the breakdown of major corporate organizations in the USA and Europe, once more, drew out the requirement for the act of good corporate governance practices, which is

a framework by which partnerships are represented and controlled with the end goal of expanding investor worth and meeting the desires for different partners [24]. Consequently, for the financial business, the maintenance of open certainty through the enthronement of good corporate administration survives from most extreme significance given the job of the business in the activation of assets, the assignment of credit to the destitute segments of the economy, the installment and repayment framework and the usage of fiscal arrangement.

In Ghana, a review, by the Securities and Exchange Commission (SEC) revealed in a distribution in a publication they made in November, 2018 that corporate governance practices was at a minimal stage, since only few financial institutions are practicing or some intentionally has refused to adhere to the corporate governance policies standards that have been set. It was referenced in the report that particularly the financial area, poor corporate governance were distinguished as one of the main considerations in for all intents and purposes every known occurrence of a financial segment trouble in the nation [28].

Because of the recent financial crisis within the Ghanaian economy, the Ghana Securities and Exchange discharged a Code of Best Practices on Corporate Governance for open cited organizations; banks had been relied upon to consent to its arrangements. This was notwithstanding a Code of Corporate Governance for Banks and Other Financial Institutions endorsed before around the same time by the Committee. Be that as it may, the board of these banks has been delayed in actualizing and settling in great corporate administration rehearses in their banks. Business organizations officially must possess a strict management and governance systems which must be adhered to averts or ascertain the occurrence of positive delinquencies or fraudulent activities [35]. To be able to ensure good corporate governance especially in sub-Saharan Africa where there are perceived corruptions and fraudulent activities, it is imperative to raise and generate consciousness with everybody's involvement about the prominence of corporate governance for progression and expansions purposes [14]. It is worthy to note that, within the context of corporate governance principles. The accomplishments of the accounting vocation show a key role and it is preserved as an essential fragment of management, with precise privileges and responsibilities[24].One of the key responsibilities of the accounting profession is to make available all the necessary accounting information to protect the rights and equity between the local shareholders and the foreign shareholders.

Conclusions and Recommendations

The job of a forensic accountant under contemporary conditions no uncertainty is significant in light of the fact that they help legal advisors, courts, the police, administrative bodies and different establishments in exploring and recording fakes. The expanding event of extortion in current business condition requires the administration of forensic accountants to uncover fake exercises inside and outside an association[32]. Likewise, proceeded with review disappointments in the course of the last five decades have provoked a change in outlook in accounting records. It is commonly acknowledged that an evaluator has the obligation to perform tests to distinguish material defalcation and blunders in the event that they exist. Nonetheless, extortion location specialists called forensic accountants are currently being employed in created economies to research instances of extortion[38].

In this manner, it is suggested that expert bodies in Ghana like the Institute of Chartered Accountants (Gh), Association of National Accountants, and the Association of Audit Firms ought to energize the formalization and specialization in the field of forensic accounting. Moreover, government ought to grow more enthusiasm for scientific representing observing and exploring suspected guilty parties in extortion cases as confirmed in the models prior referred to. Additionally, our laws ought to be in the know regarding most recent progression in innovation to guarantee tolerability of proof in a law court for effective arraignment of lawbreaker and community cases[15]. Government should have a powerful arrangement with other nations in removing flee fraudsters from anyplace around the world. Finally, it is additionally prescribed that administration ought to enhance the costs associated with connecting with the administrations of a forensic accountant. It is hopeful that if these proposals are adhered to and offenders are properly dealt with, without bias; the occurrence of misrepresentation will decrease

significantly in the Ghanaian society especially in the government sectors. This should have an overall effect on Ghana's economic rating in the world.

References

J. A. De França, C. C. Pereira, and E. T. Vieira, "ACCOUNTANTS TOWARDS THE ACCOUNTING OF KNOWLEDGE: An analysis of the results of the first technical qualification exam for the creation of the Brazilian National Register of Forensic Accountants," International Journal of Innovation Education and Research, vol. 6, pp. 190-226, 2018.

E. Okoye and E. N. Ndah, "Forensic Accounting And Fraud Prevention in Manufacturing Companies in Nigeria," 2019.

I. F. Awolowo, N. Garrow, M. C. Clark, and D. Chan, "Accounting scandals: Beyond corporate governance," in 9th Conference on Financial Markets and Corporate Governance (FMCG), 2018.

P. Eisenberg, "Application of the net worth method in forensic accounting investigations," International Research Journal of Multidisciplinary Studies, vol. 4, pp. 1-23, 2018.

Y. Taminiau, S. Heusinkveld, and L. Cramer, "Colonization contests: How both accounting and law firms gain legitimacy in the market for forensic accounting," Journal of Professions and Organization, vol. 6, pp. 49-71, 2019.

D. Z. DIANATI, A. SOLTANI, and H. OMRANI, "CURRICULUM DEVELOPMENT: A MASTER'S DEGREE PROGRAM IN ANTI-FRAUD AND FORENSIC ACCOUNTING," 2018.

B. K. P. Kramer, M. Seda, and G. Bobashev, "Divergent Views among Practitioners and Educators on Forensic Accounting Education," Management Accounting Quarterly, vol. 19, pp. 3-3, 2018.

C. G. Jones and K. Dosanjh-Zucker, "Using a Forensic Accounting Novel to Increase Student Engagement with Accounting Ethics and the Profession," Journal of Forensic & Investigative Accounting, vol. 10, 2018.

I. S. Neamah and F. N. Abdullah, "Enhancement the Controlling Role to the Board of Directors under Forensic Accounting," Tikrit Journal For Administration & Economics Sciences, vol. 15, pp. 1-15, 2019.

M. A. Crain, W. S. Hopwood, R. S. Gendler, G. R. Young, and C. Pacini, Essentials of forensic accounting: John Wiley & Sons, 2019.

V. Botes and A. Saadeh, "Exploring evidence to develop a nomenclature for forensic accounting," Pacific Accounting Review, vol. 30, pp. 135-154, 2018.

M. Garbowski, S. Drobyazko, V. Matveeva, O. Kyiashko, and V. Dmytrovska, "Financial accounting of ebusiness enterprises," Academy of Accounting and Financial Studies Journal, vol. 23, 2019.

I.-L. Lin, K.-H. Shih, and S.-L. Lin, "Following the Money-Constructing the Prototype of Digital Evidence Forensic Accounting Standard Operation Procedure for Government Audits," Journal of Accounting, Finance & Management Strategy, vol. 13, 2018.

A. M. Ismail, F. A. Azizan, and F. Fahmi, "Forensic Accountant Skills: An Empirical Investigation in the Malaysian Forensic Accounting Education Curriculum," The Journal of Social Sciences Research, pp. 150-158: 1, 2019.

L. Heitger and O. L. Greer, "FORENSIC ACCOUNTANTS TO THE RESCUE: A good forensic accountant with experience in cost/managerial accounting has the ability to save your organization's reputation and finances," Strategic Finance, vol. 99, pp. 48-54, 2018.

M.-J. Kranacher and R. Riley, Forensic accounting and fraud examination: John Wiley & Sons, 2019.

M. Chakraborty, "Forensic Accounting in India–A Look into Recent Developments," International Journal of Innovative Knowledge Concepts, vol. 7, pp. 218-224, 2019.

C. O. Olaoye, A. A. Ogundipe, and R. A. Dada, "Formal Education and Forensic Accounting Development in Nigeria," Acta Universitatis Danubius. Œconomica, vol. 15, 2018.

F. J. M. Arboleda, J. A. Guzman-Luna, and I.-D. Torres, "Fraud detection-oriented operators in a data warehouse based on forensic accounting techniques," Computer Fraud & Security, vol. 2018, pp. 13-19, 2018.

B. B. Anifowose, "Impact of Forensic Accounting Practice on Corporate Crime Mitigation in Manufacturing Companies in Nigeria," Kwara State University (Nigeria), 2018.

A. Rehman and F. Hashim, "Impact of Mature Corporate Governance on Detective Role of Forensic Accounting: Case of Public Listed Companies in Oman," KnE Social Sciences, pp. 637–665-637–665, 2019.

M. Hitchcock, "The Importance and Implications of Forensic Accounting in the Financial World," 2018.

K. Miles, "Introductory Guide to Forensic Accounting: A Synthesis of Scholarly Research and One Student's Experience," 2018.

Y. Y. Jusoh, R. N. H. Nor, N. C. Pa, J. H. Yahaya, H. Bakri, N. Maryann, et al., "Knowledge Management in Forensic Accounting: The Future Trends," Advanced Science Letters, vol. 24, pp. 5212-5215, 2018.

Z. Rezaee and J. Wang, "Relevance of big data to forensic accounting practice and education," Managerial Auditing Journal, vol. 34, pp. 268-288, 2019.

A. M. Hadi, A. R. Abed, and H. O. Kadim, "The Role of Forensic Accounting and Its Relationship with Taxation System in Iraq," Academy of Accounting and Financial Studies Journal, vol. 22, pp. 1-10, 2018.

M. E. Al-Sharairi, "The Role of Forensic Accounting in Limiting Tax Evasion in the Jordanian Public Industrial Shareholding Companies through the Perspective of Jordanian Auditors," International Journal of Economics and Finance, vol. 10, pp. 233-243, 2018.

M. Gaither, "The role of forensic accounting in US counterterrorism efforts," 2018.

A. Ozcan, "The Use of Beneish Model in Forensic Accounting: Evidence from Turkey," Journal of Applied Economics & Business Research, vol. 8, 2018.

C. M. Ile and C. G. Odimmega, "Use of forensic accounting techniques in the detection of fraud in tertiary institutions in Anambra State, Nigeria," African Research Review, vol. 12, pp. 66-76, 2018.

N. Tschakert, Z. Blaber, and L. Chen, "Using Engagement Triggers in Forensic Accounting and Fraud Investigation Classes," Available at SSRN 3353115, 2019.

M. K. Shah, "WILL IMPLEMENTATION OF FORENSIC ACCOUNTING IDENTIFY THE SENSE OF FINANCIAL FRAUD?," Journal of Commerce & Accounting Research, vol. 7, 2018.

C. A. Zhang, J. Dai, and M. A. Vasarhelyi, "The Impact of DisruptiveTechnologies on Accounting and Auditing Education: How Should the Profession Adapt?," The CPA Journal, vol. 88, pp. 20-26, 2018.

J. Birt, K. Chalmers, S. Maloney, A. Brooks, J. Oliver, and D. Bond, Accounting: Business reporting for decision making: John Wiley & Sons, 2019.

N. Suleiman and A. Ahmi, "Mitigating Corruption Using Forensic Accounting Investigation Techniques," Indian-Pacific Journal of Accounting and Finance, vol. 2, pp. 4-25, 2018.

S. Aghili, Fraud Auditing Using CAATT: A Manual for Auditors and Forensic Accountants to Detect Organizational Fraud: Auerbach Publications, 2019.

O. M. Khersiat, "The Role of the Forensic Accountant in the Detection of Tax Fraud in Financial Statements: A Survey Study in the Jordanian Accounting and Auditing Offices and Firms," International Journal of Economics and Finance, vol. 10, pp. 145-153, 2018.

R. Nandy, "Will forensic accounting improve the quality of financial statements, enhance corporate governance and ensure organizational cost effectiveness?," 2018.

Analysis of the effect of mergers and acquisition on the financial performance of banks in Ghana

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Mergers and Acquisitions; Financial Performance; Commercial Banks; Asset Quality; Capital Base; Liquidity Level; Ghana.

Abstract

In Ghana, most commercial banks have gone into receivership because of their inability to meet the Bank of Ghana's new minimum capital requirement of 400 million Cedis. This has resulted in dwindling of returns on assets, profits, reduced investments and hence instability in the financial sector. To overcome these challenges and improve their financial performance, some commercial banks in Ghana have opted for mergers. The problem nonetheless is that, recent studies to establish the effect of mergers on financial performance of banks has revealed mixed results. While some researchers found a positive and significant effect of mergers on financial performance of banks, others have found no meaningful effect of mergers on financial performance. These inconsistent results make it difficult for players in the banking sector to say with conviction as to whether merging two banks is a viable venture or not.

The effect of mergers on financial performance was measured using liquidity, asset quality and capital base. Multiple regression, descriptive and correlation analysis were performed on the secondary data obtained.

The findings of the study led the researcher to conclude that the three predictor variables which are asset quality, liquidity level and capital base contributed significantly to financial performance at the selected Bank in Ghana.

In spite of the above achievement, the study still found a gap that the three predictor variables could not meet. This means that for the Banks to fully benefit from its merger in terms of financial performance, it must complement asset quality, capital base and liquidity level with other factors and measures.

Introduction and background of study

Mergers and acquisition have gained a growing societal significance in recent years as a strategy to increase the profit of companies or generally improve their operations (Kumar & Bansal, 2018).

A merger usually occurs when two or more companies combine their forces to operate as one company (Kovacich & Halibozek, 2018). It is a deliberate combination of two or several firms coming together to form one larger firm. It encompasses cash payments or stock swaps to the target firms. This makes it possible for shareholders of the target firms to share in the risks involved in the transaction (Hitt, 2017). The trend is extensively becoming the preferred choice for many firms including banks globally due to its numerous benefits (Fofack, 2018). According to Baldwin (2018), merged companies are able to gain a higher bargaining power because of their sizes and leverage on those powers to force suppliers to sell to them at a price that they are willing to pay, which is often cheaper. Quality goods and services acquired at a cheaper price and sold to customers at a high price implies that the merged firms are able to generate more profits on their investments. This often makes them more successful in their market (Franke, 2017).

This study seeks to examine the effect of mergers and acquisition on the financial performance of some of the Banks that has gone through mergers or acquisition. Financial performance is a measure of how well a company utilizes its assets to generate income or revenue (Pandey, 2018). It can also be regarded as a measure of the overall financial health position of a company over a stipulated period of time (Akguc, 2018). According to Kihanda (2017), financial performance is used to compare the performance of companies operating across the same sector or industry in aggregation. Examining the performance of a company is critical as it helps managers and investors to establish whether the business is viable or not.

A major performance measure applied in contemporary financial management is the financial ratio examination and it differs based on the explicit interest of the parties involved. According to McLaughlin (2018), trade creditors are concerned basically with the liquidity of the company. Their claims are short term, and the aptitude of the company to settle these claims is best shown by means of an orderly analysis of the company's liquidity. The claims of bond holders is long-term in nature. As a result, they are more concerned in the cash flow ability of the company in order to ensure that it can pay their debts in due course. Investors in a firm's common stock are interested largely in the current and anticipated future earnings and the steadiness of these earnings.

Financial performance can be measured using financial indicators and non-financial indicators. Common examples of financial indicators are Return on Equity, Return on Assets, Return on Capital employed, etc. Non-financial performance indicators include efficiency, customer satisfaction, and market share among others.

In this research, financial performance will be measured using financial indicators such as ROE and ROA. Mergers and acquisition will be examined using asset quality, liquidity and capital base respectively as used by Kovacich & Halibozek (2018). The study will predominantly use financial data drawn from audited financial statement of selected Banks in Ghana covering a period of five years, 2014 to 2019. This will enable the researcher to establish whether the merger of OMNI bank and Sahel Sahara Bank has led to a greater benefit in terms of profits or not.

In Ghana, most commercial banks have gone into receivership because of their inability to meet the Bank of Ghana's new minimum capital requirement of 400 million Cedis. This has resulted in dwindling of returns on assets, profits, reduced investments and hence instability in the financial sector (Adjei, 2018).

To overcome these challenges and improve their financial performance, some commercial banks in Ghana have opted for mergers and acquisitions. The problem nonetheless is that, recent studies to establish the effect of mergers and acquisition on financial performance of banks has revealed mixed results. While researchers such as Kihanda (2017), Mwangi (2017), Kovacich & Halibozek (2018) found a positive and significant effect of merger on financial performance of banks, others like Saple (2017), Wachira (2018) and Chesang (2018) have found no meaningful effect of mergers on financial performance.

In order to clear this doubt and determine the effect of mergers on financial performance, the researcher seeks to examine mergers from the perspective of Ghanaian Banks. The researcher considers this as a knowledge gap that must be bridged, hence this research.

Empirical Review

Effect of Asset Quality on Financial Performance

In Nairobi, Kenya, Nzoka (2015) undertook a study for the motive of determining the effect of asset quality on the financial performance of commercial banks in Kenya between the years 2010 and 2014. The researcher applied a descriptive research design to the study and this was targeted at all 43commercial banks in Kenya at the time. Secondary data was taken from annual Central Bank of Kenya banks supervision reports. Statistical as well as narrative methods were employed in analyzing the data. The findings of the study revealed that, statistically, asset quality had a fairly significant impact on financial performance. This is because asset quality alone cannot be used to determine the financial performance of commercial banks.

A study was also undertaken by Adeolu (2014) on the effect of asset quality on bank performance for commercial banks in Nigeria. Again, secondary data was obtained from the annual reports and accounts of the six largest banks listed on the Nigeria Stock Exchange. After using the Pearson correlation and

regression tool of the SPSS for data analysis, Adeolu concluded that asset quality and bank performance had a statistically strong and positive relationship and influence.

Another study undertaken by Eyup et al (2017) to ascertain whether non-performing loans affected banks' profitability in Turkey. The study analyzed secondary data obtained from financial statements prepared in line with IFRS of 55 banks in Turkey using a panel regression method for the period 1st quarter of 2005 to 3rd quarter of 2016. From the findings, Eyup et al (2017) concluded that there existed a significant negative relationship between a non-performing loan (NPLs) and a bank's profitability which is usually measured by return of assets (ROA) and return on equity (ROE). This simply means that the higher the NPLs (lower asset quality) the lower the ROA and ROE. and vice versa.

To sum this up, asset quality is definitely an important variable in assessing a bank's financial performance. However, it is not sufficient. This is because a bank may record lower asset quality ratios and yet be doing well in terms of liquidity, solvency, capital base and others and thus will be seen as performing quite well financially. High NPL ratios is a struggle that most commercial banks get to deal with from time to time and therefore stringent measures must be put in place to beat down these ratios since they could affect a firm's financial performance in the long run.

Relationship between Capital base and Financial Performance

In 2017, Nyawira et al (2017) undertook a study to evaluate the relationship that exists between capital requirement set by the Central Bank of Kenya and the financial performance for the Kenyan banking sector. A descriptive research design was employed and a total of forty-three commercial banks operating in Kenya as the target population. The study used secondary data which was collected from bank supervision and banking sector reports and the data was analyzed using descriptive statistics, correlation and regression analysis. The findings of this study revealed that there was a positive linear relationship with financial performance. It was also found that the results were significant for ROA and ROE but insignificant for NIM. In sum, the study concluded that when capital requirement increases financial performance also increases.

Aymen (2013) also undertook a study to ascertain the impact of capital on the financial performance of banks in Tunisia using 19 banks from 2000 to 2009. Using a static panel to analyze secondary data from their annual reports, the researcher represented capital with the ratio equity to total assets while financial performance was measured using ROA, ROE and Net Interest Margin (NIM). From the findings, the researcher established that the relationship between capital and financial performance was positive. However, it was only the relationship between capital and ROA that was statistically significant.

Capital, indeed, is the bedrock of any business entity and banks must not downplay its significance in the success of the firm. We can therefore conclude, especially with the studies referenced above, that when capital increases, financial performance also increases to a large extent and experts say these and many others informed the Bank of Ghana's decision to increase the minimum capital requirements for all banks in 2017.

Effect of liquidity level on Financial Performance of Banks

Charmler et al (2018) conducted research to assess the impact of liquidity on performance of commercial banks in Ghana. The study was aimed at examining the level, the trend and impact of bank liquidity on profitability of commercial banks in Ghana. A sample of 21 banks were used for a 10-year period (2007 to 2016) and data was arranged in the form of a panel. Descriptive statistics, regression and correlation analysis were used in analyzing the data. The results showed a positive association between bank liquidity and profitability which means that bank liquidity is very important as it affects banks' profitability. The researchers, however, noted that though liquidity improves profitability, increase in liquidity in some situations could be counterproductive and could reduce profitability.

For the financial sector and particularly the banking industry, liquidity is such a big deal since liquidity crisis in one bank could lead to a run on other banks within the jurisdiction. Though liquidity may not be a sufficient variable to measure financial performance, it is an important variable that banks must never downplay.

General Studies on Effect of Mergers on Financial Performance

With respect to the area of mergers and acquisitions, there are quite a number of studies that have been conducted. One of them is the study by Moeller (2016) in Nairobi, Kenya which was undertaken for the motive of determining the impact of merger restructuring on the performances of four chosen banks. The researcher applied a casual research design to the study. A total of 75 respondents provided the data via questionnaires. Statistical as well as narrative methods were employed in analyzing the data. In the findings, it was observed that, merger restructuring did not bring about any improved financial performance regarding the four chosen banks that partook in the merger and acquisition. Solvency percentages in addition to capital adequacy were discovered to have made enormous contributions to the merged banks' financial performance.

In a similar investigation conducted in Dashen, Addis Ababa, Shanmugam (2018) evaluated the implications of mergers on banks. A quantitative research and descriptive study were adhered to during the study. The study's participants included 54 accounting and finance. During the examination, primary data was utilized. The data collected was taken through descriptive and inferential analysis. The study employed the SPSS in carrying out the analysis. The investigation's revelation was that, merging as an individual activity does not lead to the achievement of competitive, efficient and strong banking systems. Nevertheless, measures like enhancing the expertise and competence of the banking personnel and introducing effective corporate governance to additionally fortify competitiveness and resilience of banking firms can be used to complement it.

The effect of mergers and acquisition on Indonesian banks was also evaluated by Viverita (2017) in a study by making comparisons among financial performances 7 years before and after mergers. Qualitative and quantitative approaches as well as descriptive research were abided by. Data collected for the study was taken through inferential analyses. It was observed after the research that, mergers actually lead to an increase in the ability of banks to generate profit. The observation manifested in performance indicators like return on asset, ROE, net interest margin, capital adequacy ratio and non-performing loans. It was also contrarily observed that, merged banks were unable to enhance their capability of carrying out the task of serving as an intermediary institution, which was evident in the decline of loans to deposits made by their customers which may be as a result of a decline in activities within the real sectors.

After 13 firms were sampled from the firms listed on the Bombay Stock Exchange which undertook mergers or acquisitions, data was gathered from them covering a period between 2002 and 2005. Based on analysis of the data collected, Selvam (2019), the researcher, drew a conclusion that, the liquidity performance of the companies that underwent the procedure of merger and acquisition witnessed improvements in the periods after the mergers and acquisitions.

Conceptual Framework

According to (Wachira, 2018), a conceptual framework is used by a researcher seeking to conceptualize the relationship between research variables diagrammatically or graphically. It permits the quantitative conceptualization; operationalization, data collection and measurement of the variables identified (McLaughlin, 2010). The conceptual framework shown in Figure 3.1 was used as a guide during this study. The conceptual framework of the study consists of independent variables; asset quality, liquidity level and capital base strategies while the dependent variable was financial performance.

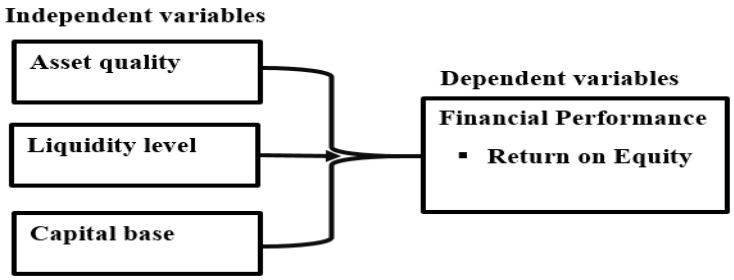


Figure 3.1: Conceptual Framework
Source: Adopted from Kovacich & Halibozek (2017).

Material And Tools

The approach of this research was mainly quantitative.

Since the researcher seeks to establish the cause-and-effect association between mergers and acquisition and financial performance, we adopted the explanatory research design in this study.

In connection to this research, the study has concentrated on few of the selected Banks that has gone through mergers and acquisition as a case study.

Secondary data published in the annual report and audited income statements of these selected Banks in Ghana, spanning a five-year period (2014-2019) was retrieved and used for the data analysis. Such data has included a comprehensive income statement of cash flows for five years after the merger, current assets and capital, current liabilities, revenue and long-term liabilities before and after the merger.

To determine the effect of mergers on financial performance, profitability ratio namely Return on Equity (ROE) is used. The focus of such analysis was on the merged banks.

A regression analysis was conducted to determine the association between the dependent and independent indicators. The dependent indicator was financial performance and was represented in the model by ROE. The independent variables were the mergers and acquisition indicators namely capital base, asset quality and liquidity.

The regression model that was used is as shown below:

$FP=\alpha+\beta_1 AQ+\beta_2 LL+\beta_3 CB+\varepsilon$

Where;

FP represent financial performance, α is the coefficient of intercept (constant term), AQ is asset quality, CB stands for capital base while L represents liquidity. β_1, β_2, and β_3 respectively are the regression coefficients for the three mergers and acquisition indicators. ε epitomizes the error term.

Results And Discussions

Descriptive Analysis

Descriptive statistics was employed to present the findings on the post-merger and acquisition ratios. These comprises capital base which was measured using equity to total assets ratio and equity to net loans ratio. Asset quality was measured using loan loss to net interest revenue, loan loss reserve to non-performing loans and non-performing loans to equity respectively. Also, Liquidity level was calculated using net loans to total assets, net loans to deposits and liquid assets to deposit in that order. The results are given in Table 4.1 below.

Table 5.1 Descriptive statistics of the Financial Ratios Variables pre- and post-merger and acquisition.

	Mean		Std. Dev		Independent t-test	
	Pre	Post	Pre	Post	t-value	Sig
Capital Base						
Equity to total assets ratio	7.12	9.31	6.20	8.32	3.075	0.000
Equity to net loans ratio	37.31	43.01	16.10	20.32	2.013	0.000
Asset Quality						
Loan loss to net interest revenue	9.21	14.17	12.36	16.83	1.347	0.142

Loan loss reserve to non-performing loans	81.24	88.58	31.67	47.75	1.231	0.126
Non-performing loans to equity	53.05	39.16	17.43	21.25	-2.74	0.002
Liquidity Level						
Net loans to total assets	21.74	29.32	10.00	13.23	1.120	0.151
Net loans to deposits	41.10	46.15	2.31	1.67	1.131	0.172
Liquid assets to deposit	77.31	72.21	19.26	20.18	-2.133	0.012

*p=0.5

The findings in table 5.1 show that most of the individual measures of the financial ratios increased after the merger. In relation to capital base, the average mean of equity to total assets ratio significantly (p= 0.00) increased from 7.12 to 9.31 whereas equity to net loans ratio average mean also significantly (p= 0.00) increased from 37.31 to 43.01.

Also, under asset quality, loan loss to net interest revenue and loan loss reserve to non-performing loans had no significant decline after the merger however non-performing loans to equity ratio significant decline (p=0.002) in their average mean. Consequently, net loans to total assets and net loans to deposit did not have any significant difference in their mean average however liquid assets to deposit average mean significantly (p= 0.012) increased from 77.31 to 72.21.

Correlation Analysis

A correlation analysis was performed to determine the relationship between capital base, liquidity level, asset quality and financial performance.

Table 5.2 Inter- correlation among the independent variables and dependent variable

	1	2	3	4
1. Capital Base				
2. Liquidity Level	.317**			
3. Asset Quality	.310**	.350**		
4. Financial Performance	.281*	.267*	.400**	

**. Correlation is significant at 0.01 level. *. Correlation is significant at 0.05 level

The table above shows that financial performance had a significant positive relationship with asset quality (r = .400, p<.01). Among the financial ratio variables tested asset quality reported a higher correlation coefficient with financial performance. The high significant correlation coefficient indicates there is a strong relationship between asset quality and financial performance. This shows that asset quality influences financial performance significantly therefore an increase in asset quality leads to an increase in the chances that the financial performance of will significantly increase.

Liquidity level accounted for a significant low positive correlation with financial performance (r= .267, p<.05) among the variables. This indicates that liquidity level influences financial performance significantly therefore an increase in liquidity level will lead to an increase in the financial performance of the bank.

Capital Base (r=. 0.281, p<.05) also significantly had a positive correlation with financial performance. This shows that an increase in financial performance increases with Capital Base.

Regression of Financial Ratios

In order to establish whether the independent financial ratios variables (asset quality, capital base and liquidity level) have any significant effect or relationship with financial performance of selected Banks after the merger a multiple regression statistical analysis was performed. The regression model that was used is as shown below.

$FP=\alpha+\beta_1 AQ+\beta_2 LL+\beta_3 CB+\varepsilon$

Where;

FP represent financial performance, α is the coefficient of intercept (constant term), AQ is asset quality, CB stands for capital base while L represents liquidity. β_1, β_2, and β_3 respectively are the regression coefficients for the three mergers and acquisition indicators. ε epitomizes the error term.

The tables below show the findings of the analysis.

Table 5.3: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.738	.783	.614	.61359

a. Predictors: (Constant), capital base, asset quality, liquidity level
b. Dependent Variable: financial performance

Table 5.3 show the regression model summary. The model reveals that the three financial ratios variables, asset quality, capital base, liquidity level predicts 78.3% of the financial performance the banks after the merger. This indicates that 78.3% of the variance in financial performance are accounted for by these variables. The findings further indicates that other factors were responsible for the financial performance (21.7%) of the bank.

Table 5.4: Summary table of ANOVA Results

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	87.187	3	20.94	37.53	.002*
	Residual	24.549	34	569.85		
	Total	111.736	37			

The regression ANOVA statistical test in Table 4.3 was used to determine the fitness of the regression model used. From the analysis regression sum of squares recorded a score of 87.187 and a residual mark of 24.549. The Table also produced a regression and residual mean squares of 20.94 and 569.85 respectively. An F-ratio and its associated p-value of .002 was also observed from the ANOVA statistical test. The findings indicates that the model is fit for the study judging from the .002 p-value recorded which is statistically significant.

