Toward the value-based business ecosystem model for 5g mobile communications networks

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Abstract
The purpose of this paper is to create a value-based business ecosystem model for fifth generation (5G) mobile communications networks. To achieve this goal, wefirst identified the value potential antecedents and opportunities for the actors in the 5G ecosystem.To do this,we conducted a workshop in which we selected nine experts from different parts of the 5G ecosystem and addressed business/services, technology and regulation viewpoints. We practiced action research as a foresight method and used visioning for creating entrepreneurial business opportunities.Applying the opportunities, we then created a frameworkcomposed of the 4C model (connection, content, context and commerce) and a technological-functional model that could illustrate the position of the actors and their specific value-based strategic activities (i.e. cooperation, competition and coopetition) in relation to each other. The created framework can be used by telecom companies to understand and analyze the overall image of the 5G ecosystem. So far, this kind of molding has not been exploited yet in the 5G context and can be developed into more complex and full details of actors and theircoopetition strategies for further application.

1. Introduction

With the emergence of the next generation of mobile communications technology, often referred to as 5G, the whole telecommunications ecosystem is expected to face a major disruption. One of the key differences of 5G compared with earlier technology generations, from 1G to 4G, is to respond to increasing service demands in different locations, such as hospitals, campuses, shopping malls, sports arenas, utilities, and factories with high traffic densities particularly indoors. Bringing mobile base stations indoors is expected to change the way how mobile networks will be built, operated