Table 5.5: Summary table of the multiple regression analysis.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.771	1.525		3.405	.000
	Asset quality	.261	.012	.612	9.375	.000
	Liquidity level	.183	.066	.214	4.128	.001
	Capital base	.458	.065	.439	7.643	.000

Dependent variable: financial performance

The coefficient results from the above Table, demonstrate that by adding the coefficients the model used which was $FP=\alpha+\beta_1AQ+\beta_2LL+\beta_3CB+\varepsilon$, now produce values of FP=5.771+.261*AQ+ .183*LL+.458*CB.

The results from the coefficient Table proved that the research found a positive relationship between asset quality, liquidity level, capital base and financial performance. The predictor or independent variables also had a significant effect on financial performance as shown by the individual p-values they recorded.

From the findings, asset quality registered a coefficient score of .261, a t-statistics of 9.375 and a probability value of .000. This is a suggestion that financial performance of those selected Banks increased at the time of this research by 26.1% when asset quality gone up by 1%. The effect of asset quality on financial performance is statistically significant at 5%. This corroborates the findings of Yin (2018), who found a positive and significant association between asset quality of three selected banks and financial performance in Nairobi.

Liquidity level also registered a coefficient of .183, a t-statistics of 4.128 and a p-value of .000, implying liquidity level has resulted in an 18.3% growth in the financial performance of selected Banks after the merger. This coincide with the findings of Greuning and Bratanovic (2017) who established that sustaining a comparative degree of liquidity in the entire banking system is of utmost significance, as the recording of a liquidity disaster at a bank can lead to a severe consequence over the entire banking system.

Capital base had a coefficient score of .458, a t-statistics of 7.643 and a probability value of .000. This result indicates that financial performance has increased by 45.8% when capital base improved by 1%. The effect of capital base on financial performance was also observed to be significant statistically as per the .000 significance score registered.

Looking at the findings above, the study concludes that the three predictor variables measured in this research which are asset quality, liquidity level and capital base are major determinants of financial performance.

Summary And Conclusions

Summary of major findings

The main aim of this research was to examine the effect of mergers on the financial performance of selected Banks in Ghana. Three main financial ratios variables were identified in literature and used for the study. They were asset quality, capital base and liquidity level. In order to establish whether the independent financial ratios variables (asset quality, capital base and liquidity level) have any significant effect/relationship with financial performance a multiple regression statistical analysis was performed. The study also conducted a descriptive statistic and a correlation analysis on the obtained data.

The findings from the descriptive analysis show that most of the individual measures of the financial ratios increased after the merger. In relation to capital base, the average mean of equity to total assets ratio significantly increased from 7.12 to 9.31 whereas equity to net loans ratio average mean also significantly increased from 37.31 to 43.01.

Also, under asset quality, loan loss to net interest revenue and loan loss reserve to non-performing loans had no significant decline after the merger however non-performing loans to equity ratio significant decline in their average mean. Consequently, net loans to total assets and net loans to deposit did not have any significant difference in their mean average however liquid assets to deposit average mean significantly increased from 77.31 to 72.21.

The findings obtained from the model summary revealed that the financial ratio variables which are asset quality, capital base and liquidity level predicted 78.3% of the financial performance of the Banks after the merger.

The results from the coefficient test showed that a positive relationship exists between asset quality, liquidity level, capital base and financial performance. These variables also had a significant effect on financial performance as shown by the individual p-values they recorded. Considering the findings of the study, the researcher concludes that the three predictor variables measured in this research which are

asset quality, liquidity level and capital base contributed significantly to financial performance. Capital base was found to be the highest contributor to financial performance with 45.8%, followed by asset quality with 26.1% and liquidity level with 18.3%.

Conclusion

From the study findings it shows that the bank is performing better after the merger. This is supported by the fact that asset quality, capital base and liquidity variables had a significant impact on financial performance. The study concludes that the merger has well positioned these Banks to be more liquid, financial stable and well placed to lend and increase profitability.

In spite of the above achievement, the study found a gap of 21.7% that asset quality, capital base and liquidity level could not meet. This means that for the Banks to fully benefit from its merger in terms of financial performance, it must complement asset quality, capital base and liquidity level with other factors and measures such as enhancing the proficiency and skill of its personnel and bringing along more effective corporate governance to further improve the elasticity and competitiveness of the bank.

Reference

Adjei, G., 2018. The effect of capital structure on profitability: an empirical analysis of listed firms in Ghana. Journal of Risk Finance, 6(5), 438-445.

Akguc, F., 2018. Analysis of financial Toblolar, 9 Printing, Istanbul: Accounting Directorate Publication No. 64, Accounting Education and Research Foundation Broadcast Institute. No. 16

Alao, K., 2017. "Capital Investment and Financial Decisions", Fifth Edition Prentice Hall, pp. 682-95

Ardjouman, D., &Asma, N. 2017. "The Impact of Mergers and Acquisitions on Corporate Performance in India", Management Decision, Vol. 46, Issue10 pp.1531-43

Baldwin, J., 2018. The dynamics of industrial competition, Cambridge, U.K. Cambridge University press.

Beck, H., 2018. An Analysis of the Impact of Mergers and Acquisitions on Commercial Banks Performance in: Nigeria. Research Journal of Finance and Accounting, 3(7),91-101.

Brissimis, W., 2019. An analysis of the Impact of Public Infrastructure on Productivity Performance of Mexican Industry.

Bruckner, S., 2018. The effect of mergers on efficiency and productivity of public transport services. Transportation Research Part A: Policy and Practice, 42(4), 696-708.

Charmler R. et al, (2018). The Impact of Liquidity on Performance of Commercial Banks in Ghana. Academic Journal of Economic Studies, Vol. 4, No. 4, pp 78 – 90.

Chesang, M., 2018. Merger restructuring and financial performance of commercial banks in Kenya. Unpublished MBA Project: University of Nairobi.

Cloodt, Z., 2018. Corporate Finance, 8th Edition, McGraw-Hill Irwin.

Eyup, K. et al, 2017. Effect of Asset Quality on Bank Profitability, Capital Markets Board, Investor Compensation Centre, Ankar, Turkey.

Fofack, H., 2018. "Value creation in corporate asset sales: the role of managerial performance and lender monitoring", Journal of Banking and Finance, Vol. 27 pp.351-75.

Franke, M., 2017. Mergers and acquisitions basics: The key steps of acquisitions, divestitures, and investments. New York: John Wiley and Sons, 2005, pp.308.

Freidheim, B., 2018. Comparative analysis of the impact of mergers and acquisitions on financial efficiency of banks in Nigeria. Journal of Accounting and Taxation, 3(1),1-7.

Gakure, X., & Kiambat, A., 2017. Globalization and Profitability of Cross-Border Mergers and Acquisitions. Economic Theory, 35(2), 241-266.

Greuning, P., & Bratanovic, A., 2017. Does operating performance really improve following corporate acquisitions? Journal of Corporate Finance, vol. 7, pp.81-96.

Hitt, D., 2017. "Strategic Management: Competitiveness and Globalisation Concepts", South-Western, London.

Javaid, G., 2019. Effect of Mergers and Acquisition on Returns to Shareholders of Conglomerates in Nigeria. Research Journal of Finance and Accounting, 3(7), 86-90.

Khan, R. A. & Ali, M., 2016. Impact of liquidity on the profitability of commercial banks in Pakistan: An Analysis on Banking Sector in Pakistan. Global Journal of Management and Business Research, 16(1).

Kihanda, G., 2018. Mergers and productivity". Journal of Economic Literature, Vol. XL pp.540-1

Kadapakkam, U & Krishnamurthy, A., 2019. Capital Structure and the Firm Characteristics: Evidence from an Emerging Market

Kovacich, G., & Halibozek, E., 2018. Mergers and acquisitions security: Corporate restructuring and management. UK: Butterworth-Heinemann,2005 pp.250

Kooli, Z., & L'Her, Y., 2017. Takeovers, restructuring & corporate finance. Third Edition-Prentice-Hall,

Kumar, F., & Bansal, H., 2018. Effects off Mergers on Financial Performance of Companies Listed at the Nairobi Stock Exchange. MBA Project, University of Nairobi

Lolos, P., & Tsionas, E., 2018.). Planning for a successful merger or acquisition: Lessons from an Australian study. Journal of Global Business and Technology, 1(2), 1.

Luypaert, B., 2018. Strategic merger waves: a theory of musical chairs, Center for the Study of Rationality, Hebrew University of Jerusalem Working Paper no. 259, 2004.

Mamatzakis, F., 2018. Let's make a deal! How shareholder control impacts merger payoffs. Journal of Financial Economics, 76, 203-228.

McLaughlin, A., 2018. Nonprofit mergers and alliances. Hoboken, N.J: Wiley.

Mwangi, B., 2017. Corporate financing and investment decisions when firms have information that investors do not have. Journal of Financial Economics

Nyawira M.E. et al, (2017). The Relationship between Capital Requirement and Financial Performance of Commercial Banksin Kenya. International Journal of Business and Social Science. Vol. 8, No. 3

Odeck, Y., 2017. Corporate finance and investment: decisions & strategies. Financial Times/Prentice Hall

Ombaba, S., 2017. The impact of mergers and acquisitions on the efficiency of banks in Greece, Bank of Greece Economic Bulletin, 22, 7-34

Owusu, K., 2016. Merger Restructuring and Financial Performance of Commercial Banks in Ghana. Journal of Economics, Management and Financial Markets, 2(4), 10-32.

Rhoades, T., 2019. The impact of industry shocks on takeover and restructuring activity, Journal of Financial Economics, Vol.41, pp. 193-229.

Robbins, C., & Stylianou, G., 2016. Theory and Corporate Policy. Pearson Addison Wesley.

Saple, F., 2017. Postmerger Integration. The Journal of Business Strategy. 7(1), pp. 65 76.

Saple, V., & Habibullah, J., 2017. "The Effective Management of Mergers," Leadership &Organizational Development Journal, Vol. 24, No. 7, pp. 447-455

Salwanee, H., 2018. Observation of unconventional quantum spin textures in topological insulators. Science, 323(5916),919-922.

Searby, B., 2019. Mergers and acquisitions, alliances and technology development: an empirical study of the global auto industry. International Journal of Technology Management, 48(3), 295-307.

Seidu, B., 2018. "Performance Measurement in Corporate Governance: Do Mergers Improve Managerial Performance in the Post-Merger Period?",Review of Accounting and Finance 4, pp. 86-101.

Selvam, A., 2019. Post-merger profitability: A case of Royal Bank of Scotland. International Journal of Business and Social Science, 2, 5, 157-162

Simsek, D., 2018. Corporate finance: 1st european edition. McGraw-Hill.

Shanmugam, P., 2018. "the Impact of Acquisitions on Operating Performance: Some Australian Evidence," Journal of Business Finance and Accounting, vol.29, No.1, pp. 155-200.

Straub, J., 2017. Reasons for frequent failure in Mergers and Acquisitions. A comparative Analysis. Deutscher University Verlag, Wiesbaden.

Stylianou, M., 2017. Rebranding in the banking industry following mergers and acquisitions. International Journal of Bank Marketing, 26(5), 328-352.

Trimbath, U., 2017. Implications for GAAP from analysis of positive research in accounting. Journal of Accounting and Economics, 50(2), 246-286.

Wachira, B., 2018. Factors of Mergers and Acquisition on the Financial Performance of Dairy Processing Industry in Kenya: Case Study of Brookside Dairies. International Journal of Management and Commerce Innovations. 3(2), pp. 105-110

Determinants of financial inclusion in Egypt: The role of consumer perceived financial regulations, technological infrastructure, and the mediating role of cultural norms

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Keywords
Consumer Perceived Financial Regulations, Cultural Norms, Egypt, Financial Inclusion, Mediation Analysis, Technological Infrastructure

Abstract
Financial inclusion has become an important policy objective due to its role in promoting economic development, reducing inequality, and expanding access to formal financial services. Despite significant progress in Egypt, a portion of the population remains excluded from the formal financial system. This study examines the determinants of financial inclusion in Egypt by investigating the influence of Consumer Perceived Financial Regulations (CPFR) and Technological Infrastructure (TI), while exploring the mediating role of Cultural Norms (CN).

A quantitative research design was employed using primary data collected through a structured questionnaire distributed to individuals in Egypt. Following data screening and outlier removal, the final sample consisted of 142 respondents. Multiple linear regressions and mediation analyses were conducted to test the proposed relationships between the study variables.

The findings indicate that Consumer Perceived Financial Regulations and Technological Infrastructure both have positive and statistically significant effects on Financial Inclusion. Furthermore, both variables positively influence Cultural Norms, which also significantly contribute to Financial Inclusion. Mediation analysis using the Delta Method and Percentile Bootstrap (5,000 resamples) confirmed that Cultural Norms partially mediate these relationships.

The study contributes to the financial inclusion literature by introducing Consumer Perceived Financial Regulations as an underexplored determinant of financial inclusion and by demonstrating the mediating role of Cultural Norms within the Egyptian context. The findings provide practical implications for policymakers and financial institutions seeking to enhance financial inclusion through integrated regulatory, technological, and social initiatives.

Introduction

In the past, many individuals who were not part of the formal financial system (e.g., commercial banks, insurance companies, etc.) were intentionally or unintentionally excluded from it, often referred to as the unbanked or underserved. They relied primarily on on-hand cash, the only method available to them, to meet all their financial needs.

There was no proper capital allocation. As a result, no cash injections (deposits) were made in the formal financial institutions, leaving these funds largely inactive and outside the formal economy. This limited the potential for such resources to be mobilised for productive investment and economic growth.

Recognising these challenges and inefficiencies deriving from the situation, it inspired governments and policymakers to begin implementing initiatives that enabled access to financial services. This process marked the beginning of integrating the unbanked into the formal financial system. Through this set of actions and policies, it was referred to as financial inclusion (FI)—an important policy objective for many countries in recent years, aiming to improve economic efficiency and productivity. In this context, the concept of financial inclusion garnered significant attention in both policy and academia.

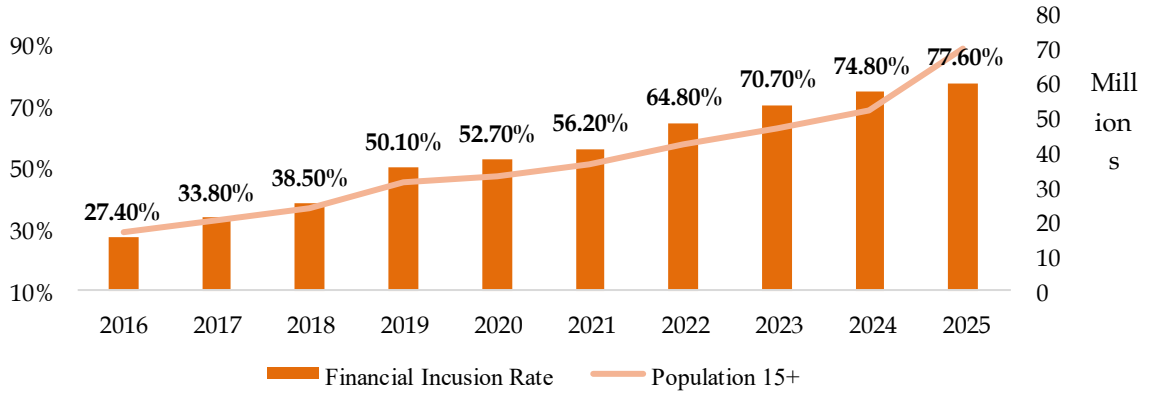
According to an Independent Evaluation Group (2023), financial inclusion enables individuals to access affordable financial services, such as payments, credit, savings products, and insurance, delivered in a responsible and sustainable way. Critical for reducing poverty rates and fuelling economic growth.

Similarly, Ndoye & Barajas (2022) defined financial inclusion as the access and formal use of financial services. Through further emphasis, they stated that, over the years, many countries in the Middle East and North Africa (MENA) region assigned a higher policy priority to financial inclusion.

As a result, financial inclusion emerged as one of the key drivers of economic development. With it, financial inclusion began to be widely recognised on a global scale as an essential component of continuous sustainable development. The willingness of a country to achieve those Sustainable Development Goals (SDGs) issued by the United Nations is contingent upon ensuring widespread financial inclusion. Existing literature in accounting and finance suggests that the increase of financial inclusion within a country has a direct positive relationship with several favourable factors.

These favourable factors might contribute to an increase in a country's Gross Domestic Product (GDP), increased production of renewable energy, improved rates of education (Raji et al., 2024).

This paper aims to study and focus specifically on financial inclusion within the context of Egypt, where, through the years, substantial progress has been achieved as part of a broader national agenda for economic reform and economic growth. According to the Central Bank of Egypt (CBE) (2025), financial inclusion rates have increased, reaching approximately 74.8% of the eligible population aged 15 and above by the end of 2024, equivalent to nearly 52 million individuals with access to and usage of formal financial services (Figure 1). This upward trend continued into 2025, with rates reaching 77.6% (Figure 1) (CBE, 2026).



Source: Central Bank of Egypt (2026)

This progress has been largely driven by a combination of regulatory reforms, government-led initiatives, and the rapid expansion of digital financial services. In particular, the promotion of mobile wallets, prepaid cards, and electronic payment systems has played a crucial role in extending financial services to previously underserved populations. These efforts are aligned with Egypt's national development framework, including Egypt Vision 2030, which emphasises financial inclusion as a key pillar for achieving sustainable economic development and social equity.

Still, a portion of the population remains unbanked or underserved, prevalent in rural communities and low-income groups, where structural challenges and personal beliefs, such as limited financial literacy leading to false perceptions, cultural preferences for cash-based transactions, disparities in technological infrastructure, and financial institutions having a bad stigma in their communities, continue to decelerate the widespread adoption of formal financial services in some areas.

Research Problem & Objective

Research Problem

Despite the extensive literature on financial inclusion, limited research has examined the combined influence of consumer perceptions of regulations, technological infrastructure, and cultural norms on financial inclusion. Furthermore, the role of consumer perceptions of financial regulations has received relatively limited attention compared with objective regulatory and institutional factors. Consequently, there remains a gap in understanding how these factors collectively shape individuals' participation in the formal financial system.

Research Objective

The objective of this research is to examine the determinants of financial inclusion in Egypt, focusing on three key factors: (1) Consumer Perceived Financial Regulations (CPFR), (2) Technological Infrastructure (TI), and the mediating role of (3) Cultural Norms (CN), overall influencing the level of Financial Inclusion (FI).

Literature Review

Consumer Perceived Financial Regulations remains an underexplored determinant of financial inclusion despite the extensive literature on financial regulation and consumer protection. Existing research has primarily focused on the role of financial regulations in promoting financial stability, institutional performance, and their effects on a macro scale, with relatively limited attention given to how individuals' perceptions of regulatory frameworks influence their willingness to engage with formal financial services. Nevertheless, studies examining regulatory awareness, institutional performance based on consumer trust, and customer perceptions provide valuable insights into the potential relationship between Consumer Perceived Financial Regulations and Financial Inclusion.

Evidence suggests that positive consumer perceptions contribute to favourable financial outcomes. Tulcanaza-Prieto et al. (2022) founded that customer perceptions of trust, service quality, and institutional reliability positively influence banking performance, highlighting the importance of subjective evaluations in shaping financial behaviour.

Similarly, financial education, regulatory awareness, and trust in financial institutions have been shown to encourage participation in the formal financial system, while inadequate awareness and low institutional confidence remain significant barriers to financial inclusion (Tambunan, 2015; Ahunov, 2018; Koomson et al., 2023). This perception of regulatory fairness is acutely shaped by real disparities, such as higher collateral requirements imposed on women-managed businesses compared to men-managed businesses (Ahunov, 2018).

The literature further suggests that financial regulation exerts both enabling and constraining effects on financial inclusion. Overly restrictive regulatory requirements may reduce financial access and services, illustrating a delicate balance where excessive oversight intended to promote stability may inadvertently constrain service usage (Momany, 2018). By contrast, effective regulatory quality creates an enabling environment that promotes financial participation and account ownership (Anarfo & Abor, 2020; Chen & Divanbeigi, 2019). In addition, consumers' perceptions of regulatory fairness, effectiveness, and consumer protection have been shown to influence behavioural intentions and confidence in financial institutions (Milosevic et al., 2025; Renganathan et al., 2012). In underserved communities, or banking deserts, this translates into a need for communal financial orientation, where individuals must perceive that engaging with a bank benefits their broader community's well-being to foster institutional trust (Mende et al., 2020).

Collectively, these findings indicate that consumers' perceptions of financial regulations may influence financial inclusion by shaping trust, confidence, and awareness of the formal financial system. However, empirical evidence directly examining Consumer Perceived Financial Regulations as a distinct determinant of financial inclusion remains limited, highlighting the need for further investigation.

Technological Infrastructure has been widely recognised as a key driver of financial inclusion by improving access to formal financial services through digital and physical delivery channels. Existing research consistently demonstrates that internet connectivity, mobile networks, and digital technologies

facilitate financial participation, while inadequate infrastructure, unreliable connectivity, and limited digital access remain significant barriers, particularly in developing economies (Demirgüç-Kunt et al., 2018; Musabegovic et al., 2019; Ediagbonya & Tioluwani, 2023; Ahunov, 2018).

Beyond digital connectivity, physical infrastructure such as automated teller machines (ATMs) and point-of-sale (POS) terminals continues to play an important role in expanding financial access, particularly where digital adoption remains limited (Mukherjee & Gaur, 2024; Obasuyi & Atanda, 2025).

In addition, fintech innovations, including mobile banking, mobile money, digital payment platforms, and digital lending, have created new opportunities for financial inclusion. However, their effectiveness depends not only on availability but also on usability, digital literacy, consumer trust, and cybersecurity (Ezeocha, 2024; Nwanegbo, 2025; Omoniwa, 2021).

Digitisation can paradoxically widen financial exclusion for those lacking the skills to navigate digital interfaces (Ediagbonya & Tioluwani, 2023), while consumer distrust is actively reinforced by social networks transmitting cautionary narratives about fraud and cyber-attacks (Ezeocha, 2024).

Furthermore, to ensure infrastructure serves inclusive development objectives and to counter the built-in advantages of big payment providers, governments may need to step in with the public provision of narrow banking services (dos Santos & Kvangraven, 2017). Overall, the literature suggests that technological infrastructure promotes financial inclusion by reducing access barriers while encouraging the adoption and sustained use of formal financial services.

Existing research on Cultural Norms suggests that shared values, beliefs, and behavioural expectations shape individuals' willingness to engage with formal financial services. Cross-country evidence indicates that national culture significantly influences financial inclusion. Studies based on Hofstede's cultural dimensions show that individualism is generally associated with greater financial inclusion, whereas uncertainty avoidance and power distance tend to discourage participation by limiting trust in formal institutions (Liaqat et al., 2022; Raji et al., 2024). This relationship is supported by the emancipation theory of trust, which argues that societies characterised by broader interpersonal trust are more likely to engage with formal financial systems (Lu et al., 2021).

Beyond national culture, socio-cultural characteristics such as religion and institutional history also shape financial behaviour. Evidence from Sub-Saharan Africa suggests that the effectiveness of financial inclusion initiatives varies across religious and linguistic contexts, reflecting differences in social values and institutional acceptance (Atadouanla Segning et al., 2024). Specifically, religious prohibitions on interest-bearing loans in Islamic-dominated countries limit engagement with conventional financial products, resulting in a lack of inclusion where Islamic finance alternatives remain underdeveloped.

Trust remains a central mechanism linking cultural norms to financial inclusion. Individuals who perceive financial institutions as trustworthy are more likely to adopt formal financial services, whereas mistrust, limited financial literacy, and concerns regarding fraud encourage continued reliance on informal financial arrangements (Lu et al., 2021; Malladi et al., 2021).

Collectively, the literature suggests that cultural norms influence financial inclusion by shaping institutional trust, social acceptance, and individuals' willingness to participate in the formal financial system.

Financial Inclusion has become a central policy objective aimed at ensuring individuals have access to and make effective use of formal financial services (Independent Evaluation Group, 2023; Ndoye & Barajas, 2022). Contemporary research recognises financial inclusion as a multidimensional concept encompassing access, usage, affordability, quality, and the suitability of financial services rather than merely account ownership.

Existing literature highlights several challenges in measuring financial inclusion. Pesque-Cela et al. (2021) argued that many existing indices overemphasise supply-side indicators while overlooking behavioural and qualitative dimensions such as financial literacy, consumer protection, and product suitability.

Similarly, Arun & Kamath (2015) stated that successful financial inclusion requires policies that extend beyond expanding access to developing financial capabilities and encouraging sustained usage, advocating for a progressive approach where countries advance by using payment products as the optimal entry point before moving to lending, long-term savings, and insurance.

Evidence also suggests that access alone does not guarantee financial participation. Osei (2021) demonstrated that individuals may voluntarily remain outside the formal financial system despite receiving financial literacy training and access to banking services, indicating that behavioural and contextual factors play an important role in determining financial inclusion.

Overall, the literature supports viewing financial inclusion as a multidimensional and behavioural phenomenon influenced by both structural conditions and individual decision-making.

Collectively, the reviewed literature suggests that financial inclusion extends beyond the provision of financial services or technological infrastructure. Rather, it is shaped by structural, technological, and behavioural factors that influence individuals' willingness to participate in the formal financial system.

The literature on Consumer Perceived Financial Regulations highlights a notable research gap. While previous studies have examined financial regulation from institutional and policy perspectives, limited attention has been given to how consumers perceive regulatory frameworks and how these perceptions influence financial inclusion. Existing evidence indicates that regulatory awareness, financial education, and institutional trust encourage participation in formal financial services (Tambunan, 2015; Ahunov, 2018; Koomson et al., 2023).

Research on technological infrastructure consistently demonstrates that internet connectivity, digital banking platforms, fintech innovations, and physical financial infrastructure facilitate financial inclusion. Nevertheless, technological access alone is insufficient, as adoption also depends on usability, trust, digital literacy, and consumer confidence (Ezeocha, 2024; Omoniwa, 2021). This suggests that the influence of technological infrastructure may operate through broader behavioural and social mechanisms.

The literature further identifies cultural norms as an important determinant of financial inclusion. Cross-country evidence indicates that cultural values, institutional trust, and social expectations shape individuals' financial behaviour and influence the effectiveness of financial inclusion initiatives (Liaqat et al., 2022; Raji et al., 2024; Atadouanla Segning et al., 2024). Similarly, studies on financial inclusion emphasise that meaningful participation depends not only on access but also on behavioural and contextual factors, highlighting the multidimensional nature of financial inclusion (Pesque-Cela et al., 2021; Osei, 2021).

Accordingly, this study integrates these four strands of literature by examining the direct effects of Consumer Perceived Financial Regulations and Technological Infrastructure on Financial Inclusion, while investigating the mediating role of Cultural Norms.

Hypothesis Development

Based on the literature, the following hypotheses were proposed, and the conceptual framework presented in Figure 2:

Direct Effects

H1: Consumer Perceived Financial Regulations positively influence Cultural Norms.

H2: Consumer Perceived Financial Regulations positively influence Financial Inclusion.

H3: Cultural Norms positively influence Financial Inclusion.

H4: Technological Infrastructure positively influences Financial Inclusion.

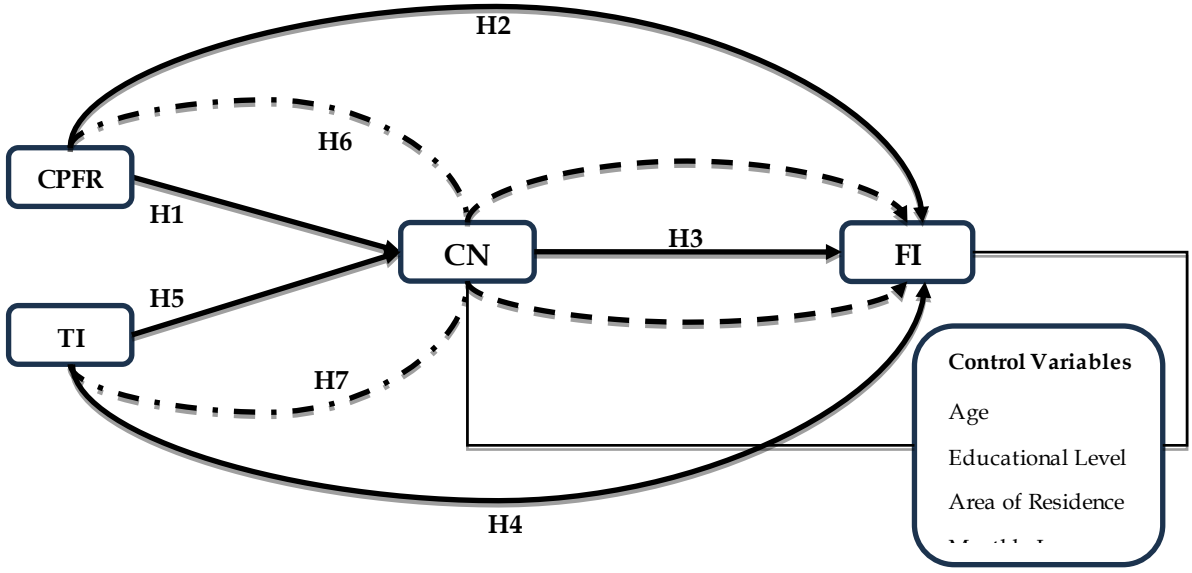
H5: Technological Infrastructure positively influences Cultural Norms.

Mediating Effects

H6: Cultural Norms mediate the relationship between Consumer Perceived Financial Regulations and Financial Inclusion.

H7: Cultural Norms mediate the relationship between Technological Infrastructure and Financial Inclusion.

Figure 2: Conceptual Framework



Research Methodology

This study adopts a quantitative research design examining the determinants of financial inclusion in Egypt. Multiple linear regression models were employed along with a two-mediator analysis model to measure the indirect effects of Cultural Norms (CN). Overall, analysing the relationships between Consumer Perceived Financial Regulations (CPFR), Technological Infrastructure (TI), Cultural Norms (CN), and Financial Inclusion (FI).

The study relied on primary data collected through a structured questionnaire distributed to individuals within Egypt. The questionnaire is designed to capture respondents' perceptions of financial regulations, technological infrastructure, cultural norms, and their level of financial inclusion. A Likert scale was used to measure all constructs, allowing for quantitative analysis of subjective perceptions. The sample was selected using a convenience sampling technique.

6. Findings

A sample of N = 150 was surveyed. A box plot was constructed to identify any outliers within the data. Eight responses were identified as outliers and subsequently removed, reducing the final sample size to N = 142.

Demographics

Demographic profile of the 142 respondents is summarised in Table 1. With respect to age, the majority of respondents fell within the 15–24 age group (51.4%). In terms of area of residence, the sample's majority was urban, with 96.5% of respondents residing in urban areas and only 3.5% in rural areas. Regarding monthly income level, the largest proportion of respondents earned between 1 – 7,000 EGP (45.1%). In educational level, the majority of respondents either held a university degree or were in the process of obtaining one, representing 97.2%.

(Table 1) Demographic Information	Category	N	%
Age	15 – 24	73	51.4%
	25 – 40	28	19.7%
	41 – 60	31	21.8%

(Table 1) Demographic Information	Category	N	%
	60+	10	7.0%
Area of Residence	Urban	137	96.5%
	Rural	5	3.5%
Monthly Income Level	1 – 7,000 EGP	64	45.1%
	7,001 – 15,000 EGP	25	17.6%
	15,001 – 30,000 EGP	35	24.6%
	30,001+ EGP	18	12.7%
Educational Level	No Formal Education	0	0%
	Primary	1	0.7%
	Preparatory	1	0.7%
	Secondary	2	1.4%
	University	138	97.2%

Reliability Test

Cronbach's Alpha was computed for each construct in the questionnaire to assess its internal consistency (Table 2).

(Table 2) Variable	Cronbach's Alpha	Reliability
CPFR	0.868	Good
TI	0.874	Good
CN	0.804	Good
FI	0.829	Good

All constructs exceeded the recommended threshold of 0.70. Indicating good internal consistency.

Descriptive Statistics

(Table 3) Survey Items	Mean	Median	SD
I'm aware of recent financial regulations related to banking & financial services	2.88	3.00	1.31
I believe financial regulations are clear and easy to understand	2.92	3.00	1.13
I believe financial regulations are applied fairly to all consumers	2.87	3.00	1.28
I trust new financial regulations introduces by the financial authorities	3.02	3.00	1.31
I believe financial regulations improve the quality of financial services provided by banks or other financial institutions	3.41	3.00	1.16
I believe financial regulations enhance the security of transactions	3.73	4.00	1.01
I believe it's easy for consumers to file complaints/report issues with financial institutions	3.51	4.00	1.18
I believe the government actively supports the development & improvement of financial regulations	3.41	3.00	1.20
I believe having internet access makes it easier for me to use financial services	4.43	5.00	0.886

(Table 3) Survey Items	Mean	Median	SD
I observe that the availability of ATMs & POS terminals facilitates financial transactions	4.23	5.00	1.01
I believe financial applications and digital banking platforms are easy to register for & use	4.11	4.00	1.01
I observe that mobile & online banking usage is increasing in my family & community	4.43	5.00	0.918
I observe people around me are using different digital payment methods instead of cash	4.46	5.00	0.796
I believe mobile money agents (e.g., Fawry, Aman) improve access to financial services & are easily accessible	4.11	4.00	1.02
I believe my family & community have sufficient knowledge to use financial services	3.75	4.00	1.07
My family & community commonly encourage saving in banks or other financial institutions	3.54	4.00	1.11
I believe people around me trust banks and other financial institutions	3.63	4.00	1.000
I believe people in my community prefer using credit cards over borrowing from friends or family	3.61	4.00	1.10
Discussing financial matters is socially acceptable in my community	3.68	4.00	1.11
I regularly use other financial services (e.g., different saving instruments, brokerage services, etc.)	3.25	3.00	1.35
I can easily access financial services when I need them	3.97	4.00	0.930
Financial services are affordable for me	3.74	4.00	1.02
Financial services feel secure to use	3.73	4.00	0.946
I use digital payments (e.g., mobile wallets, debit/credit cards, or online payments) for transactions instead of cash	4.05	4.00	1.02
I save, use credit, or make payments using online financial services	3.71	4.00	1.24
Financial services meet my personal and financial needs	3.99	4.00	0.922

Correlation Matrix

CPFR, TI, and CN all showed correlations above $r > 0.5$ and $p < 0.001$ with the dependent variable Financial Inclusion. Indicating a positive and significant correlation with the dependent variable (Table 4). The correlations between the independent variables and the mediator were positive and significant ($p < 0.001$) but were below $r < 0.5$ (Table 4), suggesting that Consumer Perceived Financial Regulations and Technological Infrastructure are moderately associated with Cultural Norms, given the hypothesised mediating role of Cultural Norms. Consumer Perceived Financial Regulations and Technological Infrastructure constructs showed an $r = 0.398$ and $p < 0.001$ (Table 4).

(Table 4) Variable	FI	CPFR	TI	CN
FI	–			
CPFR	r = 0.529, p < 0.001	–		
TI	r = 0.525 , p < 0.001	r = 0.398, p < 0.001	–	
CN	r = 0.626, p < 0.001	r = 0.498, p < 0.001	r = 0.451, p < 0.001	–

Regression & Mediation Analysis

Control variables were incorporated into the regression models and mediation analysis to better account for variations in respondents' demographic characteristics and behavioural differences that may influence financial inclusion. Control variables included: Age, Area of Residence, Monthly Income Level, and Educational Level.

Direct Effects Model

The regression results indicate that both CPFR and TI have a positive and statistically significant effect on FI. CPFR recorded a coefficient of b = 0.338 and p < 0.001, while TI recorded a coefficient of b = 0.342 and p < 0.001. The model produced an R^2 value of 0.465, indicating that approximately 46.5% of the variance in financial inclusion is explained by the independent variables included in the model (Table 5).

Independent Variables' Effect on the Mediator Model

Regression results indicated that both independent variables demonstrated a positive and statistically significant effect on CN. CPFR recorded a coefficient of b = 0.349 and p < 0.001, while TI recorded a coefficient of b = 0.291 and p = 0.001. The model produced an R^2 value of 0.375, indicating that approximately 37.5% of the variance in cultural norms is explained by the independent variables included in the model. This value is considered acceptable given the multidimensional nature of cultural norms (Table 5).

Full Model

When CN were introduced into the regression model, CPFR and TI both remained positive and statistically significant predictors of FI. CPFR recorded a coefficient of b = 0.225 and p < 0.001, while TI recorded a coefficient of b = 0.247 and p = 0.001, the decrease in the coefficients for both independent variables is consistent with the proposed mediation of CN. In addition, CN demonstrated a positive and significant relationship with Financial Inclusion, with a coefficient of b = 0.325 and p < 0.001. The model produced an R^2 of 0.541, indicating that the Full Model explained 54.1% of the variance in Financial Inclusion (Table 5).

(Table 5) Models	Path	b	t	p	R	R^2	Adj. R^2	F	df1	df2	Model P
Direct Effects Model	CPFR→FI	0.338	5.325	< 0.001	0.682	0.465	0.415	9.35	12	129	< 0.001
	TI→FI	0.341	4.448	< 0.001							
Mediator Model	CPFR→CN	0.348	4.733	< 0.001	0.612	0.375	0.317	6.45	12	129	< 0.001
	TI→CN	0.291	3.273	= 0.001							
Full Model	CPFR→FI	0.224	3.514	< .001	0.736	0.541	0.495	11.6	13	128	< 0.001
	TI→FI	0.246	3.321	= 0.001							
	CN→FI	0.325	4.607	< .001							

Mediation Analysis

Indirect effects were estimated with 95% confidence intervals derived using two methods: (1) the Delta Method and (2) the Percentile Bootstrap (5,000 resamples) to assess the robustness of the results.

The indirect effect of CPFR on FI through CN was positive and statistically significant (b = 0.113, p < 0.001), as was the indirect effect of TI on FI through CN (b = 0.095, p = .005), using the Delta Method, while nearly replicate results were shown using the Percentile Bootstrap (Table 6).

These findings support the argument that cultural norms partially mediate the relationship between CPFR and FI, and between TI and FI (Table 6).

(Table 6) Method	Indirect Path	b	z	p	Lower	Upper
Delta Method	CPFR→CN →FI	0.113	3.470	< 0.001	0.0493	0.1774
	TI→CN→FI	0.0948	2.803	= 0.005	0.0285	0.1611
Bootstrap	CPFR→CN→FI	0.113	3.470	< 0.001	0.0479	0.1855
	TI→CN→FI	0.0948	2.803	= 0.005	0.0208	0.1908

The findings show that the study's hypotheses are all supported (Table 7), indicating that both Consumer Perceived Financial Regulations (CPFR) and Technological Infrastructure (TI) positively influence Financial Inclusion (FI).

(Table 7) Hypothesis	Statement	Condition
H1	CPFR Positively Influences CN	Supported
H2	CPFR Positively Influences FI	Supported
H3	CN Positively Influences FI	Supported
H4	TI Positively Influences FI	Supported
H5	TI Positively Influences CN	Supported
H6	CN Mediates Between CPFR and FI	Supported
H7	CN Mediates Between TI and FI	Supported

Collinearity Statistics

VIF values for both predictors were well below the conventional threshold of 5, CPFR = 1.13 and TI = 1.17, with corresponding Tolerance values above 0.85 for both predictors, indicating no multicollinearity concerns between Consumer Perceived Financial Regulations and Technological Infrastructure in the Direct Effect and Independent Variables' Effect on the Mediator Models.

(Table 8) Variable	VIF	Tolerance
CPFR	1.13	0.883
TI	1.17	0.856

With Cultural Norms introduced as a mediator, VIF values increased slightly but remained well below the threshold of 5 across all three predictors, CPFR = 1.23, TI = 1.22 and CN = 1.26, while Tolerance values remained above 0.79. These results confirm that multicollinearity does not threaten the stability or interpretability of the Full Model's coefficients. The slight increase in VIF is expected, as Cultural Norms is theoretically and empirically related to both CPFR and TI. This reflects the shared variance inherent in a mediation model rather than problematic multicollinearity.

(Table 9) Variable	VIF	Tolerance
CPFR	1.23	0.815
TI	1.22	0.823
CN	1.26	0.791

Discussion & Conclusion

The findings of this study, derived from primary survey data collected from 142 respondents, indicate that both Consumer Perceived Financial Regulations and Technological Infrastructure have positive, statistically significant direct effects on Financial Inclusion. Individuals are significantly more likely to engage with formal financial services when they perceive financial regulations as transparent, fair, and effective, and when adequate technological infrastructure is readily available.

These results closely align with previous research highlighting the critical importance of regulatory quality, consumer trust, and robust technological development. Furthermore, both of these structural variables significantly influence Cultural Norms, which in turn positively affect Financial Inclusion.

This underscores that social attitudes, institutional trust, and community perceptions play an indispensable role in shaping individuals' financial behaviour.

Importantly, the mediation analysis confirmed that Cultural Norms partially mediate the relationships between these structural factors and Financial Inclusion. This indicates that regulatory and technological advancements enhance financial participation not only directly, but also indirectly by shaping societal attitudes and shifting behavioural norms over time. These results reinforce the theoretical view that financial inclusion is both a structural and a behavioural phenomenon that extends far beyond the mere physical availability of banking accounts or digital networks. Consumers' subjective perceptions

of regulatory effectiveness and the prevailing social norms within their communities are equally vital to their willingness to integrate into the formal financial system.

From a practical policy perspective, these findings strongly imply that national efforts to expand financial inclusion must extend beyond physical infrastructure development and macroeconomic regulatory reform. Policymakers and financial institutions should focus concurrently on strengthening public trust, actively increasing awareness of consumer protections, and fostering positive social attitudes toward formal financial services. By comprehensively addressing both the structural supply-side factors and the behavioural demand-side dimensions, stakeholders can substantially improve the effectiveness and long-term sustainability of inclusion initiatives. Ultimately, this study contributes to the growing literature by introducing Consumer Perceived Financial Regulations as an underexplored determinant and conclusively demonstrating the essential mediating role of cultural norms within the Egyptian context.

Limitations & Recommendations

This study has several limitations that should be considered when interpreting its findings. First, the use of convenience sampling limits the generalisability of the results, as the sample was largely composed of urban, university-educated respondents and may not adequately represent rural populations or low-income groups. Second, the study relied on self-reported questionnaire data, making the results susceptible to response and social desirability bias. In addition, some respondents were hesitant to participate due to concerns that the survey was linked to government monitoring or taxation, despite assurances of anonymity, which may have influenced the accuracy of some responses. Finally, the study examined only a limited set of determinants of financial inclusion, excluding other potentially relevant factors such as income inequality, and GDP per capita.

Based on these findings, policymakers should strengthen regulatory transparency by clearly communicating consumer protection measures and increasing public awareness of financial rights to enhance trust in formal financial services. They should also support educational and community-based initiatives that promote positive attitudes towards financial inclusion, particularly in underserved communities. Financial institutions and FinTech providers should continue improving the accessibility and usability of digital financial services, especially for rural and digitally underserved populations. Future research should employ larger and more representative samples across different governorates and incorporate additional determinants of financial inclusion to provide a more comprehensive understanding of the factors influencing financial inclusion in Egypt.

References

Independent Evaluation Group, 2023. Financial Inclusion: Lessons from World Bank Group Experience, Fiscal Years 2014–22.

Ndoye, A. and Barajas, A., 2022. Financial inclusion. Promoting inclusive growth in the Middle East and North Africa: Challenges and opportunities in a post-pandemic world, pp.103-117.

Raji, A.A.H., Alabdoon, A.H.F., Shaker, A.S. and Almagtome, A., 2024. The effect of national cultural values on the financial inclusion: An international perspective. Futurity Economics&Law, 4(2), pp.65-82.

Central Bank of Egypt. (2025). Financial inclusion indicators report. Cairo: CBE.

Central Bank of Egypt. (2026). Financial inclusion indicators report. Cairo: CBE.

Momany, D.K., 2018. Influence of financial regulation in Kenya on financial inclusion: A case study of the banking industry in Kenya (No. 25). KBA Centre for Research on Financial Markets and Policy Working Paper Series.

Tulcanaza-Prieto, A.B., Aguilar-Rodríguez, I.E. and Lee, C.W., 2022. Customer perception and its influence on the financial performance in the Ecuadorian banking environment. Sustainability, 14(12), p.6960.

Tambunan, T., 2015. Financial inclusion, financial education, and financial regulation: A story from Indonesia (No. 535). ADBI Working Paper.

Ahunov, M., 2018. Financial inclusion, regulation, and literacy in Uzbekistan (No. 858). ADBI Working Paper.

Koomson, I., Koomson, P. and Abdul-Mumuni, A., 2023. Trust in banks, financial inclusion and the mediating role of borrower discouragement. International Review of Economics & Finance, 88, pp.1418-1431.

Mende, M., Salisbury, L.C., Nenkov, G.Y. and Scott, M.L., 2020. Improving financial inclusion through communal financial orientation: How financial service providers can better engage consumers in banking deserts. Journal of Consumer Psychology, 30(2), pp.379-391.

Anarfo, E.B. and Abor, J.Y., 2020. Financial regulation and financial inclusion in Sub-Saharan Africa: does financial stability play a moderating role?. Research in International Business and Finance, 51, p.101070.

Chen, R. and Divanbeigi, R., 2019. Can regulation promote financial inclusion?. World Bank Policy Research Working Paper, (8711).

Milosevic, I., Plotnic, O., Dumancic, K. and Bojkovska, K., 2025. The role of legislation and consumer perception in shaping circular economy behaviour. Serbian Journal of Management, pp.349-365.

Renganathan, R., Balachandran, S. and Govindarajan, K., 2012. Customer perception towards banking sector: Structural equation modeling approach. African Journal of Business Management, 6(46), pp.11426-11436.

Demirguc-Kunt, A., Klapper, L., Singer, D., Ansar, S. and Hess, J., 2018. The Global Findex Database 2017: Measuring financial inclusion and the fintech revolution. World Bank Publications.

Musabegovic, I., Özer, M., Djukovic, S. and Jovanovic, S., 2019. Influence of financial technology (fintech) on financial industry. Економика пољопривреде, 66(4), pp.1003-1021.

Ediagbonya, V. and Tioluwani, C., 2023. The role of fintech in driving financial inclusion in developing and emerging markets: issues, challenges and prospects. Technological Sustainability, 2(1), pp.100-119.

Dos Santos, P.L. and Harvold Kvangraven, I., 2017. Better than cash, but beware the costs: electronic payments systems and financial inclusion in developing economies. Development and change, 48(2), pp.205-227.

Mukherjee, A. and Gaur, A., 2024. Role of Atms in Financial Inclusion (No. 24-r-05). Indian Council for Research on International Economic Relations (ICRIER), New Delhi, India.

Obasuyi, F.O.T. and Atanda, H.O., 2025. Assessing Point-of-Sale (POS) Services as Financial Inclusiveness and Local Economic Activities in Ekiti State, Nigeria.

Ezeocha, C.M., 2024. Financial technology as a tool for promoting financial inclusion in Nigeria: A theoretical review. African Journal of Management and Business Research, 15(1), pp.166-181.

Nwanegbo, A., 2025. Credit Card Access and Income Inequality: The Mediating Roles of Financial Inclusion and Digital Payment Adoption in Developing Nations. International Journal of Research and Innovation in Social Science (IJRISS), 9(11).

Omoniwa, O., 2021. Technology adoption, cultural values, and digital financial inclusion (Master's thesis, University of Pretoria (South Africa)).

Liaqat, I., Gao, Y., Rehman, F.U., Lakner, Z. and Oláh, J., 2022. National culture and financial inclusion: Evidence from belt and road economies. Sustainability, 14(6), p.3405.

Lu, W., Niu, G. and Zhou, Y., 2021. Individualism and financial inclusion. Journal of Economic Behavior & Organization, 183, pp.268-288.

Atadouanla Segning, B., Fouopi Djiogap, C., Piabuo, S.M. and Ngasseu Noupie, E., 2024. Financial inclusion and income inequality in sub-Saharan Africa: Taking socio-cultural particularities into account. Journal of the Knowledge Economy, 15(2), pp.7307-7330.

Malladi, C.M., Soni, R.K. and Srinivasan, S., 2021. Digital financial inclusion: next frontiers—challenges and opportunities. csi Transactions on ict, 9(2), pp.127-134.

Pesque-Cela, V., Tian, L., Luo, D., Tobin, D. and Kling, G., 2021. Defining and measuring financial inclusion: A systematic review and confirmatory factor analysis. Journal of International Development, 33(2), pp.316-341.

Arun, T. and Kamath, R., 2015. Financial inclusion: Policies and practices. IIMB Management Review, 27(4), pp.267-287.

Osei, Y.A., 2021. The role of demand-side factors in financial inclusion in Ghana (Doctoral dissertation, University of Pretoria (South Africa)).

Beyond the label: Examining packaging effects on consumer purchase intention for healthy snacks with generational and gender moderation

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Product packaging, purchase intention, Generation Z, Generation Millennials, packaging color, packaging label, packaging material, packaging graphics.

Abstract

Manufacturers are considering healthy snack as a growing consumer market, and have extended investment in the production of healthy snack, However existing literature paid limited attention to examine how the gender and generational differences moderate the relationship between product packaging and purchase intentions in the Egyptian healthy snack industry, this highlights a significant research gap that this study addresses.

This study adopts a qualitative & quantitative approach, & non probability Quota sampling technique to examine the impact of product packaging elements (colors, labels, graphics, and materials) on consumer purchase intention in the healthy snacks sector. With 215 responses out of 384, from different genders and different generations, the results showed that packaging colors and packaging materials has the highest impact on purchase intentions, the results stated also a statistically significant variation among Generations Z and millennials, where the young Generation Z responded less significantly than older Generation Z in their intention to buy healthy snacks due to packaging elements. In contrast, results indicating no statistically significant difference in purchase intention between male and female respondents, and these results align with the two industry experts from healthy snacks retailers in Egypt.

Our study's findings suggest that enhancing packaging materials and colors can increase consumers' purchase intentions towards such snacks, so manufacturers can focus on drivers to purchase intention thereby enhancing the appeal of healthy snacks in a market full with options. where packaging material & colors explains 56.3% effect on Purchase Intention of healthy snacks market, with also significant need to further explore the young Generation Z drivers to purchase intentions in the healthy snack market.

Introduction

The Demand has increased among Egyptian consumers in choosing healthier snack options, and that is driven by the rise of health consciousness among Egyptian consumers in different age groups (Statista, 2025), that is accompanied by the increase of brands offering healthy snacks alternatives, where The Egyptian healthy snacks market was valued at approximately USD 1.28 billion in 2025 and is projected to reach USD 2.21 billion by 2034 (Deep Market Insights, 2025). Within these insights, the product packaging then plays a vital role in affecting consumer purchase intention to buying healthy snacks, In addition, the aspect of creativity in the design of packaging is increasingly becoming an area of focus for academic scholars. By using the optimal arousal model, (Shukla et al. 2022) showed that creativity in packaging design, which is achieved through the use of dimensions of divergence and relevance, has an effect on the curiosity, persuasion, and purchasing behavior of customers, its found to be the key factor affecting

purchase intention. This research, differentiating between visual cues (size, color, material, graphics) and information cues, is still one of the most cited classifications on packaging.

To provide a deeper understanding if there is generational differences related to the product packaging effect on purchase intention, each generation was divided into two age-based cohorts. Rather than treating Generation Z and Millennials as one group, based on an industry expert interview, it was suggested that even within the same generation, different consumer attitudes and decision-making patterns due to differences in life stage, purchasing power, financial independence, and accumulated consumption experience could be detected. Furthermore, there is a lack of research that explores how demographic moderators such as Generation Z and Millennials and gender can moderate the relationship between packaging and its dimensions (colors, graphics, labels, material) and purchase intention, particularly in the healthy snacks industry which is an emerging market ,that is still in its growth phase to examine how consumers interpret cues of packaging that guides marketers of how far to invest in packaging elements depending on its effect on purchase intention.

Literature Review and research hypotheses:

Packaging as a marketing tool:

Packaging was historically viewed as a logistics tool which primarily aimed at the protection and transport of the product. However, as time passed, a more extended concept of packaging was formed. One of the earliest and highly significant reconceptualization was offered (Rundh , 2005) suggested that packaging performs not only the function of logistics but also serves as a marketing tool.

It was a key turning point for academic research in this field. (Silayoi and Speece ,2007) took this work forward when they used conjoint analysis to prove that package design is the main medium through which consumers communicate with the brand.(Wang et al. 2023), while studying the phenomenon of snack food packaging, pointed out that consumers tend to view packaging as the "silent salesman on the shelf," which serves as the live brand representative in the absence of any sales representatives. The combination of all evidence states that packaging does not represent the neutral container or the means of information delivery, but the encoded system where the visual and information components of packaging interact to form systematic, measurable and business-related consumer reactions. In this theoretical context, the current research studies four characteristics of packaging – color, labeling, graphics, and material as predictors of purchase intentions among different generations and genders.

H1: There is a significant relationship between packaging and customer purchase intention

Packaging colors:

Packaging color serves as an inexpensive and available heuristic that consumers apply when cues intrinsic to the item (such as taste and nutritional content) are not available before the purchase decision is made. And this accurately describes the case where shoppers consider purchasing healthy snacks. Color is one of the first packaging features that attracts people's attention, and its impact on the product evaluation process at an early stage is much greater than the impact of either shape or typography (Su & Wang, 2024) , Moreover its empirically demonstrated that the use of warm colors on packaging increased consumers' intentions to buy products that signal that those products are pleasing in taste but unhealthy, while cool colors increased intentions to purchase snacks that are healthier but less tasty.

A large body of experimental literature examines the role of various aspects of colors in making health inferences. (Mai et al. 2016) found, that light and pale colors increase perceived healthiness but negatively influence perceived taste; this negative taste effect is especially strong when no tasting is possible and the healthiness is not the main goal of the consumer. In spite of some uncertainties about what specific color attribute is the most important one, three consistent conclusions can be drawn from the literature review and relevant for our study: (1) the color of the package is a powerful extrinsic stimulus that can capture attention and elicit affective response even before the consumer processes the information provided by the label; (2) the inferences about the healthiness and quality of the product made by consumers based on the color are incorporated into their evaluations of the product; and (3) the evaluations in turn influence

purchase intention. Since healthy snacks belong to the category of products that rely heavily on visual cues for their health communication - Accordingly, the following hypothesis is proposed:

H1.1: there is a significant relationship between packaging color and customer purchase intention.

Packaging Graphics

The term "packaging graphics" refers to the non-color components of the visual design of a product's packaging, comprising images either photographic or illustrative that form the overall visual identity of the package excluding its color (Wang, 2013).

Some of the more recent multi-characteristics studies confirm this finding and show that graphic, along with color and logo, have a direct effect on purchase intentions that are partially mediated by brand experience (Liu, Samsudin, & Zou, 2025).According to construal level theory, as shown by (Septianto et al. 2019), illustrations have more persuading power than photographs in advertisements for organic food due to their increased visual abstraction.

In the study by (Schnurr 2019) using healthy snack packaging as stimuli, "cute" packaging designs (with playful colors and cartoon imagery) made the product seem tastier yet less healthy, this had different effects on purchase intention: cute graphics increased purchase intention for those healthy snacks. There is an agreement among the existing literature that packaging graphics including images, icons, typography, and style have an effect on attention, quality perception, emotions, trust and purchase intention. However, there is also consensus that the effect of graphics is reliant: their impact varies depending on how consistent the style is with the health orientation of the product, (b) which particular graphic element we analyze (e.g., style of images, typefaces, characters) and (c) whether tastiness or healthiness is the more relevant attribute within this specific product category. Since healthy snacks involve a conflict between two aspects (enjoyment and health) of consumer expectations, well-designed congruent graphics are expected to resolve this conflict and make evaluation easier, thus increasing purchase intention. Given the convergence of evidence, taking into account the contingencies, the following hypothesis is advanced:

H1.2: there is a significant relationship between packaging graphics and customer purchase intention

Packaging Labels

Package labels include nutrition facts, health claims, ingredients list, and logos from third parties certifying the product to be organic. Package labels provide information regarding the composition and origin of the product as well as the health-related aspects of the product (Ikonen et al., 2020),) and that labeling increases consumers' skills in detecting healthier foods and affects product attitudes in a positive way. However, its effect on real purchase decisions is considerably less pronounced compared to other perceptual effects, which highlights an important attitude-behavior gap that is highly relevant for research that examines purchase intentions, like the current one. On the other hand, a study conducted by (Prates et al. 2022), which focused on cereal bars, cookies, and savory snacks, indicated that the use of nutrition claims may work against nutrition labeling. This is because nutrition claims may distract consumers from warning labels and make it difficult for them to comprehend the actual nutrition value of the food item objectively, despite increasing health perceptions and purchase intentions.

Labels work as credibility enhancers in the formation of perceptions of the healthiness and quality of the items but have less and less consistent effects on purchase intentions than on perception and attitudes (Ikonen et al., 2020). Secondly, the combined use of several label components – claims, & labeling scheme, can result in both additive and interference effects depending on the product type, which means that healthy snacks cannot be considered to respond to the labeling process in the same way as other products (Prates et al., 2022). Thirdly, trust can be identified as the mediating factor of the relationship between labels and purchase intention and plays an especially critical role in case of certification and organic labeling (Watanabe et al., 2021). Despite this gap, there is a strong support from the majority of evidence for the general proposition that packaging labels affect positively consumers' purchase intentions by increasing perceived credibility, healthiness, and quality of the product. Therefore, the following hypothesis is formulated:

H1.3: There is a significant relationship between packaging labels and customer purchase intention.

Packaging material

The packaging material is the physical material used for containing and protecting the product, which includes typical materials like plastic and glass, fiber-based materials like paper and cardboard, and sustainable materials like biodegradable, compostable, and recyclable materials. Based on the theory of cue utilization, the relevant literature considers packaging material as an important extrinsic cue through which consumers derive information about intrinsic properties of products such as quality, naturalness, and environmental effects before processing any other aspect of the package (Steenis et al 2017).

To consider the effects of packaging on health-related factors, (d'Astous ,2021) conducted an empirical study involving two mediators in two studies and revealed that responsibility of food packaging (being recyclable, reusable, or compostable) had a significant impact on purchase intention. This sequence-mediation finding is theoretically relevant as it explains the mechanism by which a mere physical packaging characteristic (material) can affect health perception of the product in question irrespective of the lack of nutritional information associated with the material. This is supported by (Ruan et al. 2026), who showed in three studies that environmentally friendly packaging increases perceptions of healthiness due to heuristics related to nature, sustainability, and morality, thereby increasing purchase intention.

(Lignou and Oloyede 2021) conducted an experiment using prototypes of biscuit and meat packaging based on paper and tested it among a sensory panel and 130 participants. Even though some types of sustainable packaging scored equally well in terms of liking compared to traditional one, purchase intention was still low for the former across all product categories. Overall, literature converges on the general principle that packaging material serves as an extrinsic cue to quality, naturalness, environment-friendliness, and, in turn, purchase intention, with sustainable and fiber-based packaging materials usually surpassing traditional plastic packaging materials in terms of these attributes. At the same time, the literature reviewed is inconsistent: the effect of sustainable packaging material is conditional on product category fit (Magnier et al., 2016); on the type of food and its perceived environmental impact (Ruan et al., 2026), Thus, based on the literature reviewed, it is hypothesized that:

H1.4 there is a significant relationship between packaging material and customer purchase intention

Purchase intention

Traditionally, purchase intention is viewed as the subjective probability of the individual engaging in some form of purchase behavior related to the product or brand. In their comprehensive review spanning almost three decades of organic food studies, where a common assumption that health consciousness is the key driver of intentions to purchase healthy food. The literature on packaging agrees with the behavioral approach by showing that cues at the level of packaging can serve as significant but imperfect drivers of purchase intention. The following three core insights can be extracted from the literature review and applied to conceptualizing the current study. Firstly, purchase intention is a well justified dependent variable; however, taking into account the intention behavior gap pointed out by (Rana and Paul 2017), the results should not be considered an indirect reflection of sales but as the consumers' disposition concerning healthy snack packaging instead. Secondly, in classical theories, the predictor to intention to buy was health consciousness, meaning that packaging cues, which can influence not only the perception of the food's healthiness but also its value and quality, could play a significant role in the current context. When viewed together with (Rana and Paul 2017), an interesting but under explored pattern appear, where despite having positive attitudes towards health products, consumers can fail to make a purchase due to negative prices or values associated with this purchase.

Moderating Role of Generations

According to the definition, generations are considered to be groups of people who were born during some time interval and developed similar values. Every generation is characterized by its own formation experience: prosperity and mass-media for Baby Boomers; digitalization and distrust of marketing messages for Generation X; internet and social networks for Generation Y; and mobile and social technologies for Generation Z (Makowska, 2024).According to (Makowska et al. 2024), conducted within a study involving several thousand participants across four generations, Baby Boomer and Generation X

cohorts paid more attention to quality and country of origin when purchasing food items, while members of the younger cohorts (Generation Y and Generation Z) focused relatively more on price.

This lack of consistency forms a substantial limitation in the contemporary academic discourse about generational consumer behavior: most of the existing papers focus on certain aspects (decision antecedents such as price, quality, convenience) while at the same time ignoring the role of generation membership with regard to healthy packaging–intention interaction. Combining all the information from the literature, about three specific points directly connected to the research design proposed in this study. The concept of generational cohort membership is a theoretically sound and empirically proven segmentation variable influencing food-related values, decision criteria and the strength of cue-behavior association, rather than a trivial demographic control variable. Thus, the following hypothesis is proposed:

H2. Generation moderates the relation between packaging and consumer purchase intention.

Moderating Role of Gender

Gender is considered as a social construction of roles, expectations, and ways of processing information in regards to male and female categories. For many years now, gender has been known as an important variable of segmentation since it affects the way consumers perceive marketing stimuli like packaging of products (Arslanagic et al., 2014).According to the latter, women are supposed to process available cues more extensively than men, who tend to use selective heuristics when evaluating products; this approach affects directly how each gender processes multiple attribute packages (Arslanagic et al., 2014), this study on healthy food packaging information found out that women's perception of packaging information value was determined primarily by advertisement cues, while men were guided both by advertisement and the credibility of the packaging information, this asymmetry suggests that there is a possibility that credibility-boosting packaging signals, including certification labels, list of ingredients, and credible claims, have gender-related impact on consumer persuasions and decisions.

The evidence of gender effect on packaging cue salience and persuasive effectiveness justify the formulation of the current study hypothesis that gender moderates the link between packaging elements and purchase intentions for healthy snacks. Thus, the following hypothesis is proposed:

H3: Gender moderates the relation between packaging and consumer purchase intention.

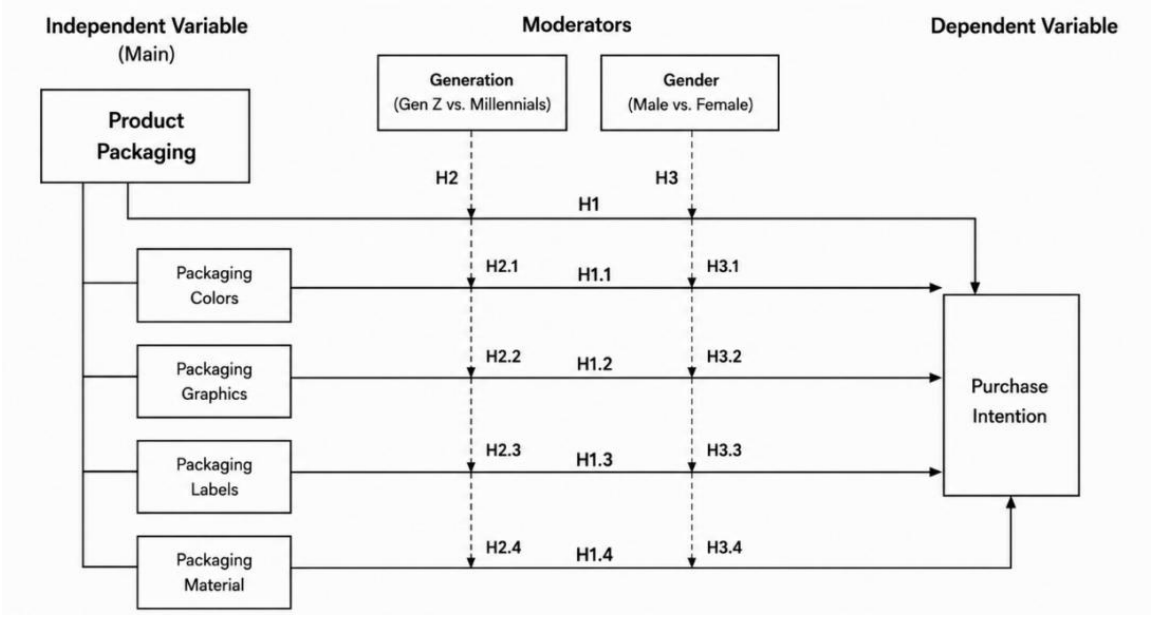


Figure 1-Conceptual Framework

Research Methodology

Sample and procedure:

This study adopts a qualitative & quantitative, descriptive research design to examine the effect of packaging elements (colors, labels, graphics, and materials) on consumers' purchase intention toward healthy snack products using non-probability Quota sampling to reach fair representation of generational cohorts & genders. The study also investigates the moderating role of generation (Generation Z and Millennials) and gender in these relationships, empirical testing of hypotheses using quantitative data, so enhancing the depth and validity of the research findings (Creswell & Plano Clark, 2017). This study adopts a survey based quantitative method to collect standardized data for measuring constructs using structured questionnaires, followed by a reliable statistical analysis and lead to the generalization of findings. (Hair et al., 2019).

Data Collection

The questionnaire consisted of five constructs: customer purchase intention, , packaging color, graphics, labels, and packaging material. Customer purchase intention was measured using five items adapted from Yeo et al. (2020). The color construct included seven items adapted from Yeo et al. (2020) and Olawepo and Ibojo (2023), while the graphics construct comprised five items adapted from the same sources. The labels construct was measured using eight items, and the packaging material construct consisted of six items, both adapted from Yeo et al. (2020) and Olawepo and Ibojo (2023). All items were assessed using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), enabling respondents to indicate their level of agreement with each statement. A total of 215 out of 384 valid responses were collected and used for data analysis after excluding incomplete or inconsistent entries.

Qualitative Findings from Industry Expert Interviews

Semi structured interviews were conducted with two marketing professionals from leading companies operating in Egypt's healthy snacks sector- Abu Auf & Breadfast. The selected healthy snack manufacturing brands were chosen because they are one of the initiators of healthy snacks in Egypt, offering variety of healthy snacks. of their popularity with consumers of various demographic segments.

Both experts agreed that the growing health consciousness among Egyptian consumers was the reason why they started their healthy snacks offerings and they agree that packaging play's vital role and affects consumers' purchase intention in the healthy snack market. where consumers often have limited previous experience with healthy snacks so they tend to focus on the packaging for details. According to two industry experts, packaging seemed to have a more important role than just the protective element of the product, yet it serves as a tool that transports health claims, brand credibility, ingredient transparency, and product quality.

Besides, both industry experts agreed that packaging effect on consumers will differ noticeably between different age groups, even within the same generation. They explained that younger consumers (approximately 16–21 years) are generally more attracted to visually colorful packages of snacks, since it reflects a less boring content inside the back, also innovative designs encourage them to try out the snacks. Yet, late Generation Z (22–30 years) were different since they held greater implications towards nutritional facts, ingredient honesty and visibility, sustainability aspects to packaging material, and value for money as their purchasing decisions become progressively health oriented since they are financially independent unlike early Generation Z.

Likewise, both experts stated differences within the Millennial generation, Where Consumers aged 31–40 years seemed to like look for packages attractiveness and the nutritional facts on the label. Yet, late Millennials 41–50 years relied more on attributes not package elements, like the authenticity and the size, and nutrition portion. According to both experts, gender didn't play any role significant to them regarding packaging and purchase intent cause the health consciousness is a common interest for both, yet generational differences are logical and expected since it shows how the changes in lifestyle, family cycle, purchasing power, affects consumers decision making.

Overall, the qualitative findings reinforce the theoretical foundation that product packaging for sure influences the purchase intention in the healthy snacks market, while they supported the subgrouping of

age and generations as a important analytical direction to deeper investigate the generational differences to packaging cues and purchase intention.

Research Results

Descriptive statistics to profile the sample

This section presents an overview of the demographic characteristics of the respondents included in the study. A total of 215 valid responses of 111 female (51.6%) and 104 male (48,.4%), age intervals where 8.8% less than 21 years, 21-30 50.2%,31-40 18.1%,41-50 15.3% and 51-60 7.4%, as for the education level, 9.8% where high school students,77.2% bachelor degree holders,10.2% master degree holders,2.8% doctorate degree holders.

Measuring reliability and validity

To ensure the rigor of the research instrument, both validity and reliability were carefully assessed. Validity refers to the extent to which the measurement instrument accurately captures the concepts it is intended to measure. In this study, content validity was established through a thorough review of the questionnaire items based on existing literature related to packaging elements and purchase intention. The measurement items were adapted from previously validated scales and were reviewed to ensure their relevance, clarity, and alignment with the research objectives. Additionally, the questionnaire was pre-tested on a small group of respondents to identify any ambiguities or inconsistencies, leading to minor revisions before final data collection.

Reliability refers to the consistency and stability of the measurement instrument. To assess internal consistency, Cronbach's alpha coefficient was calculated for the study constructs. Accordingly, the reliability analysis was conducted on the devised questionnaire indicating excellent internal consistency with Cronbach's alpha more than 0.8, suggesting that the items are highly reliable and consistently measure the related constructs according to the acceptance level of Cronbach's alpha score.

Table 1-Reliability Test

Variable	# of Questions	Cronbach's alpha	Reliability
Packaging Colors	6	0.826	Very Reliable
Packaging Graphics	5	0.867	Very Reliable
Packaging Labels	8	0.924	Very Reliable
Packaging Material	5	0.812	Very Reliable
Customer Purchase Intension	4	0.908	Very Reliable

Correlation Matrix

Table 5 shows the correlation matrix between the independent variables (Product packaging, packaging, colors, packaging graphics, packaging labels and material) and the dependent variable (customer purchase intention). Correlation coefficient is used to test the strength of the relationship between the variables.

Table 2-Correlation

Correlations

		AVE of Colors	AVE of Graphics	AVE of Labels	AVE of Materials	AVE of Purchase Intention
AVE of Colors	Pearson Correlation	1	.763**	.614**	.653**	.596**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	215	215	215	215	215
AVE of Graphics	Pearson Correlation	.763**	1	.753**	.425**	.388**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	215	215	215	215	215
AVE of Labels	Pearson Correlation	.614**	.753**	1	.298**	.287**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	215	215	215	215	215
AVE of Materials	Pearson Correlation	.653**	.425**	.298**	1	.644**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	215	215	215	215	215
AVE of Purchase Intention	Pearson Correlation	.596**	.388**	.287**	.644**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	215	215	215	215	215

**. Correlation is significant at the 0.01 level (2-tailed).

A person correlation analysis was conducted to examine the relationship between the four independent constructs and the dependent construct. The results revealed a moderate statistically significant positive correlation between the dependent (Purchase intentions) and packaging colors and materials. There is also multi-collinearity between packaging colors and graphics, and between packaging graphics and labels leading us to use Step-wise regression in the coming section.

Regression

Step1: to check test the theoretical framework relationships

Regression analysis is conducted via SPSS , where the dependent variable is Cus tomer intension and the independent variables are Product Packaging, Packaging Colors, Packaging Labels, Graphics and Material. Also, normality of the error term is satisfied as the value of Durbin Watson 2.068 in the second round of the modeling.

Results indicate that packaging colors and packaging materials managed to explain 46.4% of the total variation in customer Purchase Intention, while the remaining 53.6 % is due to other variables are not included in the model, other variables can be shown by (Rana and Paul 2017) where intention is predicted by attitude, health-consciousness, and perceived value, the influence of intention on consumer behavior is often reduced and this can be due to other factors such as pricing, availability, and consumption habits.

Table 3-Regression

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.644[a]	.415	.412	.723	
2	.685[b]	.469	.464	.691	2.061

a. Predictors: (Constant), AVE of Materials

b. Predictors: (Constant), AVE of Materials, AVE of Colors

c. Dependent Variable: AVE of Purchase Intention

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	78.906	1	78.906	150.883	.000[a]
	Residual	111.392	213	.523		
	Total	190.298	214			
2	Regression	89.175	2	44.587	93.475	.000[b]
	Residual	101.123	212	.477		
	Total	190.298	214			

a. Predictors: (Constant), AVE of Materials

b. Predictors: (Constant), AVE of Materials, AVE of Colors

c. Dependent Variable: AVE of Purchase Intention

Table 4-Anova Test

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.280	.238		5.378	.000
	AVE of Materials	.695	.057	.644	12.283	.000
2	(Constant)	.637	.266		2.391	.018
	AVE of Materials	.479	.071	.444	6.717	.000
	AVE of Colors	.369	.080	.307	4.640	.000

a. Dependent Variable: AVE of Purchase Intention

Only two independent variables / constructs (packaging colors and material) were found statistically significant at 5% significance level. The packaging materials had a higher impact Consumer Purchase Intention followed by Packaging colors.

Table 5-Anova Test

Model Summary[f]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.626[a]	.392	.389	.737	
2	.685[b]	.469	.464	.691	
3	.720[c]	.518	.511	.659	
4	.750[d]	.562	.554	.630	
5	.757[e]	.574	.563	.623	2.201

a. Predictors: (Constant), I like packaging color of a product.

b. Predictors: (Constant), I like packaging color of a product., I can recall a brand when the similar color is viewed.

c. Predictors: (Constant), I like packaging color of a product., I can recall a brand when the similar color is viewed., The quality of packaging material of a product does not matter to me.

d. Predictors: (Constant), I like packaging color of a product., I can recall a brand when the similar color is viewed., The quality of packaging material of a product does not matter to me., The Standard of the Picture Quality should be Appetizing

e. Predictors: (Constant), I like packaging color of a product., I can recall a brand when the similar color is viewed., The quality of packaging material of a product does not matter to me., The Standard of the Picture Quality should be Appetizing, The quality of packaging material of a product means the product is better.

f. Dependent Variable: AVE of Purchase Intention

Step 2: To devise detailed recommendations: Regression analysis is conducted via SPSS , where the dependent variable is Customer intension and the specific questions of all four suggested independent variables Product Packaging, Packaging Colors, Packaging Labels, Graphics and Material. Also, normality of the error term is satisfied as the value of Durbin Watson 2.201 in the fifth round of the modeling.

Model Summary[f]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.626[a]	.392	.389	.737	
2	.685[b]	.469	.464	.691	
3	.720[c]	.518	.511	.659	
4	.750[d]	.562	.554	.630	
5	.757[e]	.574	.563	.623	2.201

a. Predictors: (Constant), I like packaging color of a product.

b. Predictors: (Constant), I like packaging color of a product., I can recall a brand when the similar color is viewed.

c. Predictors: (Constant), I like packaging color of a product., I can recall a brand when the similar color is viewed., The quality of packaging material of a product does not matter to me.

d. Predictors: (Constant), I like packaging color of a product., I can recall a brand when the similar color is viewed., The quality of packaging material of a product does not matter to me., The Standard of the Picture Quality should be Appetizing

e. Predictors: (Constant), I like packaging color of a product., I can recall a brand when the similar color is viewed., The quality of packaging material of a product does not matter to me., The Standard of the Picture Quality should be Appetizing, The quality of packaging material of a product means the product is better.

f. Dependent Variable: AVE of Purchase Intention

Table 6-Anova Test

Results indicate that the following specific questions managed to explain 56.3% of the total variation in customer Purchase Intention, while the remaining 43.7 % is due to other variables are not included in the model, this validates the results of the above mentioned hypotheses that packaging materials and packaging colors has the most significant effect on purchase intentions, the below table states the most significant statements measuring the constructs, it also indicates that graphics highest significant statement was related to picture quality which might interrelate with the color statements which act as the visual attraction to the consumer.

Table 7-Anova Test

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
5	(Constant)	.397	.244		1.627	.105
	I like packaging color of a product.	.220	.053	.254	4.125	.000
	I can recall a brand when the similar color is viewed.	.193	.053	.218	3.665	.000
	The quality of packaging material of a product does not matter to me.	.129	.030	.212	4.299	.000
	The Standard of the Picture Quality should be Appetizing	.244	.057	.229	4.280	.000
	The quality of packaging material of a product means the product is better.	.114	.049	.129	2.352	.020

a. Dependent Variable: AVE of Purchase Intention

Table 8-Anova Test

ANOVA[f]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	74.566	1	74.566	137.236	.000[a]
	Residual	115.732	213	.543		
	Total	190.298	214			
2	Regression	89.165	2	44.583	93.457	.000[b]
	Residual	101.133	212	.477		
	Total	190.298	214			
3	Regression	98.533	3	32.844	75.520	.000[c]
	Residual	91.765	211	.435		
	Total	190.298	214			
4	Regression	107.005	4	26.751	67.446	.000[d]
	Residual	83.293	210	.397		
	Total	190.298	214			
5	Regression	109.153	5	21.831	56.228	.000[e]
	Residual	81.145	209	.388		
	Total	190.298	214			

Only 5 independent variables were found statistically significant at 5% significance level. These results support the previous output of regression through the 4 independent variables related to packaging color & materials, and ads to it only one variable from packaging graphics related to the appeal of the picture used.

Testing of Hypothesis

With respect to the age intervals , ANOVA was used to test if there is a significant difference between the various age intervals with respect to Consumer Purchase Intention, and the result was significant indicating that there is a significant difference in Consumer Purchase Intention between the age intervals.

Table 9-Anova Test

ANOVA

AVE of Purchase Intention

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.575	4	3.144	3.715	.006
Within Groups	177.723	210	.846		
Total	190.298	214			

The Tukey HSD test indicated that there is a significant difference between young generation Z (16-20 years old) and Millennials (30-45 years old). This states that hypothesis number 2 is partially supported as respondents from young generation z aged from 16 to 21 their effect isn't significant on purchase intention compared with the elder group of Generation Z and millennials.

Table 10-Tukey HSD test

Multiple Comparisons

AVE of Purchase Intention
Tukey HSD

(I) Age Intevals	(J) Age Intevals	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Less than 21 years old	21-30 years old	-.361	.229	.515	-.99	.27
	31-40 years old	-.714*	.257	.047	-1.42	.00
	41 - 50 years old	-.842*	.265	.015	-1.57	-.11
	51-60 years old	-.592	.312	.322	-1.45	.27
21-30 years old	Less than 21 years old	.361	.229	.515	-.27	.99
	31-40 years old	-.353	.172	.244	-.83	.12
	41 - 50 years old	-.481	.183	.068	-.98	.02
	51-60 years old	-.231	.246	.881	-.91	.45
31-40 years old	Less than 21 years old	.714*	.257	.047	.01	1.42
	21-30 years old	.353	.172	.244	-.12	.83
	41 - 50 years old	-.128	.218	.977	-.73	.47
	51-60 years old	.122	.273	.992	-.63	.87
41 - 50 years old	Less than 21 years old	.842*	.265	.015	.11	1.57
	21-30 years old	.481	.183	.068	-.02	.98
	31-40 years old	.128	.218	.977	-.47	.73
	51-60 years old	.250	.280	.900	-.52	1.02
51-60 years old	Less than 21 years old	.592	.312	.322	-.27	1.45
	21-30 years old	.231	.246	.881	-.45	.91
	31-40 years old	-.122	.273	.992	-.87	.63
	41 - 50 years old	-.250	.280	.900	-1.02	.52

*. The mean difference is significant at the 0.05 level.

With respect to the gender, two independent sample were used to test if there is a significant difference between the gender with respect to Consumer Purchase Intention, and the result was insignificant indicating that there is no significant difference in Consumer Purchase Intention between the two genders when it comes to measuring the effect of packaging on purchase intention.

Table 11-Anova Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
AVE of Purchase Intention	Equal variances assumed	1.738	.189	-.795	213	.428	-.102	.129	-.356	.152
	Equal variances not assumed			-.791	204.081	.430	-.102	.129	-.358	.153

Further analysis with respect to Age Intervals, we noticed that ANOVA test indicated a significant difference with respect to: Average of Purchase intention across young Generation Z compared to elder generation Z & millennials, Average of Package Colors across young Generation Z compared to elder generation Z & millennials, Average of Package Materials across young Generation Z compared to elder generation Z & millennials, However a non-significant result on the graphics and labels constructs, which coincide with the regression output .

Table 12-Anova Test

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
AVE of Purchase Intention	Between Groups	12.575	4	3.144	3.715	.006
	Within Groups	177.723	210	.846		
	Total	190.298	214			
AVE of Colors	Between Groups	5.931	4	1.483	2.488	.044
	Within Groups	125.139	210	.596		
	Total	131.071	214			
AVE of Graphics	Between Groups	3.761	4	.940	1.450	.219
	Within Groups	136.179	210	.648		
	Total	139.940	214			
AVE of Labels	Between Groups	3.399	4	.850	1.109	.353
	Within Groups	160.935	210	.766		
	Total	164.333	214			
AVE of Materials	Between Groups	11.061	4	2.765	3.818	.005
	Within Groups	152.084	210	.724		
	Total	163.145	214			

The next table indicates that the score of all constructs (packaging color, packaging graphics, packaging labels, packaging materials) was less among Young generation Z (16-20 years old) in comparison to other age intervals. This leads us to believe that further detailed research is required to cover Young generation Z (16-20 years old) and may include generation Alpha as well.

Table 13-Anova Test

Age Intevals			AVE of Purchase Intention	AVE of Colors	AVE of Graphics	AVE of Labels	AVE of Materials
Less than 21 years old	N	Valid	19	19	19	19	19
		Missing	0	0	0	0	0
	Mean		3.66	3.825	3.95	3.776	3.63
	Std. Deviation		.859	.8597	.995	.8287	.764
21-30 years old	N	Valid	108	108	108	108	108
		Missing	0	0	0	0	0
	Mean		4.02	4.059	4.15	3.906	4.03
	Std. Deviation		.884	.7871	.835	.8357	.831
31-40 years old	N	Valid	39	39	39	39	39
		Missing	0	0	0	0	0
	Mean		4.37	4.355	4.39	4.103	4.39
	Std. Deviation		.953	.5950	.633	.9656	.738
41 - 50 years old	N	Valid	33	33	33	33	33
		Missing	0	0	0	0	0
	Mean		4.50	4.273	4.33	4.136	4.39
	Std. Deviation		.942	.8456	.856	1.0243	.898
51-60 years old	N	Valid	16	16	16	16	16
		Missing	0	0	0	0	0
	Mean		4.25	4.385	4.34	4.180	4.00
	Std. Deviation		1.095	.7834	.578	.5682	1.189

Discussion

This study examined the impact of Product packaging and its dimensions packaging colors, packaging labels, packaging graphics and packaging material expertise on purchase intentions measuring the moderation effect of both generation and genders this within the healthy snack industry. Based on the findings the first hypothesis was partially accepted indicating that within the healthy snack sector not all packaging dimensions (Colors, Labels, Graphics, Materials) affects the purchase intentions, however packaging still affects the purchase intentions and this align with the work of (Mehta et al. 2024) states that in the case of healthy foods, consumers always use extrinsic cues from the package to assess product quality and safety before experiencing intrinsic cues like taste or texture.

This also aligned with the results of (Li et al., 2024) stating that in healthy food markets, consumers concurrently evaluate healthiness, sustainability, convenience, and product quality, making positive packaging attributes more obvious than others. However, the finding also proposes that trusting solely on an attractive package is insufficient to fuel purchase intention unless the package deliver meaningful health related benefits.

For the sub-hypothesis 1.1 the results showed that packaging color significantly impacts the purchase intentions, our results are aligned with the work of (Kunz et al., 2020) stating that color can be considered the chromatic characteristics of the outer packaging of products, which include types, value, and saturation and which people perceive before experiencing the product. Our results also aligned with the

results of (Su & Wang, 2024) stating that color is one of the first packaging features that attracts people's attention, and its impact on the product evaluation process at an early stage is much greater than the impact of either shape or typography. However a study previously was done by (Theben et al., 2019) reported that packaging color did not significantly influence consumers' purchase intentions for healthy yogurt products. This discrepancy might be due to differences in product categories, as healthy snacks are usually purchased through quick, low involvement decisions where colors has a higher impact on the choice than in dairy products. Also work done by (Mai et al. 2016) contradicts with our findings as they measured the shades of colors used for example light and pale colors increase perceived healthiness but negatively influence perceived taste which may result in demotivating customers to purchase this product.

For the sub-hypothesis 1.2 the results showed that packaging graphics insignificantly impact the purchase intentions, our result is aligned with of Li et al. (2024), who argued that consumers purchasing healthy foods prioritize functional cues related to health benefits over packaging graphics features. But our result contradicts with most of previous studies for example in contradicts with the results of (Liu, Samsudin, & Zou, 2025) stating that packaging graphics have a direct effect on purchase intentions, Also Retamosa et al. (2024) stated that graphics improve product attractiveness and increase purchase intention by grabbing the customers attention.

For the sub-hypothesis 1.3 contrary to the expectations packaging labels didn't significantly affects purchase intention, leading us to reject the third hypothesis, this finding align with the work of (Ikonen et al., 2020) and (Croker et al., 2020) stating that Labels work enhances the credibility of perceptions towards the product healthiness and quality of the items but have less consistent effects on purchase intentions than on perception and attitudes. However, our results contradict with several studies as (Watanabe et al., 2021) stating that labels can have an impact on increasing product trust which will improve the purchase intentions, our result also contradicts with the findings of Retamosa et al. (2024), who found that labels on healthy snack packaging appeals substantial visual attention and positively effects both product choice and purchase intention. We can explain this as customers in the present study may already expecting healthy snack products to show nutritional claims like "high protein," "low sugar," or "natural ingredients." As a result, labels may have become standardized market necessities rather than a point of difference between competitors.

For the sub-hypothesis 1.4 results showed that a positive impact of packaging materials on purchasing intentions in the healthy snacks sector, this result aligned with the work of (Steenis et al., 2017) stating that packaging material as an important extrinsic cue by which consumers got information about essential properties of products such as quality, naturalness, and environmental effects. Our result also aligned with the findings of (d'Astous and Labrecque 2021) revealed that responsibility of food packaging (being recyclable, reusable, or compostable) had a significant impact on purchase intention. This result is also supported by (Ruan et al. 2026), who showed in three studies that environmentally friendly packaging increases perceptions of healthiness thereby increasing purchase intention. Li et al.,2024) also aligns with our results showing that environmentally friendly packaging materials positively impacts customer's perceptions of sustainability, product quality, and healthfulness which might lead to increasing the purchase intentions. However, our result is contradicting with (Lignou and Oloyede 2021) conducted an experiment using prototypes of biscuit and meat packaging stating that the packaging materials impact on purchase intention was still low.

For the second hypothesis results showed that generation partially moderates the relation between product packaging and purchase intentions, this was due to the results of the rest of the sub hypotheses related to the moderation effect as results stated that for the sub hypothesis 2.1 that there is a significant difference between young generation Z (16-20 years old) and Millennials (30-45 years old). Same applies to the sub hypothesis 2.4 stating that packaging materials differs between young generation Z and elder generation z and Millennials, by which elder in generation Z with Millennials are affected by packaging materials with regards to their purchase intentions in the healthy snack sector. However for the sub hypotheses 2.2 and 2.3 measures the moderating effect of packaging graphics and packaging labels on purchase intentions results showed a non-significant impact of product graphics on purchase intentions, same applies to sub hypothesis 2.3 as results stated that non-significant effect of product labels on

purchase intentions. This states that the second hypothesis is partially supported as respondents from young generation z aged from 16 to 21 their effect isn't significant on purchase intention compared with the elder group of generation z and Millennials. , the data about snack and beverage consumption suggest that younger generations, especially Gen Z, may prioritize taste, price, and convenience over health or nutrition-related cues more often than other generations, which means that the relative impact of color, graphics, labels, and packaging materials on purchase intentions might differ among generations In total, (Wahyuningsih etal., 2022; Makowska, Boguszewski, & Hrehorowicz, 2024) show that the connection between generational membership and different preferences can not only change the nature of the correlation between marketing constructs but also influence its strength. This contradicts with the research results by (Lassen et al. 2016), after studying intentions to buy healthy food, revealed that women preferred healthier and sustainable menus as well as reacted better to labeling by indicating healthy foods, while men focused more on promotions and more satisfying foods ,Another important observation of the study is the continued use of habits, taste, and price as key factors of the choices of both genders, also confirmed by (Arslanagic et al. 2014) and (Lassen et al. 2016) that women are more attentive to details and have more concern for health, sustainability, and packaging in general. However, it should be pointed out that according to (Chirilli et al. 2022), there was evidence that men were more concerned about some features of environmental packaging. Moreover (Chirilli, Molino, and Torri 2022), while studying food-packaging sustainability among 646 consumers, they have observed significant differences between men and women in terms of their attitudes and awareness about packaging sustainability aspect in material used.

Nevertheless, our results is aligned with the industry experts' interviews. For the third hypothesis results showed that gender doesn't moderate the relation between the product packaging and the purchase intentions, this means that male and females both have the same perception of product packaging with regards to their purchase intentions. Those results are also aligned with the results of the interviews done by industry experts suggesting that the influence of packaging whether visual or informational operates consistently across males and females' customers within the Egyptian healthy snack sector. Both male and female customers show comparable effects on purchase intentions when evaluating healthy snacks, focusing more healthy attributes, nutritional impact, and product usefulness.

Conclusion:

This research examined the effect of product packaging and its sub variables (color, label, graphics & material) on the purchase intention in the Egyptian healthy snacks market, moderated by the generational differences and genders. The results showed that the packaging effect explained 46.4% on purchase intention meaning that there are other variables than the product packaging that affects the purchase intention to be tested.

Packaging color & packaging material had significant effect on purchase intention when it comes to purchase intention in the healthy snacks market, yet packaging graphics and labels were not significantly affecting purchase intention and the hypothesis was rejected.

Moreover, the moderation of generational differences showed that Generation Z which was divided into two subgroups (16–21 years and 22–30 years) showed great significance with the young Generation Z compared to late Generation Z & Millennials, which were divided into two subgroups (31–40 years and 41–50 years). This division enabled the examination of generational variations in the effect of product packaging and purchase intention. According to the expert interview, younger consumers of each generation may respond differently to packaging elements than the other older cohort, this could be due to differences in how they tent to buy either online or offline, their purchasing power, lifestyle, family responsibilities, and exposure to marketing communications, especially social media influencers and response to in store activities, which aligned with this research results, Finally the moderation of gender revealed that there is no significant difference, thus both genders had the same interpretation of packaging elements with regard to purchase intention , which supports the industry experts' interviews.

Recommendations:

As much as packaging is important and has an effect on purchase intention but when applied on the Egyptian healthy snacks industry, it's recommended for Companies to invest only in packaging material to be more appealing, Eco friendly and of high quality since it conveys quality to consumers seeking healthy snacks, and on packaging color, where studying the meaning that colors imply to these Generations is advised based on the research results. Particularly marketers should not focus on the packaging elements, like packaging graphics and packaging label since they had no significant effect on purchase intention among Generation Z, nor Millennials.

Moreover, marketers should not create gender-based variations in packages, since results revealed that both genders had no change in their intention to buy driven by packaging and its elements for Egyptian consumers in healthy snacks market.

Further Research:

The results indicated that the generations' breakdown led to difference among the young Generation Z respondents who had no significant effect of product packaging on the purchase intention, which leads the way to further research among those aged 16 to 21 years old and even further research what drives purchase intention to alpha generation since they seem to act differently than elder Generation Z & millennials as supported by the industry expert interviews & prior research. Moreover, use price as a mediating variable in order to examine more precisely the effect of packaging on the purchase intention to better understand consumers behavior. It's also valuable to examine the healthy snacks purchase when applied on digital platforms, that may influence purchase intention differently than physical stores.

Further research is suggested to compare several Generations like X & baby boomers as well to apply the packaging elements and its effect in another healthy product category like healthy beverages, organic food, to assess the pattern with several sectors, also its suggested to test the effect on a high involvement product category.

References

Arslanagic, M., Pestek, A. and Kadic-Maglajlic, S. (2014) 'Perceptions of healthy food packaging information: Do men and women perceive differently?', Procedia - Social and Behavioral Sciences, 109, pp. 78–82. https://doi.org/10.1016/j.sbspro.2013.12.422

Chen, J., Xu, A., Tang, D. and Zheng, M. (2024) 'Divergence and convergence: A cross-generational study on local food consumption', Scientific Reports, 14, Article 13463. https://doi.org/10.1038/s41598-024-64284-1

Chirilli, C., Molino, M. and Torri, L. (2022) 'Consumers' awareness, behavior and expectations for food packaging environmental sustainability: Influence of sociodemographic characteristics', Foods, 11(16), p. 2388. https://doi.org/10.3390/foods11162388

Croker, H., Packer, J., Russell, S.J., Stansfield, C. and Viner, R.M. (2020) 'Front-of-pack nutritional labelling schemes: A systematic review and meta-analysis', Journal of Human Nutrition and Dietetics, 33(4), pp. 518–537. https://doi.org/10.1111/jhn.12758

d'Astous, A. and Labrecque, J. (2021) 'The impact of responsible food packaging perceptions on naturalness and healthiness inferences and consumer buying intentions', Foods, 10(10), p. 2366. https://doi.org/10.3390/foods10102366

Deep Market Insights (2025) Egypt healthy snacks market size, share & growth report by 2034. Available at: https://deepmarketinsights.com/vista/insights/healthy-snacks-market/egypt

Franco-Arellano, B., Vanderlee, L., Ahmed, M., Oh, A. and L'Abbe, M. (2020) 'Influence of front-of-pack labelling and nutrition claims on consumer perceptions and purchase intentions', Appetite, 149, p. 104629. https://doi.org/10.1016/j.appet.2020.104629

Gadekar, V.L. and Jain, D.P. (2023) 'Role of packaging as the fifth "P" of the marketing mix in influencing purchase decisions: A structured literature review', Journal of Advance and Future Research. Available at: https://rjwave.org/jaafr/viewpaperforall.php?paper=JAAFR2602023

Ikonen, I., Sotgiu, F., Aydinli, A. and Verlegh, P.W.J. (2020) 'Consumer effects of front-of-package nutrition labeling: An interdisciplinary meta-analysis', Journal of the Academy of Marketing Science, 48(3), pp. 360–383. https://doi.org/10.1007/s11747-019-00663-9

Kunz, S., Haasova, S. and Florack, A. (2020) 'Fifty shades of food: The influence of package color saturation on health and taste judgments', Psychology & Marketing, 37(7), pp. 900–912. https://doi.org/10.1002/mar.21317

Lassen, A.D., Lehmann, C., Andersen, E.W., Werther, M.N., Thorsen, A.V., Trolle, E., Gross, G. and Tetens, I. (2016) 'Gender differences in meal selection and purchase intentions', Food Quality and Preference, 47, pp. 123–129. https://doi.org/10.1016/j.foodqual.2015.06.011

Li, X., Wang, S., Ruan, Y., Pan, Y. and Huang, Y. (2024) 'Taste or health: The impact of packaging cues on decision-making', Appetite, 203, p. 107636. https://doi.org/10.1016/j.appet.2024.107636

Lignou, S. and Oloyede, O.O. (2021) 'Consumer acceptability of sustainable packaging', Foods, 10(5), p. 990. https://doi.org/10.3390/foods10050990

Liu, C., Samsudin, M.R. and Zou, Y. (2025a) 'The multidimensional impact of packaging design on purchase intention', Humanities and Social Sciences Communications, 12, Article 785. https://doi.org/10.1057/s41599-025-05122-1

Liu, C., Samsudin, M.R. and Zou, Y. (2025b) 'The impact of visual packaging elements on purchase intention', Behavioral Sciences, 15(2), p. 181. https://doi.org/10.3390/bs15020181

Mai, R., Symmank, C. and Seeberg-Elverfeldt, B. (2016) 'Color cues in food packaging', Journal of Retailing, 92(4), pp. 426–444. https://doi.org/10.1016/j.jretai.2016.08.002

Makowska, M., Boguszewski, R. and Hrehorowicz, A. (2024) 'Generational differences in food choices', Foods, 13(4), p. 521. https://doi.org/10.3390/foods13040521

Mehta, A., Serventi, L., Kumar, L., Morton, J.D. and Torrico, D.D. (2024) 'Packaging and consumer perception', International Journal of Food Science & Technology, 59(10), pp. 6725–6745. https://doi.org/10.1111/ijfs.17463

Müller-Perez, J., Acevedo-Duque, Á., Garcia-Salirrosas, E.E. et al. (2025) 'Factors influencing healthy product consumer behavior', Frontiers in Public Health, 13, p. 1576427. https://doi.org/10.3389/fpubh.2025.1576427

Olawepo, G.K. and Ibojo, B.O. (2023) 'The influence of packaging elements on consumers' purchase intention', June.

Prates, S.M.S., Reis, I.A., Rojas, C.F.U., Spinillo, C.G. and Anastácio, L.R. (2022) 'Nutrition claims and purchase intention', Frontiers in Nutrition, 9, p. 921065. https://doi.org/10.3389/fnut.2022.921065

Rana, J. and Paul, J. (2017) 'Consumer behavior toward organic food', Journal of Retailing and Consumer Services, 38, pp. 157–165. https://doi.org/10.1016/j.jretconser.2017.06.004

Retamosa, M., Aliagas, I. and Millán, A. (2024) 'Ingredients display and purchase intention', Journal of Sensory Studies, 39(4), e12944. https://doi.org/10.1111/joss.12944

Ruan, C., Zhang, X., Quan, Y., Zhang, T. and Zhao, X. (2026) 'Eco-friendly packaging and purchase intentions', Foods, 15(1), p. 165. https://doi.org/10.3390/foods15010165

Rundh, B. (2005) 'The multi-faceted dimension of packaging', British Food Journal, 107(9), pp. 670–684. https://doi.org/10.1108/00070700510615351

Schifferstein, H.N.J., de Boer, A. and Lemke, M. (2021) 'Conveying information through packaging', Journal of Functional Foods, 86, p. 104734. https://doi.org/10.1016/j.jff.2021.104734

Schnurr, B. (2019) 'Cute packaging and consumer perception', Journal of the Association for Consumer Research, 4(4), pp. 363–375. https://doi.org/10.1086/705029

Septianto, F., Kemper, J. and Paramita, W. (2019) 'The role of imagery in organic food marketing', Journal of Business Research, 101, pp. 104–115. https://doi.org/10.1016/j.jbusres.2019.04.016

Shafiq, R. and Rashid, M. (2011) 'Impact of packaging on consumer buying behavior', October.

Shukla, P., Singh, J. and Wang, W. (2022) 'Creative packaging and purchase decisions', Journal of Business Research, 147, pp. 338–347. https://doi.org/10.1016/j.jbusres.2022.04.026

Silayoi, P. and Speece, M. (2007) 'Packaging attributes and consumer decisions', European Journal of Marketing, 41(11/12), pp. 1495–1517. https://doi.org/10.1108/03090560710821279

Statista (2025) Snack food market in Egypt – Market insights and trends.

Steenis, N.D., Van Herpen, E., van der Lans, I.A., Ligthart, T.N. and Van Trijp, H.C.M. (2017) 'Packaging design and sustainability perceptions', Journal of Cleaner Production, 162, pp. 286–298. https://doi.org/10.1016/j.jclepro.2017.06.036

Su, J. and Wang, S. (2024) 'Packaging color and purchase intention', Frontiers in Nutrition, 10, p. 1344237. https://doi.org/10.3389/fnut.2023.1344237

Wang, E.S.T. (2013) 'Visual packaging design and consumer perception', International Journal of Retail & Distribution Management, 41(10), pp. 805–816. https://doi.org/10.1108/IJRDM-12-2012-0113

Wang, H., Ab Gani, M.A. and Liu, C. (2023) 'Snack food packaging and purchase decisions', SAGE Open, 13(2). https://doi.org/10.1177/21582440231167109

Watanabe, E.A. de M., Alfinito, S. and Barbirato, L.L. (2021) 'Certification labels and consumer trust', British Food Journal, 123(12), pp. 4089–4105. https://doi.org/10.1108/BFJ-09-2020-0808

Yeo, S.F., Tan, C.L., Lim, K.B. and Khoo, Y.-H. (2020) 'The influence of packaging attributes on consumers' purchase intention'.

Zhang, X., Gao, M., He, B., Chen, C.H. and Hu, L. (2025) 'Typography and consumer perception', Sustainability, 17(9), p. 3961. https://doi.org/10.3390/su17093961

Financial innovation and access to funding among micro, small and medium enterprises in developing countries

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Keywords
Financial innovation, digital payment innovation, digital lending innovation, mobile banking, access to funding, MSMEs, developing countries.

Abstract

The shortage of funding is a key obstacle facing micro, small and medium enterprises (MSMEs) in developing nations, which restricts their expansion, innovation, and impacts on economic development. The intention of this study was to investigate the financial innovation - financial funding linkage of MSMEs in Nigeria. Particularly, these were linked as relationship between digital payment innovation and accessing government grants, digital lending innovation and accessing FinTech loans, then lastly as mobile and internet banking relationship with access to traditional bank loans. The study used a cross sectional survey design, involving the owners and managers of the MSMEs from Abia, Akwa Ibom and Kogi States, Nigeria. A total sample of 750 participants was captured for the study, the hypotheses were analyzed by using Partial Least Squares Structural Equation Modeling (PLS-SEM) through the SmartPLS 4. The results showed that digital payment innovation significantly contributes to the access to grants. Digital lending innovation was also seen to positively and significantly impact access to FinTech loans. In the same way, access to traditional bank loans also had a significant improvement with the mobile/internet banking services. With regard to financing options, the study concludes that financial innovation is a key determinant of easing the financing constraints and broadening financing opportunities to MSMEs in developing economies. The study suggests that it is necessary for MSME owners and managers to be optimistic in the use of digital payment systems, digital lending platforms, and mobile or smartphone value-added service to better avail their access to a variety of funding sources.

Introduction

Micro, Small and Medium Enterprises (MSMEs) play an important role in the developing world economies, both in terms of the number of businesses registered and the proportion of employment and value addition they contribute. Empirical synthesis of the sector has shown that MSME growth is significantly influenced by the combination of entrepreneurial skills, optimization of resources and the institutional environment, and that entrepreneurial developmental growth is significantly different across developed and developing economies due to differences in infrastructure, regulations and maturity of the markets. Similarly, it is reported by the International development institutions that the MSME sectors constitute about 90% of all businesses and more than half of all employment around the world, and their contribution to the gross domestic product is particularly high in developing and emerging economies (International Finance Corporation [IFC], 2024; World Bank Group, 2024). Nevertheless, MSMEs in developing nations remains highly disadvantaged and remain constrained in terms of managerial capability, lack of formalization, and worst of all, receive limited access to the capital needed to be able to start, sustain and scale their business activities (Fajarika et al., 2024).

There is a consensus that funding is the biggest limitation for the survival and growth of MSMEs in a developing economy. Previous empirical research by Beck et al. (2006) on survey responses from more than 10,000 companies in 80 countries strongly indicated that the availability of external financing was not necessarily evenly distributed but was rather systematically linked to firm size, firm age and ownership

structure, with the financing difficulties to using external finance being significantly higher for smaller and younger companies. For MSMEs, this financing constraint proves to be enduring versus being a short-term barrier, as recent evidence and gap mapping of the global literature indicate that credit is often a prerequisite that MSMEs cannot provide and is denied to them on a regular basis by traditional lenders (Dela Cruz et al, 2025). The size of the shortfall is large as well, international financial institutions, for example, estimate that annually, there is a financing gap of several trillion dollars that needs to be plugged for the world's formal MSMEs in the developing world, and this figure certainly exceeds the total required financing for the informal sector.

This constant deficiency has incentivised both the research community and policy makers to explore the assets available for funding other than the traditional bank loan channel, seeking a wider variety of funding sources. Evidence and gap-mapping efforts in this area have identified a minimum of five distinct forms of intervention to enhance MSME financial access which have emerged starting from regulatory reforms, financing systems, to direct lending instruments, as well as demand-side financial-literacy programming, revealing that the landscaping of 'access to funding' is no longer a one-size-fits-all concept, but an outcome occurring across multiple channels through varying institutional logics (Dela Cruz et al., 2025). The government-backed schemes, fintech-backed loans, and bank-originated loans all have different screening procedures, risk levels, and eligibility criteria, such that a particular MSME may be suitable for one while not being suitable for others. Therefore, analyzing access to funding calls for disaggregation of access to financial facilities over time, especially since digital technologies have become the medium that's increasingly used to uncover, apply for, and be awarded funding by MSMEs. (Kumar et al., 2024)

Financial innovation is a major cause of this change; it represents new invention in technology, platforms, and service delivery that will change the way financial products are brought to previously untouched businesses. Gomber et al. (2017) describe this phenomenon in very general terms as "digital finance": an umbrella term for a range of new financial services products, business models, and customer interaction channels that are delivered online and via mobile devices instead of through brick-and-mortar banks. These, broadly speaking, can be broken down into three dimensions relevant to MSMEs in developing countries: digital payment innovation, which reduces the cost of transaction; digital lending innovation, which uses non-traditional data and algorithmic credit scoring to reach a credit market which would not have been reached with traditional "paper" documentation; and mobile and internet banking, which provides access to financial accounts and management where there are no local bank branch offices. Results across Sub-Saharan Africa indicate that FinTech development has overall positive impacts, though with variance across the development of a firm and the prevailing regulatory landscape (Sanga & Aziakpono, 2024). The positive impacts of digital inclusive finance on financing constraint of SMEs has also been substantiated through complementary evidence obtained from China, finding that digital inclusive finance has a more significant positive effect on non-state-owned firms (NSOEs) and technology-rich firms (TRFs) (Gu et al., 2023). The series as a whole indicates that financial innovation does not impact all MSMEs equally or equally all funding channels.

It is in the unevenness that this study is significant. Most of the literature on financial innovation recognises the positive impact of financial innovation in general on MSME lending outcomes, however, financial innovation and financial access are treated as lumpsum, undifferentiated concepts and there has been a tendency to consider only overall effects in recent studies of large cross sections of data, which register the variety of financial innovations found in their evidence to be heterogeneous rather than homogeneous on impact, therewith only limited evidence on the effects on MSMEs in region-specific contexts exists (Kumar et al., 2024); and cross-country evidence on the effects of financial innovation similarly shows that effects are complex and not uniformly applicable across financial firms and settings (Sanga & Aziakpono, 2024), that is that effects are heterogeneous. The gap is a study which breaks down financial innovation by channels, digital payments, digital lending and mobile-Internet banking, and applies each to the unique funding options that MSMEs use: government grants, FinTech loans, and traditional bank loans. The present study takes off from that definite departure point. This study moves the more specific, actionable, and useful question from the existing literature of so many "does financial innovation help MSMEs" towards a central question of who can be useful to MSME managers to put their

financial innovation technology into practice, and who and what can be useful to policy makers looking to target specific intervention of hybrid combinations, rather than blanket interventions, to address the MSME financing gap in developing countries.

Statement of the Problem

Micro, small, and medium enterprises (MSMEs) in developing countries continue to have funding access issues, the World Bank Group estimates that these companies suffer from an annual financing gap in the trillions of dollars because they are denied credit by mainstream lenders because they do not provide collateral and have no formal credit history (Beck et al., 2006; IFC, 2024; World Bank Group, 2024). This gap in financing hampers broader economic growth, especially in developing economies, where MSMEs contribute the majority of employment and economic value. This financing gap not only affects individual businesses but can negatively impact the overall economic growth of developing economies, particularly for MSMEs, which provide the bulk of the employment and value in an economy. Financial innovativeness; digital payment platforms, digital lending, and mobile/internet banking has been proposed as the solution that can close this gap because it helps to mitigate the information gap by lending credit using a collateral model that is not extensive (Gomber et al., 2017; Sanga & Aziakpono, 2024). However, it is yet to be determined which variant of financial innovation has a positive impact on access to which specific source of funds, because current research tends to focus on the aggregate level of both financial innovation and financial sources of funds (Kumar et al., 2024). The present attempt to explore the relationship which is still unresolved, particularly in terms of the channel.

Literature Review

Theoretical Framework

Diffusion of Innovation Theory

This study is grounded, on the independent variable end, in Roger's (2003) Diffusion of Innovation theory that provides a conceptual framework for understanding the spread of new ideas and technologies into a population of potential adopters, their subsequent adoption, and the speed at which the process occurs. Rogers 2003, identifies five attributes which affect the speed of innovation adoption; relative advantage, compatibility, complexity, trialability, and observability, stating that innovations perceived to have clear and visible benefits above their alternatives to others have more chances of spreading than those that are not perceived this way. In this application financial innovation is understood to be to this very thing precisely a diffusing technology: the new lending possibilities offered though mobile and online banking and digital platforms, and the growth of digital payments are all innovations that compete with one another for market share from their legacy and established counterparts of cash banking and branch centricity payments. The theory is a good fit for this study because it not only posits that MSMEs will adopt these innovations in actually doing so, but that there will be variation in adoption according to their perceived relative advantage and expected compatibility with adapting to the innovation such that the pattern of variation in funding outcomes will resemble that of their digital tool adoption.

Pecking Order Theory

The dependent variable side of this study is based on the Pecking Order Theory by Myers and Majluf (1984) which is the theory in relation to the sequence of financing the firm when it faces a problem of information asymmetry between the manager and the outside investor. By demonstrating that external investors can not fully verify the true value of a firm, Myers and Majluf (1984) argue that firms would prefer to use internal financing before debt financing, and external equity financing only as a last resort; each level on this hierarchy signifies increased risk of investors in this stage. As extended to the MSME funding environment, this theory is able to explain why enterprises with asymmetric information tend to seek financing at initial and less demanding levels before seeking loans where they are required to provide the most verifiable proof of creditworthiness, informal and government-funded financing before moving to the digital and FinTech financing before conventional bank loans. This theory is appropriate for this study because it builds a theory directly on the reason why MSMEs are able to access or not to access government grants, FinTech loans and traditional banks loans; since each pathway for funding comes

with its threshold of verifiable information, and Pecking Order Theory provides the theory that links availability of verifiable information to the funding pathway available an enterprise.

Financial innovation

Financial innovation is a concept that finds its origin in classical financial economics, and, in broad terms, it refers to the generation and popularisation of new financial instruments, technologies, institutions and markets, instigated by a number of factors, including lower transaction costs, information asymmetry and market incompleteness (Tufano 2003). On this basis, Frame and White (2004) adapted its classification between "process" innovations (which are ones that afford new methods for carrying out older financial transactions) and "product" innovations (which are ones involving actually new financial instruments). These are the various types of remote banking that have already been developed, including telephone and internet banking. This classical framing has firmly placed the development of "financial innovation" in the context of structural market inefficiencies, a lens which still governs researchers' understanding of the current digitally facilitated reconfiguration of financial innovations.

Since then, with the advent of ICTs like the Internet and mobile applications, financial innovation has been reframed as financial channels operating online. This change Gomber et al. in 2017 call "digital finance" and refer to a variety of financial products, business models and particularly channels of communication between customer and the bank, which are offered by the Internet, mobile phones and other technologies in contrast to bank branches. However, digital finance is a more complex phenomenon, as identified by Ozili (2018), which includes mobile money, digital payment systems and a digital banking platform which tackle different barriers: cost, distance or documentation, that have historically kept historically-lesserved individuals and businesses out of formal financial services.

Research using the digital lens and enterprise financing is generally finding that financial innovation helps to make the financing conditions of small and micro businesses better — although, not invariably good conditions. Sanga's and Aziakpono's 2024 research of 47 African countries revealed that the developments in FinTech are not necessarily creating a universal increase in the digital finance available to SMEs, and this strengthening effect depends on the growth stage of the SME. Next, Gu et al. (2023) determined that, broadly speaking, the use of digital inclusive finance substantially alleviates SME financing constraints, and that the impact is particularly pronounced among high-technology and non-state owned enterprises in China. This pattern of "meaningful but uneven impact" strengthens the argument about the need to simultaneously consider financial innovation by means of multiple dimensions rather than an all-encompassing construct.

In this literature, three prominent themes of financial innovation that relate to enterprises' financial access are emerging: digital payment innovation that reduces transacting costs and geographical distance (Ozili, 2018; Sanga & Aziakpono, 2024); digital lending innovation based on alternative data (Sanga & Aziakpono, 2024; Gu et al., 2023); and mobile and internet banking, which facilitates access to accounts and financial management without relying on a physical bank branch (Kumar et al., 2024; Ozili, 2018). The three dimensions of financial innovation that are also considered in this study are as follows: Digital payment innovation is the term used for technological solutions which are implemented across the various digital payment platforms, such as mobile money and instant payment solutions and which enable the MSMEs to send and receive payments and process payments without the physical infrastructure and cash. Digital lending innovation is composed of platform-based and algorithmic-based lending instruments that evaluate the creditworthiness of MSMEs based on a range of nontraditional data to provide credit to MSMEs beyond the scope of traditional collateral-based screening process. Mobile and internet banking is the digital interface in which MSMEs can open accounts, access their finances and carry out banking activities without having to leave the home bank.

Access to funding

Access to funding is the capacity of enterprises to secure external funds for business commencement, maintenance and development; access to funding is long recognized in literature of finance as one of the most limiting factors in enterprise development. A close look at other studies suggests that the ability to access financing is truly a growth constraint, not just a mater of convenience: Beck and Demirgüç-Kunt 2006 found that (evasively reported) small and medium enterprises with a higher degree of financing

constraints grow systematically slower than those that access financing with ease. This conclusion was confirmed in a large sample of survey respondents from more than 10,000 firms in 80 countries, which showed that financing constraints are not arbitrarily assigned but are closely related in a predictable fashion to the age and size of the firm, and the ownership of the firm, with younger, smaller and domestic firms being subject to the most stringent constraints on formal credit sources, as found by Beck et al., (2006).

The impact of this constraint is significant particularly for MSMEs in developing countries. These companies usually do not have audited financial statements, fixed assets as security and have irregular credit histories as these entities do not exist in the mainstream credit market despite the strength of their businesses (Dela Cruz et al., 2025). Relying on estimates from international financial institutions, the informal MSMEs (IMSMEs) financing gap is estimated to be billions of dollars more, reaching the trillion dollars per year in the formal MSMEs alone for developing economies (IFC, 2024; World Bank Group, 2024). Through a systematic evidence and gap map of the global literature, delivered by Dela Cruz et al. (2025), it is clear that closing the gap in accessing funding becomes more of a multi-channel outcome than a simple, uniform construct, as interventions addressing the gap lean towards an approach that includes regulatory reforms, financing systems and institutions, access facilitation, direct lending instruments, and demand-side financial-literacy programs.

In practice, enterprises obtain external capital from different channels, which is clearly shown in the multi-channel picture. Although a host of other financing channels have studied on top of credit through official banking, traditional bank lending is foremost and in many settings most important or most prominent, at the same time it is the most constrained channel by collateral and documentation demands (Beck & Demirgüç-Kunt, 2006). As an intentional policy tool to connect to types of enterprises that those banks consider too risky, government-backed finance is the subject of a systematic review of 89 studies, undertaken by Crawford et al (2024), which reveals that government support is specifically carried out for enterprises that not yet capable of obtaining private loans or conventional bank loans; awareness and uptake of such schemes among these enterprises is also often low. Over the last few years, a third model in Financial Technology has come into existence and that is P2P and platform-based financial lending. Abbasi et al. (2021), using panel data for OECD nations, established that the adoption of peer-to-peer lending FinTechs has a substantial positive impact on SMEs' access to finance, and that this impact is accentuated, particularly in countries with better institutional quality. These are the three literatures that suggest that the funding flows of MSMEs today involve not just one credit market, but are truly diversified.

These three measures of access to funding as separate forms of enterprise finance reappear most consistently across this literature: traditional bank financing through collateral- and documentation-based credit assessment by conventional bank lenders (Beck & Demirgüç-Kunt, 2006; Beck et al., 2006); official funding from government grants or loans issued by public authorities (or via guarantee schemes to access the public sector) to finance enterprises with less access to private financing (Crawford et al., 2024, Dela Cruz et al., 2025); and FinTech loans, technically provided by digital and platform-based lenders performing credit appraisal based on alternative data (non-collateral) that are absent from conventional banking systems (Abbasi et al., 2021). This study will use the same three indicators for access to funding. Government Grant: Government support that is extended to MSMEs in the form of concessionary or non-repayable loans through the government agencies., schemes by the government that go the extra mile to access MSMEs. FinTech Lending is the name given to the credit available on a digital and non-banking lending platform that is not based on traditional collateral practices, but instead a credit assessment based on the algorithm or alternative data. The credit granted by a traditional commercial bank via the conventional lending model, the documentation procedure and the type of packages used as collateral.

Hypotheses Development

Digital Payment Innovation and Access to Government Grants

Unlike traditional hand-to-hand transactions, digital payment systems allow for the creation of a trail of verifiable and traceable records of payments, which could ease the blind nature of traditional hand-to-hand payments and make it more difficult for public agencies to identify and track eligible payments going to MSMEs (Ozili, 2018). As payments, savings and transaction data flow through digital finance channels rather than informal cash channels, they leave behind a trail of the financial information that governments normally require prior to granting public funds, and this can be seen as one of the main advantages that digital finance brings to users, as well as to governments (Gomber et al., 2017; Ozili, 2018). In the face of extensive cash transactions and MSMEs' lack of documentation, even if schemes may be well-funded, government agencies find it difficult to verify the work that SMEs carry out and their ongoing eligibility (Crawford et al., 2024). In light of this, MSMEs with greater digital payment penetration would be better poised to comply with verification and reporting requirements of the government granted schemes. $H0_1$: This hypothesis suggests that digital payment innovation does not have a significant relationship among the MSMEs of developing countries referring to availability of government grants.

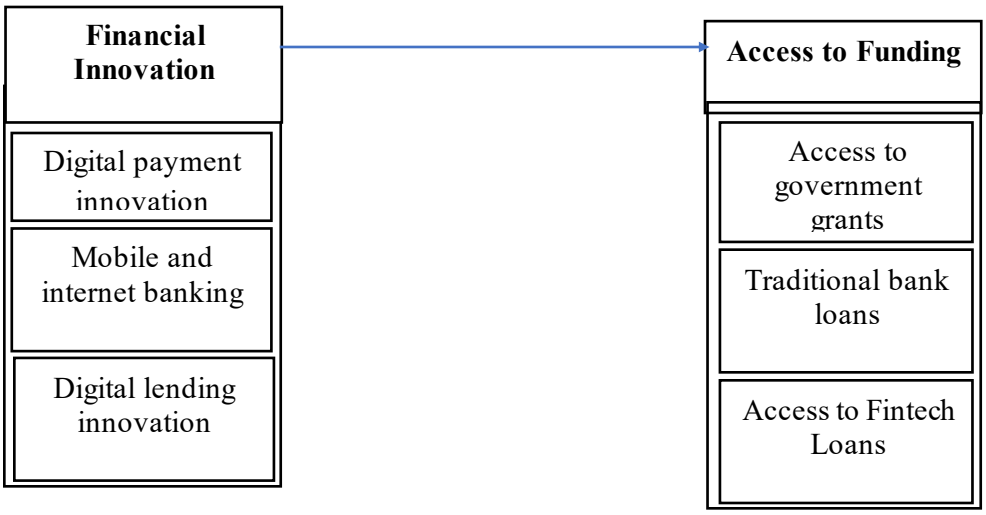
Digital Lending Innovation and Access to FinTech Loans

Therefore, digital lending innovation is the driving force, which includes the application of algorithmic credit scores and alternative information sources to help determine borrower risks, instead of the traditional method involving collateral and audited financial statements – these are the grounds that led to the development of FinTech loans as a distinct financing channel (Abbasi et al., 2021; Sanga & Aziakpono, 2024). Study findings from OECD nations confirmed that the introduction of P2P lending FinTechs had a positive impact on improving SMEs' access to financing, and the impact of digital inclusive finance was even larger when the institutional quality was high (Abbasi et al., 2021), while evidence from China revealed that digital inclusive finance had a clear impact on SMEs' financing difficulties, especially on high-tech enterprises and non-state owned enterprises (Gu et al., 2023). MSMEs will become smoother targets to be evaluated, approved, and provided funding through digital lending channels due to the essential data that they generate in the course of the transactions, which is the same kind of data that FinTech lenders are seeking. Based on this, it is hypothesized that: $H0_2$: There is no correlation between the practice of innovation in digital lending and availability of FinTech loans for the MSMEs present in developing countries.

Mobile & Internet Banking and Availability of Traditional Bank Loans

Mobile and internet banking systems enhance account ownership, transaction history, and day-to-day banking engagement among MSMEs who might not have broadened or any interaction with traditional banks, resulting in precisely the kind of documented financial record that traditional banks use to measure a potential borrower's loan application (Kumar et al., 2024; Ozili, 2018). For MSMEs, a greater interaction with mobile and internet banking increases the banks' chances of verifying their documented financial history and formal banking relations, which improves access to financing drawn from the bank (Beck & Demirgüç-Kunt, 2006). Expansion of financial access through digital platforms also shows digital financial access is an important determinant of financial outcomes for SMEs, especially formal bank credit access, which has not been explored in many developing-country contexts in depth (Kumar et al., 2024). Based on this, it is assumed that $H0_3$: There is no significant relationship between mobile and internet banking and availability of traditional bank loans for MSMEs in developing countries.

Figure 1: Conceptual Framework



Source: Adapted by Researcher

Methodology

Research Design

The design of this study was quantitative and cross-sectional survey research design with evidence drawn from the three selected states in Nigeria which are located in different geopolitical and economies of Nigeria. The cross sectional survey design was found to be suitable because it allows for the collection of standardized quantitative data from respondents at one single point in time and would enable an investigation of the interrelationships between variables without altering the study context/situation (Saunders et al. 2023).

This study was conducted in an empirical context which is Nigeria, one of the largest developing economies in Africa. There are several indices such as level of industrialization, income distribution, infrastructure development, financial inclusion indicators and socio economic indices which classifies Nigeria as a developing country, according to reports from various international development institutions like the World Bank, International Monetary Fund (IMF) and the United Nations Development Programme (UNDP); World Bank (2024), IMF (2024) and UNDP (2024).

Population, Sample Size and Sampling Technique of the Study

The study population consisted of all the registered micro, small and medium enterprises (MSMEs) in Abia State, Akwa Ibom and Kogi State in Nigeria. However, due to the lack of a complete sampling frame for all MSMEs that are registered in the various states, probability sampling techniques were deemed impractical. Therefore, a mix of purposive and quota sampling was used in this study.

Purposive sampling method was used to select the enterprises and include enterprises in the sample that meet the inclusion criteria. In particular, the companies involved had to:

- be registered & running;
- run (operate) for at least three years;
- Rule out any or more than one formal financial service; and
- own or manage an organization where the funding decision is made by the person involved; and
- indicate desire to participate in the study.

Then balanced geographical representation was achieved through use of quota sampling. There were equal quotas for each state in order to ensure that there would not be an imbalance between the different regions and that everyone was being represented alike on the selected geopolitical zones.

The total population of all selected MSMEs for the study was 750 MSMEs with 250 MSMEs from Abia State, 250 MSMEs from Akwa Ibom State and 250 MSMEs from Kogi State. All enterprises were represented by one owner/manager. One respondent per enterprise was selected since owners and

managers are the ones to have sufficient knowledge about financing decisions of their firm, financial innovations at the enterprise and its financing experiences.

The number of samples was deemed sufficient when the sample size is applied to the Partial Least Squares Structural Equation Modeling. According to Hair et al. (2022); PLS-SEM has high statistical power for studies with moderate and large sample sizes, especially those aimed at prediction and extension of theories. Similarly, Kock and Hadaya (2018) suggested to determine sample size based on statistical power in PLSSEM studies rather than on the arbitrary decision to have a minimum sample size. The sample selected thus offers sufficient statistical power for the estimation of the proposed structure model and allows for possible non-response and incomplete questionnaires.

The distribution of the sample is given below in Table 1.

Table 1: Distribution of Sample

State	Geopolitical Zone	Sample
Abia	South-East	250
Akwa Ibom	South-South	250
Kogi	North-Central	250
Total		750

Source: Field survey (2026)

Data and Instrumentalization

Primary data were collected from the owners and managers of the MSMEs, with the primary data being the key source of data for this study. Primary data was deemed suitable as it can bring the first-hand information regarding the various financial innovations practices and firms' experience in accessing external financing sources. The data were collected through the utilization of a structured questionnaire, formulated based on the scales used and validated in studies conducted on financial innovation, financial inclusion, SME financing in previous studies. The form of the questionnaire was divided into three parts. The data and information collected in Section A included demographic and business characteristics such as age of business, sector, ownership structure and years of operation. Section B was on financial innovation with digital payment innovation, digital lending innovation and mobile/internet banking. For Section C, it studied access to funds from the government grants, fintech loans and the traditional banking system. Four questions related to the student's responses were posed on a Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree. The content was evaluated for it's validity, using the expert reviewing process. The questionnaire has been reviewed by experts on entrepreneurship, financial and banking and methodology of research, to determine the relevance, clarity and completeness of the measurement items. The final version of the instrument was developed after incorporating observations from the experts. The validity and reliability was conducted by convergent validity and discriminant validity and reliability based on the PLS-SEM analysis in the data analysis process. The indicator loadings, Average Variance Extracted (AVE), Fornell-Larcker criterion, the Heterotrait-Monotrait (HTMT) ratio, Cronbach alpha and composite reliability were used following well-known recommendations (Hair et al., 2022).

The questionnaires were administered by trained research assistants by the researcher in the three selected states. The participants were informed that participation was voluntarily and they were assured of anonymity and confidentiality. The retrieved questionnaires were checked as soon as they were retrieved so as to minimise missing data and to maximise quality of response. The valid copies of questionnaire for the study was finally determined at the end to be 726 copies.

Method of Data Analysis

Rewritten data was coded and analyzed with the help of the software named as SmartPLS Version 4.1. The data analysis was conducted according to a two-step procedure suggested in the Partial Least Squares Structural Equation Modeling (PLS-SEM). The assessment of the measurement model was carried out in the first phase and the assessment of the structural model was carried out in the second phase.

Results and Discussion
Demographic of Respondents

Table 2: Demographic Characteristics of Respondents

Demographic Variable	Category	Frequency	Percentage (%)
Gender	Male	436	60.1
	Female	290	39.9
Age of Respondent	Below 30 years	102	14.0
	30–39 years	247	34.0
	40–49 years	221	30.4
	50 years and above	156	21.5
Educational Qualification	Secondary education	96	13.2
	Diploma/NCE	158	21.8
	Bachelor's degree/HND	315	43.4
	Postgraduate degree	157	21.6
Position in Enterprise	Owner	462	63.6
	Manager	264	36.4
Years of Business Operation	3–5 years	185	25.5
	6–10 years	276	38.0
	11–15 years	161	22.2
	Above 15 years	104	14.3
Business Sector	Manufacturing	164	22.6
	Trading/Commerce	238	32.8
	Services	177	24.4
	Agriculture/Agribusiness	72	9.9
	Hospitality/Transportation/Other	75	10.3
Enterprise Size Category	Micro enterprise	394	54.3
	Small enterprise	251	34.6
	Medium enterprise	81	11.2

Source: Field Survey Data (2026)

The gender distribution reveals that males accounted for 60.1% of respondents, and females, 39.9%, indicating that the MSME business ownership and management creates a predominantly male business environment, although there is still a good percentage of females.

Concerning age, majority of respondents were of age group 30 to 49 years (64.4%) indicating that most MSME operators had enough age to have enough years of experience in business which gives them adequate decision making power. Educational profile shows that majority of the respondents had attained tertiary education with 43.4 % having obtained Bachelor's degree and HND, while 21.6 % of the respondents had Postgraduate qualification. This indicates a satisfactory level of educational attainment that would allow respondents to understand different matters that were part of the financial innovation topics, digital financial services topics or business financing decision topics.

On enterprise leadership, the respondents were drawn from people running enterprises, with 63.6% representing business owners, and 36.4% representing managers, thus ensuring that most of the responses were from those who are directly involved in enterprise decision-making. Additionally, the distribution of years as a business reveals that the majority of the businesses were over 5 years old, meaning that the respondents had enough organizational experience to give honest responses on their access of funding. The sectoral distribution shows that trading/commerce was by far the largest among the sectors (32.8%) followed by services (24.4%) and manufacturing (22.6%). This actually mirrors the predominant types of

business entrepreneurship activities in Nigeria which are commercial and services. In the last segment, the size of the enterprise reveals that micro enterprises were the largest (54.3%) followed by small enterprises (34.6%) and medium enterprises (11.2%) which is reflective of the typical structure of MSMEs in developing economies where Micro enterprises form the bulk of the enterprises.

As a whole, the demography shows fairly good representative coverage of the various categories of enterprises and of the characteristics of the respondents, giving a sound basis for the analysis of how financial innovation is associated with access to funding among MSMEs in developing countries.

Analytical Model Evaluation

Data collected were analysed using the Partial Least Square-Structural Equation Modelling by SmartPLS Version 4.1. Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed for the analysis, which used the recommended process of two-stage SEM. The preliminary procedure of this research was assessing the measurement model. These involved convergent validity, discriminant validity and reliability. The convergent validity was evaluated using factor loading and Average Variance Extracted (AVE), the discriminant validity was evaluated by utilizing the Fornell-Larcker criterion and HTMT, the reliability check was carried out by Cronbach alpha coefficient and composite reliability (Hair et al., 2022). The second phase consisted of evaluating the structural model. Bootstrapping was used with 5,000 bootstrapped subsampled to evaluate hypothesized relationships. Path coefficients (β), t-values and p-values (Hair et al., 2022) were used to identify the structural model evaluation.

Measurement Model Assessment

Convergent validity

Table 3: Convergent Validity - Factor Loadings and Average Variance Extracted

	Access to FinTech Loans	Access to Government Grants	Access to Traditional Bank Loans	Digital Lending Innovation	Digital Payment Innovation	Mobile and Internet Banking	AVE
AFL1	0.836						
AFL2	0.778						0.660
AFL3	0.861						
AFL4	0.771						
AGG1		0.852					
AGG2		0.790					0.622
AGG3		0.791					
AGG4		0.716					
ATBL1			0.807				
ATBL2			0.842				0.730
ATBL3			0.876				
ATBL4			0.891				
DLI1				0.740			
DLI2				0.779			0.609
DLI3				0.802			
DLI4				0.799			
DPI1					0.859		
DPI2					0.870		0.677
DPI3					0.819		
DPI4					0.737		
MIB1						0.778	
MIB2						0.766	0.632
MIB3						0.822	
MIB4						0.813	

The results obtained by conducting the convergent validity test for the measurement model are shown in Table 3. Table 3 shows the results of convergent validity test of the measurement model by

indicator factor loading and Average Variance Extracted (AVE). For converging validity, tests are the intensity of correlation amongst the indicators of a similar construct along with the extent to which the indicators correspond to the underlying latent variable. Hair et al (2022) suggested that indicator loadings may be preferred to be 0.708 or even higher, and AVE values of each construct may be at 0.50 or over, which means that the variance of its indicators is more than 50%.

The results indicated that factor loadings for all measurement items were good for the constructs they were associated with (0.716 – 0.891). In particular, the loadings of the indicators for Access to FinTech Loans were between 0.771 and 0.861, with the indicators for Access to Government Grants ranging from 0.716 to 0.852. Likewise, each item of the indicator for Traditional Bank Loans had high loadings from 0.807 to 0.891, reflecting good coverage of the indicator. The factor loadings of Digital Lending Innovation are 0.740 to 0.802, Digital Payment Innovation is 0.737 to 0.870 and Mobile and Internet Banking is 0.766 to 0.822. Each value is above the 0.70 minimum requirement for the measure of its hypothesized latent construct, supporting the argument that all these indicators make significant contributions to the measures of their hypothesized latent constructs.

In addition, all of the constructs had AVE values greater than the desired threshold of 0.50. In particular, Access to FinTech Loans had an AVE of 0.660, Access to Government Grants 0.622, Access to Traditional Bank Loans 0.730, Digital Lending Innovation 0.609, Digital Payment Innovation 0.677 and Mobile and Internet Banking 0.632. These values suggest between 60.9% to 73.0% of the variations in indicators are explained by each construct, which is well above the acceptable minimum.

In sum, the results indicate good measurement model convergent validity. That is because that the measurement items have good standard factor loadings and AVE values, so the items in the measurement are very much convergent with the constructs that they measure. As such, the constructs are appropriate for subsequent analysis of the structural model and testing of the hypotheses with SmartPLS, yielding good internal consistency.

Discriminant validity

Table 4: Discriminant Validity – Fornell–Larcker Criterion

	Access to FinTech Loans	Access to Government Grants	Access to Traditional Bank Loans	Digital Lending Innovation	Digital Payment Innovation	Mobile and Internet Banking
Access to FinTech Loans	0.813					
Access to Government Grants	0.633	0.789				
Access to Traditional Bank Loans	0.515	0.612	0.855			
Digital Lending Innovation	0.471	0.587	0.611	0.780		
Digital Payment Innovation	0.322	0.377	0.381	0.514	0.823	
Mobile and Internet Banking	0.437	0.653	0.677	0.691	0.397	0.795

The Fornell–Larcker criterion was used to check the discriminant validity, which reveals in Table 4. Fornell and Larcker (1981) and Hair et al. (2022) suggested that the square root of the AVE on the diagonal is higher than the correlations on the off-diagonal representing the relationship between the construct and the rest of the constructs.

Based on these results, it can be concluded that all constructs meet this criterion. For instance, Access to FinTech Loans recorded a square root of AVE of 0.813, which is higher than its correlations with the other constructs (0.322–0.633). The same applies to the diagonal values of Access to Government Grants (0.789), Access to Traditional Bank Loans (0.855), Mobile and Internet Banking (0.795), Digital Payment Innovation (0.823) and Digital Lending Innovation (0.780) which are above their respective between construct correlations.

The results confirm good discriminant validity for each construct from its others. So the measurement model is valid and can be used for hypothesis testing and assessment of a structure model.

Table 5: Discriminant validity – Heterotrait–Monotrait (HTMT) ratio

	Access to FinTech Loans	Access to Government Grants	Access to Traditional Bank Loans	Digital Lending Innovation	Digital Payment Innovation	Mobile and Internet Banking
Access to _FinTech Loans						
Access to _Government Grants	0.716					
Access to Traditional Bank Loans	0.600	0.646				
Digital Lending Innovation	0.581	0.721	0.715			
Digital Payment Innovation	0.406	0.422	0.424	0.621		
Mobile and Internet Banking	0.531	0.826	0.800	0.807	0.507	

Table 5 shows the results of the discriminant validity test performed by Heterotrait–Monotrait (HTMT) ratio. Hair et al. (2022) recommend that the values for the former trait must be less than 0.90 to validate proper discriminant between constructs.

The result reveals that all HTMT values obtained lie between 0.406 to 0.826, which is below the recommended value of 0.90. Access to Government Grants and Mobile and Internet Banking had the highest value of HTMT (0.826), whereas the lowest value was seen for the relationship between the two factors: Access to FinTech Loans and Digital Payment Innovation (0.406).

The findings confirm that all the HTMT values are within the acceptable limits and hence the constructs are empirically different from each other. As a result, the measurement model can be considered having an acceptable discriminant validity and it can be used for the evaluation and testing of the structural model.

Reliability

Table 6: Reliability – Cronbach alpha and Composite reliability

	Cronbach's alpha	Composite reliability (rho_c)
Access to _FinTech Loans	0.828	0.886
Access to _Government Grants	0.813	0.868
Access to _Traditional_Bank Loans	0.882	0.915
Digital_Lending Innovation	0.791	0.862
Digital_Payment Innovation	0.854	0.893
Mobile and _Internet Banking	0.807	0.873

The reliability analysis of the Measurement Model is shown in Table 6. Cronbach's alpha and Composite Reliability (CR) were analyzed to determine the reliability of the measurement model.Reliability analysis of the Measurement Model was conducted using Cronbach's alpha and Composite Reliability (CR) as seen in Table 6. Hair et al. (2022) set the threshold for acceptable measurement of internal consistency reliability at 0.70 for both measures.

Based on the results, all constructs were greater than recommended. The Cronbach's alpha for the scale for Digital Lending Innovation was 0.791, and the scale for Access to Traditional Bank Loans had a Cronbach's alpha of 0.882 and Composite Reliability values ranged between 0.862 and 0.915. In detail, the Cronbach's alphas of the scales for the measures of Access to FinTech Loans (AFL), Access to Government Grants (AGG), Access to Traditional Bank Loans (ATBL), Digital Lending Innovation (DLI), Digital Payment Innovation (DPI), and Mobile and Internet Banking (MIB) were 0.828, 0.813, 0.882, 0.791, 0.854

and 0.807, respectively, and their Composite Reliabilities were 0.886, 0.868, 0.915, 0.862, 0.893 and 0.873, respectively.

The internal consistency reliability for all of the constructs are satisfactory as indicated in the results of the study, thus the items used to measure the latent constructs in each construct are able to measure the latent constructs consistently. Thus, reliability of the measurement model has been met.

Common Method Bias and Multicollinearity Analysis

To minimize the potential effects of common method bias (CMB) and multicollinearity, a series of procedural, and statistical measures were used prior to data analysis. In the development of the questionnaire, the items of the measurement were adapted from existing validated questionnaires, worded clearly, followed the constructs each item in the scale and anonymity and confidentiality was ensured to respondents, so as to prevent ambiguity in the items of the measurement, to facilitate free response from the respondents and to minimize common method variance (Podsakoff et al, 2003). After that, the level of common method bias was evaluated using the Full Collinearity Variance Inflation Factor (Full Collinearity VIF) in which a value lower than 3.3 signifies that common method bias is not considered to be a problem (Kock, 2015). In addition, the multicollinearity was checked for the predictor constructs by employing the Inner Variance Inflation Factor (Inner VIF) of the structural model which was generated by SmartPLS. The authors of Hair et al. (2022) suggest that the problematic and influential multicollinearity should be considered absent when the values of the inner-VIF are not greater than 5.0 (and preferably less than 3.3). These procedures resulted in a consistent and coherent data for structural model estimation and testing of hypotheses.

Structural Model Assessment

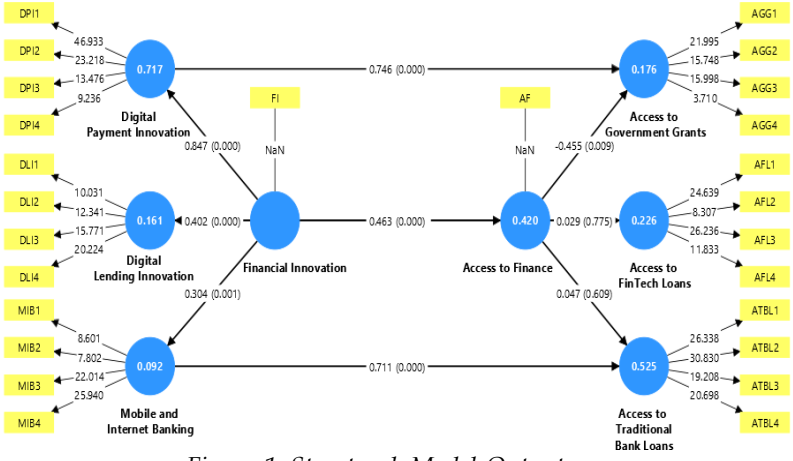


Figure 1: Structural Model Output

Table 7: Structural Model Output

		Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Digital Payment Innovation -> Access to _Government Grants	H1	0.746	0.756	0.164	4.563	0.000
Digital Lending Innovation -> Access to _FinTech Loans	H2	0.463	0.480	0.093	5.005	0.000
Mobile and _Internet Banking -> Access to _Traditional Bank Loans	H3	0.711	0.712	0.067	10.574	0.000

The details of the results obtained from the structural model are presented in Table 7 below. It shows the relationship between financial innovations in size and sources of funding by MSMEs. The results suggest that all three assumed relationships are positively oriented and statistically significant.

The result of Digital Payment Innovation and Access to Government Grants (β = 0.746, t = 4.563, p value = 0.000) indicates that there is a positive and significant relationship between Digital Payment Innovation and Access to Government Grants (H1). This means that the innovation of digital payments is positively linked to greater access to the opportunities of grants from the government for MSMEs.

Similarly, Access to FinTech Loans (β = 0.463, t = 5.005, p = 0.000) is supported by Digital Lending Innovation with a positive trend. This means that digital lending platforms are enabling the ability to avail loans using FinTech platforms for MSMEs by making the digital credit services more accessible and efficient.

Also, the correlation between Mobile and Internet Banking and Access to Traditional Bank Loans (β = 0.711, t = 10.574, p = 0.000) was positive and significant, which provides support to H3. This indicates that the increased adoption of mobile/internet banking services facilitates MSMEs' access to traditional bank lending, which could be achieved by the enhanced visibility of transactions, financial records and interactions between MSMEs and formal financial organizations.

Discussion

Enabling access to government grants and payment innovation via digital channels. The strongest coefficient among the three relationships was between digital payment innovation and access to government grants, suggesting that for every 1-unit increase in a MSME's digital payment engagement, a substantial increase in government grants is present. Therefore, the null hypothesis $H0_1$ is rejected and it is concluded that there exists a positive relation between payment innovation and access to government grants of MSMEs in the south-East zone. The result is very supportive of the arguments of Ozili (2018) and Gomber et al. (2017) that digital finance provides verifiable and traceable evidence of financial transactions, which reduces information asymmetry faced by public agencies when assessing their grant applications. It also supports Crawford et al. (2024) who postulated that it is 'a particularly designed method of government-backed financial facilitation for enterprises whose financial activity can be independently verified'. Meanwhile, this pathway is partially counterintuitive to Crawford, et al. (2024), who noted that the uptake and awareness of government finance schemes among enterprises eligible to access them is generally low, meaning that small businesses using digital payments could be close to the threshold for documentation to access such schemes, but the magnitude of the coefficient may vary somewhat between different types of MSMEs.

Digital Lending Innovation + Access to FinTech loans. The digital lending innovation to access to FinTech loans, which is still very important, but gives the weakest relationship among the three. It is therefore concluded that there is a significant relationship between the digital lending innovation and access to FinTech loans, with $H0_2$ being rejected. This is consistent with the findings of Abbasi et al., (2021), Gu et al., (2023), and Sanga and Aziakpono, (2024), which respectively discovered that digital/FinTech credit giving methods purposefully influence SME financing outcomes. The effect of peer to peer lending FirTechs on access to finance for SMEs, however, is relatively small, compared to the impact of H1 and H3, and is strongly grounded in the findings of Abbasi et al. (2021), which showed how the impact of P2P lending FirTechs on access to finance for SMEs is strongly influenced by institutional quality. Unlike the OECD economies studied by Abbasi et al. (2021), Nigeria's FinTech lending regulatory system is not quite as developed, resulting in a comparatively lower, albeit strong and significant, coefficient, which largely confirms that weaker regulatory environments of FinTech innovation do not prevent but rather lessen the funding advantages of digital lending.

Mobile and Internet Banking, Traditional Bank Loans. The coefficient for this path was also strong and had the highest t-statistic and lowest standard deviation amongst the 3 paths, suggesting that this path had the highest significance and was most precisely estimated of the 3 paths in the model. $H0_3$ is therefore accepted indicating that mobile and internet banking have a proper relationship with traditional bank loan availability with MSMEs in the zone. This result supports the findings of Beck and Demirgüç-Kunt (2006) that it is the history of documented transactions which is crucial for bank credit-screening decisions and Kumar et al. (2024) who emphasized the importance of digital financial access for influencing the outcome of financing decisions for SMEs. The precision of this estimate (even by small standard deviation) indicates the causal link between a sustained pattern of digital banking use and that of

conventional bank credit is the most robust from the three innovationfunding pairings tested, plausibly because digital banking activity results in a type of transaction history that is the highest order of predictability and measurability that Beck and Demirgüç-Kunt (2006) identified as the key ingredient in bank lending decisions.

Conclusion and Recommendations

Conclusion

The study sought insights into the link between financial innovation and access to finance in a developing economy through evidence in selected states in Nigeria among MSMEs. The research concluded that digital payment innovation can significantly make government grants more accessible to the population, digital lending innovation can make FinTech loans more accessible to the population, while mobile and Internet banking can strengthen the access to traditional bank loans. Overall, the study finds financial innovation to be an important means to promote better financing outcomes for MSMEs through its ability in lowering financial obstacles, improving financial inclusion and making financing more accessible. This means, increased market penetration and support for innovative financial instruments is of crucial importance to overcome some of the longstanding funding constraints of MSMEs in developing economies.

Recommendations

Based on the findings, the study recommends that:

1. MSME owners and managers should adopt digital payment innovations such as electronic payment platforms and digital transaction systems to improve their financial visibility and strengthen their eligibility for government grant opportunities.
2. MSME owners and managers should utilize digital lending platforms as alternative financing channels to overcome limitations associated with traditional borrowing processes and improve access to FinTech-based loans.
3. MSME owners and managers should actively integrate mobile and internet banking into their business operations to enhance financial record keeping, improve relationships with formal financial institutions, and increase their chances of accessing traditional bank loans.

Suggestions for Further Studies

Future work could build on the findings of this study, analyze other aspects of financial innovation (including open banking, crowdsourcing, artificial intelligence, credit assessment, blockchain-based finance), and apply these data to a broader understanding of the impact emerging financial technologies has on MSME financing. Future studies can also take into account the moderating role of other factors such as financial literacy, digital capability, regulatory framework, or institutional backing in the link between financial innovations and access to finance. Furthermore, cross-referencing similar research in other parts of Nigeria and other developing economies can further improve the cross-versality of findings and give a comparative perspective on how financial innovation is impacting on the financing of MSMEs in Nigeria.

References

Abbasi, K., Alam, A., Brohi, N. A., Brohi, I. A., & Nasim, S. (2021). P2P lending Fintechs and SMEs' access to finance. Economics Letters, 204, Article 109890. https://doi.org/10.1016/j.econlet.2021.109890

Beck, T., & Demirgüç-Kunt, A. (2006). Small and medium-size enterprises: Access to finance as a growth constraint. Journal of Banking and Finance, 30(11), 2931–2943. https://doi.org/10.1016/j.jbankfin.2006.05.009

Beck, T., Demirgüç-Kunt, A., Laeven, L., & Maksimovic, V. (2006). The determinants of financing obstacles. Journal of International Money and Finance, 25(6), 932–952. https://doi.org/10.1016/j.jimonfin.2006.07.005

Crawford, J., Cui, Z.-Y. A., & Kewley, D. (2024). Government finance, loans, and guarantees for small and medium enterprises (SMEs) (2000–2021): A systematic review. Journal of Small Business Management, 62(5), 2607–2637. https://doi.org/10.1080/00472778.2023.2246061

Dela Cruz, N. A., Villanueva, A. C. B., Tolin, L. A., Disse, S., Lensink, R., & White, H. (2025). Effects of interventions to improve access to financial services for micro, small, and medium-sized enterprises in low- and middle-income

countries: An evidence and gap map. Campbell Systematic Reviews, 21(3), Article e70061. https://doi.org/10.1002/cl2.70061

Dike, O. N., Uwaoma, U. G. A., & Nwodo, S. I. (2024). Market forces and marketing performance of leather products manufacturers in Abia State, Nigeria. British Journal of Marketing Studies, 12(6), 114–133.

Fajarika, D., Trapsilawati, F., & Sopha, B. M. (2024). Influential factors of small and medium-sized enterprises' growth across developed and developing countries: A systematic literature review. International Journal of Engineering Business Management, 16(2). https://doi.org/10.1177/18479790241258097

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research, 18(1), 39–50. https://doi.org/10.1177/002224378101800104

Frame, W. S., & White, L. J. (2004). Empirical studies of financial innovation: Lots of talk, little action? Journal of Economic Literature, 42(1), 116–144. https://doi.org/10.1257/002205104773558065

Gomber, P., Koch, J.-A., & Siering, M. (2017). Digital finance and FinTech: Current research and future research directions. Journal of Business Economics, 87(5), 537–580. https://doi.org/10.1007/s11573-017-0852-x

Gu, F., Gao, J., Zhu, X., & Ye, J. (2023). The impact of digital inclusive finance on SMEs' technological innovation activities—Empirical analysis based on the data of new third board enterprises. PLOS ONE, 18(11), Article e0293500. https://doi.org/10.1371/journal.pone.0293500

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). A primer on partial least squares structural equation modeling (PLS-SEM) (3rd ed.). Sage Publications.

International Finance Corporation. (2024). MSME finance. https://www.ifc.org/en/what-we-do/sector-expertise/financial-institutions/msme-finance

International Monetary Fund. (2024). World economic outlook: Policy pivot, rising threats. IMF.

Kock, N., & Hadaya, P. (2018). Minimum sample size estimation in PLS-SEM: The inverse square root and gamma-exponential methods. Information Systems Journal, 28(1), 227–261. https://doi.org/10.1111/isj.12131

Kumar, M. V., Almuraqab, N., Moonesar, I. A., Braendle, U. C., & Rao, A. (2024). How critical is SME financial literacy and digital financial access for financial and economic development in the expanded BRICS block? Frontiers in Big Data, 7, Article 1448571. https://doi.org/10.3389/fdata.2024.1448571

Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. Journal of Financial Economics, 13(2), 187–221. https://doi.org/10.1016/0304-405X(84)90023-0

Ozili, P. K. (2018). Impact of digital finance on financial inclusion and stability. Borsa Istanbul Review, 18(4), 329–340. https://doi.org/10.1016/j.bir.2017.12.003

Rogers, E. M. (2003). Diffusion of innovations (5th ed.). Free Press.

Sanga, B., & Aziakpono, M. (2024). FinTech developments and their heterogeneous effect on digital finance for SMEs and entrepreneurship: Evidence from 47 African countries. Journal of Entrepreneurship in Emerging Economies, 17(7), 127–155. https://doi.org/10.1108/JEEE-09-2023-0379

Saunders, M. N. K., Lewis, P., & Thornhill, A. (2023). Research methods for business students (9th ed.). Pearson.

Small and Medium Enterprises Development Agency of Nigeria, & National Bureau of Statistics. (2021). National survey of micro, small and medium enterprises (MSMEs) in Nigeria. SMEDAN.

Tufano, P. (2003). Financial innovation. In G. M. Constantinides, M. Harris, & R. M. Stulz (Eds.), Handbook of the economics of finance (Vol. 1A, pp. 307–335). Elsevier. https://doi.org/10.1016/S1574-0102(03)01010-0

United Nations Development Programme. (2024). Human development report 2023/24: Breaking the gridlock: Reimagining cooperation in a polarized world. UNDP.

World Bank. (2024). World development indicators. https://databank.worldbank.org/source/world-development-indicators

World Bank Group. (2024). SMEs finance. https://www.worldbank.org/ext/en/topic/competitiveness/small-and-medium-enterprises-smes-finance

Reverse logistics for e-waste management: A new role for makerspaces

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Keywords
Circular economy; CReW; E-waste; Makerspaces; PURE framework; Reverse logistics

Abstract

Purpose: This paper condenses the paper's argument that e-waste reverse logistics requires a formal, scalable and economically viable network design. Design/methodology: A structured literature-based synthesis is used to develop two linked contributions: the Present–Unique–Repeatable–Environmentally-friendly (PURE) framework and the Centre for Refurbishment and Recycling of Electrical and Electronic Waste (CReW) concept. Findings: The review indicates that existing approaches emphasise recycling, policy, legal compliance and optimisation methods, but give limited attention to the operational role of makerspaces in collection, inspection, repair, disassembly and value recovery. The proposed CReW concept positions makerspaces as distributed hubs connected to central refurbishment, recycling and material recovery centres. Material passports, Industry 4.0/5.0 tools and operations research methods can improve traceability, customer participation, routing, facility location and decision-making. Practical implications: The proposed structure offers businesses, policymakers and circular economy actors a route to organise e-waste flows while balancing profitability, environmental performance and lean operations. Conclusion: A combined PURE–CReW approach provides a strategic and operational basis for formalising e-waste reverse logistics and for future quantitative modelling of facility location, routing, collection and recovery decisions.

Introduction

The rapid growth of electrical and electronic waste creates a supply chain challenge as well as a business opportunity. E-waste contains valuable metals and components, but also hazardous materials that require controlled handling. Although responsible production and consumption are embedded in the United Nations Sustainable Development Goals, many businesses continue to view e-waste collection, recycling and disposal as costly support activities rather than as sources of value.

This paper focuses on the reverse logistics of e-waste and proposes an integrated approach that balances profitability, sustainability and lean operations. Reverse logistics concerns the flow of products, materials and equipment after use, including collection, reuse, repair, recovery, remanufacturing and recycling. In e-waste systems, these flows are often fragmented: consumers store obsolete devices, informal collectors recover materials unevenly, and formal recycling is not always accessible or economically attractive.

The paper's central contribution is the combination of two ideas. First, the Present–Unique–Repeatable–Environmentally-friendly (PURE) framework provides a strategic guide for designing reverse logistics solutions. Second, the Centre for Refurbishment and Recycling of Electrical and Electronic Waste (CReW) concept provides an operational network in which makerspaces perform local inspection, disassembly, repair and maintenance, while CReW centres undertake refurbishment, recycling, cannibalisation and material recovery. This structure formalises roles that already exist informally and connects them to business-led and policy-supported circular economy systems.

The paper is guided by two research questions: RQ1: What optimisation methods are relevant to reverse logistics management of e-waste? RQ2: How can e-waste reverse logistics be organised using the makerspace concept?

Literature review

E-waste is defined here as discarded, obsolete or non-functional electrical and electronic equipment, including computers, mobile phones, refrigerators, washing machines and other consumer or business devices. Prior literature identifies e-waste as both resource-rich and risk-intensive because valuable metals may be recovered while hazardous compounds require careful processing. Core definitions and scale indicators are supported by (Materials Focus, 2023; Ahirwar and Tripathi, 2021; Anam and Syed, 2013; BBC, 2018; BBC News, 2024; Bridgens et al., 2017; Electronic waste and the Circular Economy, 2019; Electronic waste and the Circular Economy, 2020; Globe Newswire, 2025; Incineration of Electronic Waste, 2010; Joshi et al., 2020; Lee et al., 2024; Ni and Chan, 2023; Parajuly et al., 2019; Problems with e-waste, n.d.; Rautela et al., 2021; Recycle Your Electricals, n.d.).

Several studies emphasise the environmental and economic significance of e-waste recovery. Devices are frequently replaced because of damage, loss, product destruction, cosmetic preferences, limited repairability, technological obsolescence or changing consumer expectations. Small appliances and consumer electronics are particularly relevant because they are widely distributed and often stored at home rather than returned to formal recovery systems. Extending product lifecycles through repair, reuse and refurbishment can reduce the demand for virgin materials, transport, packaging and manufacturing inputs.

Circular economy research highlights the importance of reducing, reusing, repairing, refurbishing, remanufacturing and recycling products. However, many circular economy frameworks remain high-level and do not fully translate strategic sustainability goals into operational procedures. E-waste management therefore requires an approach that can move from policy ambition to physical network design, customer engagement, sorting, product assessment, repair decisions and material recovery. Circular economy and reverse-logistics interpretations are supported by (Bove and Swartz, 2016; Brown, 2020; Chang et al., 2017; Debnath and Sarkar, 2023; Elmas and Erdoğmuş, 2011; Ferrer and Whybark, 2000; Ellen MacArthur Foundation, 2013; H et al., 2021; Hussain et al., 2023; Jayaraman and Luo, 2007; Korra, 2022; Lai et al., 2022; Lloveras et al., 2025; Lund and Hauser, 2010; Ellen MacArthur Foundation, 2016; McFarland et al., 2013; Trojan Electronics, 2023; Zils et al., 2023).

Industry 4.0 technologies such as data-carrying devices, sensors, digital tracking, additive manufacturing and automation can support traceability and repair-oriented operations. Industry 5.0 extends this agenda by emphasising human-centric, sustainable and resilient industrial systems. Makerspaces align with this shift because they combine technical capability, community participation and flexible repair or redesign capacity. They can also support localised value creation by enabling disassembly, diagnostics, minor repairs and parts recovery before products are moved to specialist centres. Digital and Industry 4.0/5.0 enablers are supported by (Abramovici et al., 2017; Agrawal et al., 2021; Alcayaga et al., 2019; Blomeke et al., 2020; Chen, 2022; Dacre et al., 2024; Fan and Sun, 2019; Feng and Yu, 2019; Ferrer et al., 2011; Gariba et al., 2024; Ghobakhloo et al., 2023; Gu et al., 2017; John et al., 2018; Kerin and Pham, 2020; Kerin and Pham, 2019; Kumar et al., 2016; Liu et al., 2018; McKinsey & Company, 2022; Nowakowski et al., 2020; OpenAI, 2023; Rejeski et al., 2018; Rocca et al., 2020; Romero and Noran, 2017; Sarkar et al., 2025; Segovia et al., 2015; Shabur, 2024; Singh et al., 2024; Steenmans et al., 2021; Stock and Seliger, 2016; Turner et al., 2022; Yawei et al., 2017; Zwolinski et al., 2007).

Material passports are also relevant to e-waste reverse logistics. A material passport is a written or digital record describing the materials, components, lifecycle data, repair history, disassembly options and end-of-life handling requirements of a product. In an e-waste setting, material passports can improve transparency, support sorting decisions and reduce uncertainty for recyclers, manufacturers, refurbishers and consumers. Material-passport arguments are supported by (Adirorn et al., 2021; Aftab and Agliata, 2026; Atta et al., 2021; Capelleveen et al., 2023; Hagedorn et al., 2023; Hoosain et al., 2021; Jansen et al., 2022; Jensen et al., 2023; Plociennik et al., 2022; Reich et al., 2023).

Operations research has an important role in formalising e-waste systems. The literature identifies facility location, collection point allocation, routing, forecasting, capacity planning, multi-objective optimisation, mixed-integer linear programming and simulation as relevant methods. These tools can help determine where collection points, makerspaces and CReW centres should be located, how vehicles should be routed, and how costs, emissions, service time and capacity constraints should be balanced.

Operations research and optimisation evidence is supported by (Abid and Mhada, 2021; Agnudei et al., 2019; Batoo et al., 2021; Chang et al., 2021; Dekker et al., 2012; Duman et al., 2020; Duman and Kongar, 2023; Echefaj et al., 2024; Egri et al., 2021; Elia et al., 2019; Fleischmann and Minner, 2004; Gao et al., 2013; Garcia and You, 2015; Ghandi and Masehian, 2015; Goli and Golmohammadi, 2022; Gupta et al., 2021 ; Jassbi et al., 2011; Kannan et al., 2010; Kiris et al., 2019; Koshta et al., 2024; Malekkhouyan et al., 2021; Matsumoto, 2010; McKelvey and Neves, 2021; Min et al., 1998; Mogale et al., 2022; Muller et al., 2016; Nagy and Salhi, 2006; Nguyen and Qi, 2019; Pathak et al., 2022; Rani et al., 2020; Reddy et al., 2022; Senophiyah-Mary et al., 2019; Teodorović and Janić, 2017; Xu et al., 2022; Yerramalli and Burra, 2014; Yu and Solvang, 2017).

Research methodology

The paper uses a structured, literature-based methodology. The original review examined reverse logistics, e-waste management, circular economy frameworks, makerspaces, Industry 4.0/5.0 technologies, material passports and optimisation methods. Web of Science, Google Scholar and Scopus were used in the source paper to identify literature relevant to e-waste reverse logistics and optimisation. The review also considered industry and public-sector sources where they provided contextual evidence on e-waste volumes, repair behaviour and collection practices. Bibliometric analysis using R is deployed for the review.

The method is conceptual rather than empirical. Its purpose is not to test an implemented network but to synthesise evidence and propose a framework that can be tested later through operations research models and pilot studies. The framework-building approach is appropriate because the identified gap concerns execution: existing work discusses recycling, policy, circular economy and optimisation, but gives limited attention to how strategic sustainability goals can be deployed through a repeatable reverse logistics structure that includes makerspaces.

Findings and proposed framework

The PURE framework

The PURE framework translates the paper's strategic argument into four design principles. Present means that the problem is immediate: e-waste is increasing and requires current action rather than future-only planning. Unique means that solutions must be adapted to the specific geography, product mix, policy environment, consumer behaviour and business model. Repeatable means that the structure should be transferable across cities, sectors and product categories once adapted to local conditions. Environmentally-friendly means that decisions must reduce waste, emissions and virgin-material dependency while remaining economically viable. The framework-building logic is supported by (Campbell, 1988; Carter and Ellram, 1998; Clark et al., 2023; Fernando and Rupasinghe, 2016; Javed et al., 2021; Miller, 2020; Nanayakkara et al., 2022; Pavlopoulou, 2020; Pollard et al., 2023; Safdar et al., 2020; Saxena et al., 2023; Seuring and MUller, 2008; Stohler et al., 2018; Takacs et al., 2022; Theories and Frameworks, n.d.; Xavier et al., 2021).

PURE therefore acts as a bridge between high-level sustainability aspirations and operational implementation. It encourages firms to treat reverse logistics not as an isolated recycling activity but as part of a broader circular supply chain that includes procurement, manufacturing, distribution, use, return, repair, refurbishment, parts recovery and recycling.

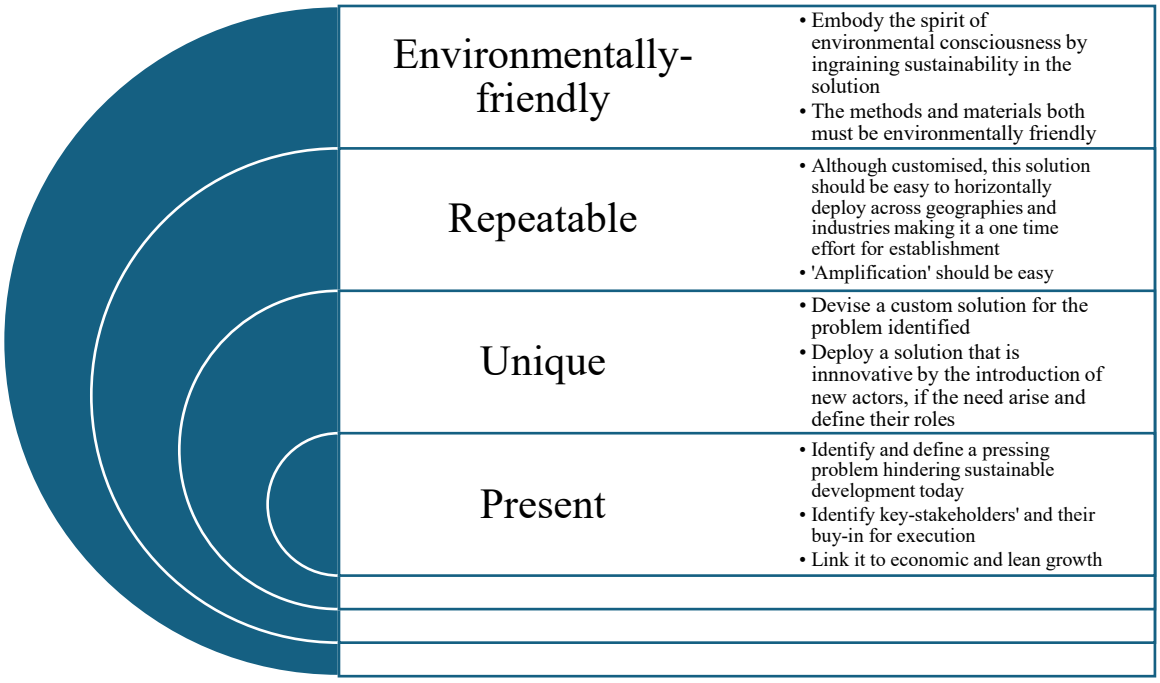


Figure 1. Proposed PURE framework for e-waste reverse logistics

The CReW concept and makerspaces

The CReW concept operationalises PURE through a network of distributed makerspaces and central CReW centres. Customers return e-waste through collection bins, take-back schemes, retail drop-off points, postal options or direct pickup. Collected products are moved first to local makerspaces where practical initial activities can occur: inspection, diagnostics, data capture, sorting, minor repair, disassembly, component harvesting and maintenance. Items requiring specialist recovery are then transported to CReW centres for refurbishment, recycling, cannibalisation or material extraction.

Makerspaces are important because they add a local and flexible layer to the reverse logistics system. They can reduce unnecessary transport to central facilities by identifying repairable or reusable items early. They can also create new revenue streams through repair services, refurbished product sales, parts recovery, training and collaboration with original equipment manufacturers. For businesses, makerspaces can complement maintenance teams, R&D units and customer service channels. For communities, they can support repair culture, skills development and circular economy participation. The makerspace and consumer-participation role is supported by (Fleischmann et al., 2016; Garai and Sarkar, 2022; Holm, 2014; Islam et al., 2021; Kerber et al., 2021; Kim and Paulos, 2011; Prendeville et al., 2017; Smith et al., 2016; Soomro et al., 2023; Vyas et al., 2023; Vyas and Vines, 2019; Yan et al., n.d.; Yan et al., 2024).

CReW centres operate as formal nodes where larger-scale decisions and processes take place. They receive flows from multiple makerspaces or collection routes, conduct more advanced refurbishment and recycling, recover materials, and redistribute products or raw materials into forward supply chains. The network therefore connects consumers, makerspaces, central recovery centres, manufacturers, retailers, recyclers and policy actors.

As shown in Figure 2, the CReW flow moves e-waste from customers to local makerspaces, then to CReW centres for cannibalisation/refurbishment, and finally to industries as recovered raw materials before re-entering forward supply chains.

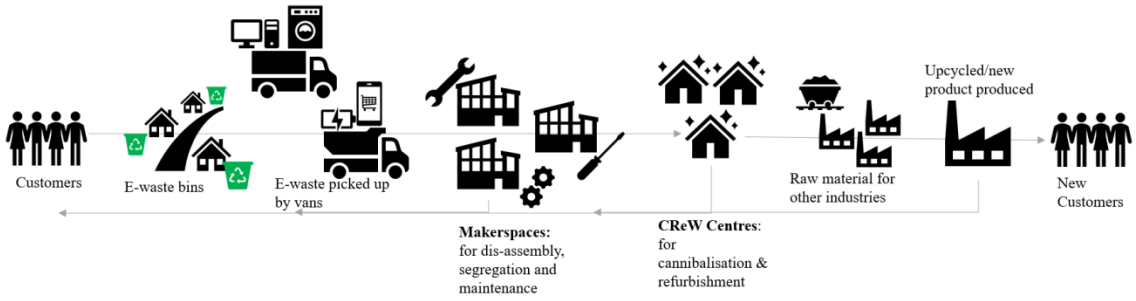


Figure 2. CReW flow of e-waste from customers to makerspaces, CReW centres and industries as raw materials

Material passports, I4.0 and I5.0

Material passports can strengthen the CReW concept by providing information on product composition, components, hazardous materials, lifecycle data, repairability, disassembly pathways and end-of-life options. This information improves decision-making at makerspaces and CReW centres, especially where handlers must choose between repair, reuse, refurbishment, recycling or disposal.

Industry 4.0 technologies can support data collection, tracking, routing and automation. Examples include QR codes, RFID, sensors, digital platforms, additive manufacturing for replacement parts, and analytics for route planning or demand forecasting. Industry 5.0 adds the human-centred dimension by emphasising collaboration between people and technologies. The combination is important because e-waste systems require technical efficiency as well as consumer trust, repair skills and local engagement.

Optimisation opportunities

The review indicates that optimisation is relevant at several points in the proposed network. Collection requires decisions on where to place bins, how to schedule pickups, whether to use vehicles, postal routes or hybrid systems, and how to minimise emissions and cost while maximising convenience. Facility location models can support decisions on where makerspaces and CReW centres should be placed relative to households, retailers, transport corridors, industrial areas and existing recycling facilities.

Vehicle routing and transshipment models can reduce travel distance, fuel use, operating cost and collection time. Forecasting models can estimate e-waste volumes and support staffing, inventory, capacity and storage decisions. Capacity planning and queueing methods can be used where repair cafes or makerspaces handle variable inflows of products. Multi-objective optimisation is particularly relevant because the system must balance cost, emissions, turnaround time, recovery rate, service quality and regulatory requirements.

Table 1. Operations Research methods relevant to e-waste reverse logistics

Application area	OR / optimisation method	Illustrative references
E-waste collection prediction, facility-location allocation and pick-up van routing	Multi-stage modelling; correlation/regression; objective functions; harmony search algorithms	Nguyen and Qi (2019); Nowakowski, Szwarc and Boryczka (2020)
E-waste prediction	Grey modelling-based forecasting; Non-linear Grey Bernoulli Model with fractional order accumulation enhanced by Particle Swarm Optimisation	Duman, Kongar and Gupta (2020); Duman and Kongar (2023)
Location of collection centres	MILP; MINLP	Nanayakkara (2022); Koshta, Patra and Singh (2024)
Location of CReW centres	MILP	Yerramalli and Burra (2014)
JIT logistics and location-routing	Stochastic models; time windows; multiple-objective optimisation	Min, Jayaraman and Srivastava (1998)

Application area	OR / optimisation method	Illustrative references
Location-routing and transportation-location decisions	Branch-and-bound; branch-and-cut; heuristics; genetic algorithms	Nagy and Salhi (2006); Fan and Sun (2019)
Transport, inventory, facility and product recovery network design	Operations Research modelling for planning and control	Dekker, Bloemhof and Mallidis (2012)
Reverse logistics network design	Heuristic approaches; integer linear programming; stochastic modelling	Reddy et al. (2022); John, Sridharan and Kumar (2018); Yu and Solvang (2017)
Facility location in reverse logistics	Bilevel optimisation and tabu search; hybrid multi-objective optimisation combining gravity method and particle swarm optimisation	Egri, David, Kis and Kresz (2021); Chang et al. (2021)
Integrated reverse logistics location-routing	Particle swarm optimisation–multi-objective immune genetic algorithm (PSO-MOIGA)	Xu, Liu, Jiang and Lin (2022)
Vehicle routing	Exact and meta-heuristic methods with sensitivity analysis	Malekkhouyan, Aghsami and Rabbani (2021)

Discussion

The combined PURE–CReW proposal addresses the gap between strategic circular economy ambitions and operational deployment. PURE provides the logic for designing solutions that are current, tailored, scalable and environmentally sound. CReW translates that logic into a network structure with specific roles for makerspaces and central recovery facilities.

The proposal also reframes consumers as active participants in reverse logistics. Return incentives, accessible collection routes and convenient drop-off systems are necessary because e-waste flows begin with the customer's willingness to release unused or damaged products. Where customers are encouraged to return devices, they act as prosumers by supplying the circular economy with products, components and materials.

For firms, the CReW concept can support both sustainability and competitiveness. Repair, parts recovery, refurbishment and material extraction can create revenue while also reducing dependence on virgin materials. Makerspaces can generate local service value and supply product-design feedback to manufacturers. The system can therefore support circular product-service models, after-sales services and reverse supply chain learning. Wider sustainability, market and resource arguments are supported by (Agrawal et al., 2015; Dua et al., 2009; Aria and Cuccurullo, 2017; Bera and Rahut, 2024; Chung and Peng, 2008; Guchhait and Sarkar, 2025; Infinity Renewables, n.d.; J.S. et al., 2016; Kaliski, 2025; Li et al., 2023; MIT Climate Portal, 2023; Oberle et al., 2019; release, n.d.; Siddique and Rosen, 1997; Thiebaud et al., 2017; Tornese et al., 2018; Yue and Gao, 2018; Zhao et al., 2019).

The proposal does not argue that recycling alone is sufficient. A hierarchy of recovery decisions is implied: repair and reuse should be prioritised where feasible; refurbishment and remanufacturing should be used where value can be restored; component cannibalisation and recycling should follow where product-level recovery is not viable. Material passports and optimisation methods support these choices by improving information quality and decision consistency.

Conclusions, limitations and future research

This condensed paper proposes a formal reverse logistics structure for e-waste management by integrating the PURE framework with the CReW concept. The first contribution is strategic: PURE offers a concise framework for designing reverse logistics systems that are Present, Unique, Repeatable and Environmentally-friendly. The second contribution is operational: the CReW concept introduces makerspaces as local nodes for inspection, repair, disassembly and maintenance, linked to central centres for refurbishment, recycling, cannibalisation and material recovery.

The two research questions are addressed as follows. For RQ1, the review identifies facility location, routing, forecasting, capacity planning, simulation, MILP/MINLP and multi-objective optimisation as relevant methods for e-waste reverse logistics. For RQ2, the paper proposes a network in which customers

return products through accessible channels, makerspaces perform local value-preserving activities, and CReW centres undertake specialised recovery and material reintegration.

It is worth mentioning that the framework is conceptual and literature-based meant for implementation. It has been tested through field implementation, quantitative modelling or stakeholder validation in the work authored by Pathak and Fatorachian (2026). This develops mathematical models for the optimal placement of makerspaces and CReW centres, evaluate routing alternatives, estimate emissions and cost trade-offs and pilot the framework with businesses, local authorities, repair cafes and consumers within UK. The key limitation is indeed the need to include legal ad policy implications of the framework and CReW concept. However, is out of scope of the research att the moment. Further work should explore how to move consumer participation from a push system, where people must be persuaded to return products, to a pull system in which return, repair and reuse become convenient and desirable.

References

Materials Focus (2023) Retrieved August 2023, from Recycle Your Electricals: **https://www.recycleyourelectricals.org.uk/ accessed on 23 Oct 2023**

Abid, S., & Mhada, F. Z. (2021). Simulation optimisation methods applied in reverse logistics: a systematic review. International Journal of Sustainable Engineering, 1463-1483.

Abramovici, M., Gobel, J., Savarino, P., & Gebus, P. (2017). Towards smart product lifecycle management with an integrated reconfiguration management. (pp. 165-168). Switzerland: Springer.

Adirorn, T., Tholen, L., & Gotz, T. (2021). Towards a Digital Product Passport Fit for Contributing to a Circular Economy. Energies, 14(8).

Aftab, U., & Agliata, R. (2026). Material passports for digital and circular construction: A bibliometric and thematic analysis. Journal of Cleaner Production, 543, Article 147651. https://doi.org/10.1016/j.jclepro.2026.147651

Agnudei, G. P., Gnoni, M. G., & Tornese, F. (2019). Modelling and simulation tools for integrating forward and reverse logistics: a literature review. Proceedings of the European Modelling and Simulation Symposium.

Agrawal, V. V., Atasu, A., & UlkU, S. (2015). Modular upgradability in consumer electronics: Economic and environmental implications. Journal of Industrial Ecology, 19(5), 859–869. https://doi.org/10.1111/jiec.12360

Agrawal, R., Wankhede, V. A., Kumar, A., Luthra, S., & Huisingh, D. (2021). Progress and trends in integrating Industry 4.0 within Circular Economy: A comprehensive literature review and future research propositions. Business Strategy and the Environment.

Ahirwar, R., & Tripathi, A. K. (2021). E-waste management: A review of recycling process, environmental and occupational health hazards, and potential solutions. Environmental Nanotechnology, Monitoring & Management.

Alcayaga, A., Wiener, M., & Hansen, E. (2019). Towards a framework of smart-circular systems: An integrative literature review. Journal of Cleaner Production, 622-634.

Anam, A., & Syed, A. (2013). Green Computing: E-waste management through recycling. International Journal of Scientific & Engineering Research, 1103-1106.

Andre Dua, Lisa Hersch, Manu Sivanandan. (2009, October 1). Consumer Packaged Goods-Insights. Retrieved from Mc. Kinsey: https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/consumer-electronics-gets-back-to-basics

Aria, M. & Cuccurullo, C. (2017) bibliometrix: An R-tool for comprehensive science mapping analysis, Journal of Informetrics, 11(4), pp 959-975, Elsevier.

Atta, I., Bakhoum, E. S., & Marzouk, M. M. (2021). Digitizing material passport for sustainable construction projects using BIM. Journal of Building Engineering, 43.

Batoo, K. M., Pandiaraj, S., Muthuramamoorthy, M., Raslan, E., & Krishnamoorthy, S. (2021). Fuzzy-based adaptive learning network using search and rescue optimization for e-waste management model: case study. Environmental Science and Pollution Research .

BBC (2018). E-waste mining could be big business - and good for the planet. Retrieved May 10, 2024, from https://www.bbc.co.uk/news/business-44642176

BBC News. (2024, March 12). Slow progress tackling UK 'e-waste tsunami' – MPs. BBC News. https://www.bbc.co.uk/news/articles/c51ep5583jyo

Bera, S., & Rahut, D. (2024). Technology development pathways: Enigmas of appropriate technology choice. Discover Sustainability, 5(45). https://doi.org/10.1007/s43621-024-00222-5

Blomeke, S., Rickert, J., Mennenga, M., Thiede, S., Spengler, T. S., & Herrmann, C. (2020). Recycling 4.0–Mapping smart manufacturing solutions to remanufacturing and recycling operations. Procedia CIRP.

Bove, A.-T., & Swartz, S. (2016, November 11). Starting at the source: Sustainability in supply chains. McKinsey & Company. https://www.mckinsey.com/capabilities/sustainability/our-insights/starting-at-the-source-sustainability-in-supply-chains

Bridgens, B., Hobson, K., Lilley, D., Lee, J., Scott, J. L., & Wilson, G. T. (2017). Closing the Loop on E-waste A Multisdisciplinary Perspective. Journal of Industrial Ecology.

Brown, A. B. (2020). Gartner: Fifty-one percent of supply chain pros expect to increase circular economy focus. Retrieved August 24, 2023, from https://www.supplychaindive.com/news/gartner-survey-supply-chain-circulareconomy/585962/

Campbell, D. J. (1988). Task Complexity: A Review and Analysis. Academy of Management Review, 13(1), 40–52. https://doi.org/10.5465/amr.1988.4306775

Capelleveen, G. v., Vegter, D., Olthaar, M., & Hillegersberg, J. v. (2023). The anatomy of a passport for the circular economy: a conceptual definition, vision and structured literature review. Resources, Conservation & Recycling Advances, 17.

Carter, C. R., & Ellram, L. M. (1998). Reverse Logistics: A Review of the Literature and Framework for Future Investigation. Journal of Business Logistics, 85-102.

Chang, L., Zhang, H., Xie, G., Yu, Z., Zhang, M., Li, T., . . . Yu, D. (2021). Reverse Logistics Location Based on Energy Consumption: Modeling and Multi-Objective Optimization Method. Applied Sciences.

Chang, M. M., Ong, S. K., & Nee, A. Y. (2017). AR-guided product disassembly for maintenance and remanufacturing. Proceedia CIRP.

Chen, X. (2022). Machine learning approach for a circular economy with waste recycling in smart cities. Energy Reports, 8, 3127-3140.

Chung, C., & Peng, Q. (2008). Enabled dynamic tasks planning in Web-based virtual manufacturing environments. Comput. Ind., 82-95.

Clark, W. C., van Kerkhoff, L., Lebel, L., & Gallopin, G. C. (2023). What is a framework? Understanding their purpose, value, development and use. Journal of Environmental Studies and Sciences, 13(3), 510–519. https://doi.org/10.1007/s13412-023-00833-w

Dacre, N., Yan, J., Frei, R., Al-Mhdawi, M. K. S., & Dong, H. (2024). Advancing sustainable manufacturing: a systematic exploration of Industry 5.0 supply chains for sustainability, human-centricity, and resilience. Production Planning & Control, 1–30. https://doi.org/10.1080/09537287.2024.2380361

Debnath, A., & Sarkar, B. (2023). Effect of circular economy for waste nullification under a sustainable supply chain management. Journal of Cleaner Production, 385, 135477.

Dekker, R., Bloemhof, J., & Mallidis, I. (2012). Operations Research for green logistics–An overview of aspects,issues, contributions and challenges. European Journal of Operational Research, 671-679.

Duman, G. M., Kongar, E., & Gupta, S. M. (2020). Predictive analysis of electronic waste for reverse logistics operations: A comparison of improved univariate grey models. Soft Computing, 24(20), 15747–15762. https://doi.org/10.1007/s00500-020-04904-w

Duman, G. M., & Kongar, E. (2023). ESG modeling and prediction uncertainty of electronic waste. Sustainability, 15(14), Article 11281. https://doi.org/10.3390/su151411281

Echefaj, K., Charkaoui, A., Cherrafi, A., Tiwari, S., Sharma, P., & Jabbour, C. J. C. (2024). From linear to circular sustainable supply chain network optimisation: towards a conceptual framework. Production Planning & Control, 1–25. https://doi.org/10.1080/09537287.2024.2302479

Egri, P., David, B., Kis, T., & Kresz, M. (2021). Robust facility location in reverse logistics. Annals of Operations Research, 163-188.

Electronic waste and the Circular Economy. (2019-21). London: Parliamentary Copyright House of Commons 2020. Retrieved September 2023, from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://committees.parliament.uk/publications/3675/documents/35777/default/

Electronic waste and the Circular Economy. (2020) Parliamentary Copyright House of Commons 2020.

Elia, V., Gnoni, M. G., & Tornese, F. (2019). Designing a sustainable dynamic collection service for WEEE: an economic and environmental analysis through simulation. . Waste Manag. Res., 402-411.

Elmas, G., & Erdoğmuş, F. (2011). The importance of reverse logistics. International Journal of Business and Management Studies, 3(1), 161–174. Retrieved from https://dergipark.org.tr/en/download/article-file/255912

Fan, T., & Sun, Y. (2019). Research on path optimization of reverse logistics network. International Conference on Image and Video Processing, and Artificial Intelligence . China.

Feng, J., & Yu, K. (2019). Moore's law and price trends of digital products: The case of smartphones. Economics of Innovation and New Technology, 29(4), 349–368. https://doi.org/10.1080/10438599.2019.1628509

Fernando, K., & Rupasinghe, T. D. (2016). A Conceptual Framework for E-waste Management through ReverseLogistics: A Case Study from Australia. International Journal of Operations and Logistics Management, 190-211.

Ferrer, G., & Whybark, D. C. (2000). From garbage to goods: successful remanufacturing systems and skills. Business Horizon, 55-64.

Ferrer, G., Heath, S. K., & Dew, N. (2011). An RFID application in large job shop remanufacturing operations. Int. J. of Prod. Econ., 612-621.

Fleischmann, K., Hielscher, S., & Merritt, T. (2016). Making things in Fab Labs: A case study on sustainability and co-creation. Digital Creativity, 27(2), 113–131. https://doi.org/10.1080/14626268.2015.1135809

Fleischmann, M., & Minner, S. (2004). Inventory Management in Closed Loop Supply Chains . Supply Chain Management and Reverse Logistics, 115-138.

Foundation, E. M. (2013). Towards the Circular Economy. Ellen Mac Arthur Foundation.

Gao, W. J., Xing, B., & Marwala, T. (2013). Teaching - Learning-Based Optimization Approach for Enhancing Remanufacturability Pre-evaluation System's Reliability. Proceedings of the 2013 IEEE Symposium on Swarm Intelligence, SIS 2013 - 2013 IEEE Symposium Series on Computational Intelligence. SSCI.

Garai, A., & Sarkar, B. (2022). Economically independent reverse logistics of customer-centric closed-loop supply chain for herbal medicines and biofuel. Journal of Cleaner Production, 334, 129977.

Garcia, D. J., & You, F. (2015). Supply chain design and optimization: Challenges and opportunities. Computers & Chemical Engineering, 81, 153-170.

Gariba, M. I., Arthur, E. E., & Odei, S. A. (2024). Assessing the impact of public digitalization on sustainability: The mediating role of technological innovation in the context of the EU. Discover Sustainability, 5(204). https://doi.org/10.1007/s43621-024-00397-x

Ghandi, S., & Masehian, E. (2015). Review and taxonomies of assembly and disassembly path planning problems and approaches. Computer Aided Design, 58-86.

Ghobakhloo, M., Iranmanesh, M., Tseng, M. L., Grybauskas, A., Stefanini, A., & Amran, A. (2023). Behind the definition of Industry 5.0: a systematic review of technologies, principles, components, and values. Journal of Industrial and Production Engineering, 40(6), 432–447. https://doi.org/10.1080/21681015.2023.2216701

Globe Newswire. (2025, April 25). E-waste management market report 2025: Revenues to grow by $52.5 billion during 2025–2029, led by Glencore Int'l, Veolia Environment, Aurubis, Waste Management, and Boliden. Yahoo Finance. https://uk.finance.yahoo.com/news/e-waste-management-market-report-081000205.html

Goli, A., & Golmohammadi, A.-M. (2022). Multi-objective Optimization of Location and Distribution in a Closed-loop Supply Chain by Considering Market Share in Competitive Conditions. International Journal of Supply and Operations Management , 483-495.

Gu, F., Ma, B., Guo, J., Summers, P. A., & Hall, P. (2017). Internet of things and Big Data as potential solutions to the problems in waste electrical and electronic equipment management: an exploratory study. Waste Management, 434-448.

Guchhait, R., & Sarkar, B. (2025). Economic evaluation of an outsourced fourth-party logistics (4PL) under a flexible production system. International Journal of Production Economics, 279, 109440.

Gupta, S., Haq, A., Ali, I., & Sarkar, B. (2021). Significance of multi-objective optimization in logistics problem for multi-product supply chain network under the intuitionistic fuzzy environment. Complex & Intelligent Systems, 7(4), 2119–2139.

Hagedorn, T., Lopes, A. do C. P., Schebek, L., Vogelgesang, M., Benner, W., Li, C., Plociennik, C., Hossein, H., Knetch, S., & Kellerer, B. (2023). The practical use of a digital product passport – Development of an application-friendly tool for e-waste decision support. In Proceedings of the 19th International Symposium on Waste Management & Sustainable Landfilling (SARDINIA 2023). CISA Publisher.

H, M., Kannan, D., Gholami-Zanjam, S. M., & Biuki, M. (2021). Transition towards circular supplier selection in petrochemical industry: A hybrid approach to achieve sustainable development goals. Journal of Cleaner Production.

Holm, E. J. (2014). What are Makerspaces, Hackerspaces, and Fab Labs? SSRN.

Hoosain, M. S., Paul, B. S., Raza, S. M., & Ramakrishna, S. (2021). Material Passports and Circular Economy. An Introduction to Circular Economy, 131-158.

Hussain, M., Khan, M., & Saber, H. (2023). Thematic analysis of circular economy practices across closed-loop supply chains: An institutional theory perspective. Sustainable Production and Consumption, 40, 122-134. https://doi.org/10.1016/j.spc.2023.06.017

Incineration of Electronic Waste. (2010, April 22). Retrieved from Incineration of Electronic Waste: https://incinerationofelectronicwaste.blogspot.com/

Infinity Renewables. (n.d.). When will the Earth run out of fossil fuels? https://infinity-renewables.com/162-2/

Islam, M. T., Huda, N., Sahajwalla, V., Bamuber, A., Shumon, R., Zaman, A., & Ali, F. (2021). A global review of consumer behavior towards e-waste and implications for the circular economy. Journal of Cleaner Production.

J.S., S., Kumar, M., Graham, G., Phillips, W., Tooze, J., Ford, S., & Beecher, P. (2016). Distributed manufacturing: scope, challenges and opportunities. International Journal of Production Research.

Jansen, M., Gerstenberger, B., Bitter-Krahe, J., Berg, H., Sebestyen, J., & Schneider, J. (2022). Current approaches to the Digital Product Passport for a Circular Economy. Wuppertal Paper no. 198, Wuppertal Institute.

Javed, H., Firdousi, S. F., Murad, M., Jiatong, W., & Abrar, M. (2021). Exploring Disposition Decision for Sustainable Reverse Logistics in the Era of A Circular Economy: Applying the Triple Bottom Line Approach in the Manufacturing Industry . International Journal of Supply and Operations Management , 53-68.

Jayaraman, V., & Luo, Y. (2007). Creating Competitive Advantages through New Value Creation: A Reverse Logistics Perspective. Academy of Management Perspectives, 56-73.

Jassbi, J., Mohamadnejad, F., & Nasrollahzadeh, H. (2011). A fuzzy DEMATEL framework for modeling cause and effect relationships of strategy map. Expert Systems with Applications, 38(5), 5967–5973. https://doi.org/10.1016/j.eswa.2010.11.026

Jensen, S. F., Kristensen, J. H., Adamsen, S., Christensen, A., & Waehrens, B. V. (2023). Digital product passports for a circular economy: Data needs for product life cycle decision-making. Sustainable Production and Consumption, 37, 242-255. https://doi.org/10.1016/j.spc.2023.02.021

John, S. T., Sridharan, R., & Kumar, P. N. R. (2018). Reverse logistics network design: A case of mobile phones and digital cameras. International Journal of Advanced Manufacturing Technology, 94(1–4), 615–631. https://doi.org/10.1007/s00170-017-0864-2

Joshi, S., Joshi, T. R., & Kapadia, H. N. (2020). SUPPLY CHAIN MANAGEMENT OF E-WASTE IN INDIA. Journal of Critical Reviews.

Kaliski, B. (2025). Moore's Law. In S. Jajodia, P. Samarati, & M. Yung (Eds.), Encyclopedia of cryptography, security and privacy. Springer. https://doi.org/10.1007/978-3-030-71522-9_420

Kannan, G., Sasikumar, P., & Devika, K. (2010). A Genetic Algorithm Approach for Solving A Closed Loop Supply Chain Model: A Case of Battery Recycling. Applied Mathematical Modelling, 655-670.

Kerber, J. C., de Souza, E. D., Bouzon, M., Cruz, R. M., & Govindan, K. (2021, August 1). Consumer behaviour aspects towards remanufactured electronic products in an emerging economy: Effects on demand and related risks. Resources, Conservation and Recycling. Retrieved from https://www.sciencedirect.com/journal/cleaner-logistics-and-supply-chain/about/call-for-papers#consumer-role-in-product-end-of-life-return-challenges-and-opportunities-for-circular-supply-chains-1

Kerin, M., & Pham, D. (2020). Smart remanufacturing: A review and research framework. J. Manuf. Technol. Manag, 1205-1235.

Kerin, M., & Pham, D. T. (2019). A review of emerging industry 4.0 technologies in remanufacturing. Journal of Cleaner Production, 237(10).

Kim, S., & Paulos, E. (2011). Practices in the creative reuse of e-waste. In CHI '11: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 2395–2404). ACM. https://doi.org/10.1145/1978942.1979292

Kiris, S. B., Borekci, D. Y., & Koc, T. (2019). A Methodology Proposal for Supplier Performance Evaluation: Fuzzy DEMATEL Method with Sustainability Integrated SCOR Model. International Conference on Intelligent and Fuzzy Systems.

Korra, C. (2022). Navigating the environmental footprint: Pathways to a circular economy. International Journal of Research Radicals in Multidisciplinary Fields (IJRRMF), 1(2), 83–91.

Koshta, N., Patra, S., & Singh, S. P. (2024). A location-allocation model for E-waste acquisition from households. Journal of Cleaner Production, 440, 140802. https://doi.org/10.1016/j.jclepro.2024.140802

Kumar, M., Graham, G., Hennelly, P., & Srai, J. (2016). How Will Smart City Production Systems Transform Supply Chain Design: A Product-Level Investigation. International Journal of Production Research.

Lai, N. G., Kuah, A. T., Kim, C. H., & Wong, K. H. (2022). Toward sustainable express deliveries for online shopping: Reusing packaging materials through reverse logistics. Thunderbird International Business Review.

Lee, J., Choi, H., & Kim, J. (2024). Environmental and economic impacts of e-waste recycling: A systematic review. Chemical Engineering Journal, 494, 152917. https://doi.org/10.1016/j.cej.2024.152917

Li, Z.-Z., Meng, Q., Zhang, L., Lobont, O.-R., & Shen, Y. (2023). How do rare earth prices respond to economic and geopolitical factors? Resources Policy, 85(Part A), 103853. https://doi.org/10.1016/j.resourpol.2023.103853

Liu, S., Zhang, G., & Wang, L. (2018). IoT-enabled dynamic optimisation for sustainable reverse logistics.

Lloveras, J., Pansera, M., & Smith, A. (2025). On 'the politics of repair beyond repair': Radical democracy and the right to repair movement. Journal of Business Ethics, 196, 325–344. https://doi.org/10.1007/s10551-024-05705-z

Lund, R. T., & Hauser, W. M. (2010). Remanufacturing-an American Perspective. Responsive Manufacturing - Green Manufacturing.

Mac Arthur, Dame Ellen; Waughray, Dominic;. (2016). Intelligent Assets: Unlocking the Circular Economy Potential. Ellen Mc Arthur Foundation.

Malekkhouyan, S., Aghsami, A., & Rabbani, M. (2021). An integrated multi-stage vehicle routing and mixed-model job-shop-type robotic disassembly sequence scheduling problem for e-waste management system. International Journal of Computer Integrated Manufacturing, 34(11), 1237–1262. https://doi.org/10.1080/0951192X.2021.1963484

Matsumoto, M. (2010). "Development of a Simulation Model for Reuse Businesses and Case Studies in Japan. Journal of Cleaner Production, 1284-1299.

McFarland, R., Reise, C., Postawa, A., & Seliger, G. (2013). AR-guided product disassembly for maintenance and remanufacturing. Verl. der TU Berlin.

McKelvey, F., & Neves, J. (2021). Introduction: Optimisation and its discontents. Review of Communication, 21(2), 95–112. https://doi.org/10.1080/15358593.2021.1936143

McKinsey & Company. (2022, August 17). What are Industry 4.0, the Fourth Industrial Revolution, and 4IR? McKinsey & Company. https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-are-industry-4-0-the-fourth-industrial-revolution-and-4ir

Miller, K. (2020). THE TRIPLE BOTTOM LINE: WHAT IT IS & WHY IT'S IMPORTANT. Retrieved June 2023, from https://online.hbs.edu/blog/post/what-is-the-triple-bottom-line

Min, H., Jayaraman, V., & Srivastava, R. (1998). Combined location-routing problems: A research directions synthesis and future . European Journal of Operational Research.

MIT Climate Portal. (2023, October 20). Will climate change drive humans extinct or destroy civilization? Ask MIT Climate. https://climate.mit.edu/ask-mit/will-climate-change-drive-humans-extinct-or-destroy-civilization

Mogale, D. G., De, A., Ghadge, A., & Aktas, E. (2022). Multi-objective modelling of sustainable closed-loop supply chain network with price-sensitive demand and consumer's incentives. Computers & Industrial Engineering. Retrieved from https://www.sciencedirect.com/journal/cleaner-logistics-and-supply-chain/about/call-for-papers#consumer-role-in-product-end-of-life-return-challenges-and-opportunities-for-circular-supply-chains-1

Muller, B. C., Nguyen, T. D., Dang, Q. V., Duc, B. M., Seliger, G., Kruger, J., & Kohl, H. (2016). Simulation-games for learning conducive workplaces: a case study for manual assembly.

Nagy, G., & Salhi, S. (2006). Location-routing:Issues,modelsandmethods. European Journal of Operational Research.

Nanayakkara, P. R., Jayalath, M. M., Thibbotuwawa, A., & Perera, H. N. (2022). A circular reverse logistics framework for handling e-commerce returns. Cleaner Logistics and Supply Chain.

Nguyen, Q., & Qi, D. (2019). Modeling and Optimization of Electronic Waste Collection System. ASEE North Central Section Conference (pp. 1-9). American Society for Engineering Education.

Nowakowski, P., Szwarc, K., & Boryczka, U. (2020). Combining an artificial intelligence algorithm and a novel vehicle for sustainable e-waste collection. Science of the Total Environment, 730, 138726. https://doi.org/10.1016/j.scitotenv.2020.138726

Ni, Z., & Chan, H. K. (2023). Systematic literature review of reverse logistics for e-waste: overview, analysis, and future research agenda. International Journal of Logistics Research and Applications.

Oberle, B., Bringezu, S., Hatfield-Dodds, S., Hellweg, S., Schandl, H., & Clement, J. (2019). Global Resurces Outlook-NATURAL RESOURCES FOR THE FUTURE WE WANT. United Nations Environment Programme.

OpenAI. (2023). ChatGPT. Retrieved August 2023

Parajuly, K., Kuehr, R., Awasthi, A. K., Fitzpatrick, C., Lepawsky, J., Smith, E., ... & Zeng, X. (2019). Future e-waste scenarios.

Pathak, S., and H. Fatorachian. 2026. "Operations Research-Based Formalisation and Design of Sustainable Reverse Logistics for E-Waste Supply Chains." *Business Strategy and the Environment*, 1–28. https://doi.org/10.1002/bse.70789.

Pathak, S., Kumar, A., Kurian , J., Garn, W., & Turner, C. (2022). Optimisation of Reverse Logistics for e-waste Management. In Proceedings of the 2nd Pritam Singh Memorial (PRISM) Conference. Nagpur.

Pavlopoulou, Y. (2020). European framework conditions of the Circular Collaborative Production. Pop-Machina, D, 2.

Plociennik, C., Pourjafarian, M., Nazeri, A., Windholz, W., Knetsch, S., Rickert, J., . . . Weidenkaff, A. (2022). Towards a Digital Lifecycle Passport for the Circular Economy. Procedia CIRP.

Pollard, J., Osmani, M., Grubnic, S., Díaz, A. I., Grobe, K., Kaba, A., UnlUer, O., & Panchal, R. (2023). Implementing a circular economy business model canvas in the electrical and electronic manufacturing sector: A case study approach. Sustainable Production and Consumption, 36, 17-31. https://doi.org/10.1016/j.spc.2022.12.009

Prendeville, S., Hartung, G., Brass, C., Purvis, E., & Hall, A. (2017). Circular Makerspaces: the founder's view. International Journal of Sustainable Engineering, 272-288.

Problems with e-waste. (n.d.). Retrieved from Recycle Your Electricals: https://www.recycleyourelectricals.org.uk/problems-with-e-waste/

Rani, S., Ali, R., & Agarwal, A. (2020). Fuzzy Inventory Model for New and Refurbished Deteriorating Items with Cannibalisation in Green Supply Chain. International Journal of Systems Science: Operations & Logistics.

Rautela, R., Arya, S., Vishwakarma, S., Lee, J., Kim, K.-H., & Kumar, S. (2021). E-waste management and its effects on the environment and human health. Science of The Total Environment, 1-16.

Recycle your Electricals. (n.d.). Retrieved 2022, from https://www.recycleyourelectricals.org.uk/press-releases/electrical-waste-challenges-and-opportunities/

Reddy, K. N., Kumar, A., Choudhary, A., & Cheng, T. E. (2022). Multi-period green reverse logistics network design: An improved Benders-decomposition-based heuristic approach. European Journal of Operational Research, 303(2), 735-752.

Reich, R. H., Ayan, J., Alaerts, L., & Acker, K. V. (2023). Defining the goals of Product Passports by circular product strategies. Procedia CIRP.

Rejeski, D., Zhao, F., & Huang, Y. (2018). Research needs and recommendations on environmental implications of additive manufacturing. Additiv. Manuf., 21-28.

release, M. (n.d.). UK residents could save the economy over £370m by recycling electricals. Material Focus.

Rocca, R., Rosa, P., Sassanelli, C., Fumagalli, L., & Terzi, S. (2020). Integrating virtual reality and digital twin in circular economy practices: A laboratory application case. Sustainability, 12(6).

Romero, D., & Noran, O. (2017). Towards green sensing virtual enterprises: Interconnected sensing enterprises, intelligent assets and smart products in the cyber-physical circular economy. IFAC-Pap, 11719-11724.

Safdar, N., Khalid, R., Ahmed, W., & Imran, M. (2020). Reverse logistics network design of e-waste management under the triple bottom line approach. Journal of Cleaner Production, 272(1).

Sarkar, B., Kugele, A. S. H., & Sarkar, M. (2025). Two non-linear programming models for the multi-stage multi-cyde smart production system with autonomation and remanufacturing in same and different cycles to reduce wastes. Journal of Industrial Information Integration, 44, 100749.

Saxena, N., Sarkar, B., Wee, H.-M., Reong, S., Singh, S. R., & Hsiao, Y. L. (2023). A reverse logistics model with eco-design under the Stackelberg-Nash equilibrium and centralized framework. Journal of Cleaner Production, 387, 135789. https://doi.org/10.1016/j.jclepro.2023.135789

Segovia, D., Ramirez, H., Mendoza, M., Mendoza, E., & Gonzalez , E. (2015). Machining and dimensional validation training using augmented reality for a lean process. Proceda Computer Science.

Senophiyah-Mary, J., Thomas, T., Loganath, R., & Meenambal, T. (2019). Optimisation of Copper Removal from E-Waste Using Bioleaching Technique by Activated Mosambi Peels. Waste Valorisation and Recycling, 363-371.

Seuring, S., & MUller, M. (2008). From a Literature Review to a Conceptual Framework for Sustainable Supply Chain Management. Journal of Cleaner Production, 16(15), 1699–1710. https://doi.org/10.1016/j.jclepro.2008.04.020

Shabur, M. A. (2024). A comprehensive review on the impact of Industry 4.0 on the development of a sustainable environment. Discover Sustainability, 5(97). https://doi.org/10.1007/s43621-024-00290-7

Siddique, Z., & Rosen, D. W. (1997). Virtual prototyping approach to product disassembly reasoning. Computer Aided Design, 847-860.

Singh, S. K., Chauhan, A., & Sarkar, B. (2024). Resilience of sustainability for a smart production system to produce biodiesel from waste animal fat. Journal of Cleaner Production, 452, 142047.

Smith, A., Fressoli, M., Abrol, D., Arond, E., & Ely, A. (2016). Grassroots innovation movements. Earthscan from Routledge.

Soomro, S. A., Casakin, H., Nanjappan, V., & Georgiev, G. V. (2023). Makerspaces fostering creativity: A systematic literature review. Journal of Science Education and Technology, 32, 530–548. https://doi.org/10.1007/s10956-023-10041-4

Steenmans, K., Taylor, P., & Steenmans, I. (2021). Regulatory Opportunities and Challenges for Blockchain Adoption for Circular Economies. Melbourne: 2021 IEEE International Conference on Blockchain .

Stock, T., & Seliger, G. (2016). Opportunities of sustainable manufacturing in industry 4.0. Procedia CIRP.

Stohler, M., Rebs, T., & Brandenburg, M. (2018). Toward the Integration of Sustainability Metrics into the Supply Chain Operations Reference (SCOR) Model. Springer, 49-60.

Takacs, F., Brunner, D., & Frankenberger, K. (2022). Barriers to a circular economy in small- and medium-sized enterprises and their integration in a sustainable strategic management framework. Journal of Cleaner Production, 362, 132227. https://doi.org/10.1016/j.jclepro.2022.132227

Teodorović, D., & Janić, M. (2017). Paper 9 – Freight transportation and logistics. In Transportation engineering: Theory, practice and modeling (pp. 569–634). Elsevier. https://doi.org/10.1016/B978-0-12-803818-5.00009-3

Theories and Frameworks: Introduction. (n.d.). Retrieved September 23, 2023, from University Library: https://academicguides.waldenu.edu/library/theory

Thiebaud, E., Hilty, L. M., Schluep, M., Widmer, R., & Faulstich, M. (2017). Service lifetime, storage time, and disposal pathways of electronic equipment: A Swiss case study. Journal of Industrial Ecology, 21(3), 603–617. https://doi.org/10.1111/jiec.12551

Tornese, F., Pazour, J. A., Thorn, B. K., Roy, D., & Carrano, A. L. (2018). Investigating the environmental and economic impact of loading conditions and repositioning strategies for pallet pooling providers. Journal of Cleaner Production, 155-168.

Trojan Electronics. (2023). The rise of refurbished electronics: Exploring consumer attitudes (Trojan Report). Trojan Electronics. https://trojanelectronics.co.uk/wp-content/uploads/2023/08/Trojan-Report_The-rise-of-refurbished-electronics_exploring-consumer-attitudes.pdf

Turner, C., Oyekan, J., Garn, W., Duggan, C., & Abdou, K. (2022). Industry 5.0 and the Circular Economy: Utilizing LCA with Intelligent Products. Sustainability, 14(22).

Vyas, D., Khan, A. H., & Cooper, A. (2023). Democratizing making: Scaffolding participation using e-waste to engage under-resourced communities in technology design. In CHI '23: Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (Article No. 301, pp. 1–16). ACM. https://doi.org/10.1145/3544548.3580759

Vyas, D., & Vines, J. (2019). Making at the margins: Making in an under-resourced e-waste recycling center. Proceedings of the ACM on Human-Computer Interaction, 3(CSCW), Article 188, 1–23. ACM. https://doi.org/10.1145/3359290

Xavier, L. H., Ottoni, M., & Lepawsky, J. (2021). Circular economy and e-waste management in the Americas: Brazilian and Candian frameworks. Journal of Cleaner Production.

Xu, X., Liu, W., Jiang, M., & Lin, Z. (2022). A multi-cycle and multi-echelon location-routing problem for integrated reverse logistics. Industrial Management and Data Systems.

Yan, Z., Dhaygude, M., & Peng, H. (n.d.). Make Making Sustainable: Exploring sustainability practices, challenges, and opportunities in making activities. arXiv preprint arXiv:2502.13254v1. https://arxiv.org/abs/2502.13254

Yan, Z., Li, J., Zhang, Z., & Peng, H. (2024). Solderless PCB: Reusing electronic components in PCB prototyping through detachable 3D printed housings. In CHI '24: Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems (Article No. 345, pp. 1–17). ACM. https://doi.org/10.1145/3613904.3642765

Yawei, X., Lihong, D., Haidou, W., Jiannong, J., & Yongxiang, L. (2017). A review of passive self-sensing tag. Sens. Rev., 338-345.

Yerramalli, R. T., & Burra, R. G. (2014). Optimisation of Electronic Waste Recycling Network and Reverse Logistics-A Literature Review. Journal of Supply Chain Management Systems, 18-24.

Yu, H., & Solvang, W. D. (2017). A carbon-constrained stochastic optimization model with augmented multi-criteria scenario-based risk-averse solution for reverse logistics network design under uncertainty. Journal of Cleaner Production, 164, 1248–1267. https://doi.org/10.1016/j.jclepro.2017.07.066

Yue, X.-L., & Gao, Q.-X. (2018). Contributions of natural systems and human activity to greenhouse gas emissions. Advances in Climate Change Research, 9(4), 243–252. https://doi.org/10.1016/j.accre.2018.12.003

Zhao, H., Waughray, D., Malone, D. M., Msuya, J., Ryder, G., Bakker, P., . . . Payet, R. (2019). A New Circular Vision for Electronics Time for a Global Reboot. Geneva: World Economic Forum.

Zils, M., Howard, M., & Hopkinson, P. (2023). Circular economy implementation in operations & supply chain management: Building a pathway to business transformation. Production Planning & Control, 1–20. https://doi.org/10.1080/09537287.2023.2280907

Zwolinski, P., Tichkiewitch, S., & Sghaier, A. (2007). The use of virtual reality techniques during the design process: from the functional definition of the product to the design of its structure. CIRP Ann., 135-138.

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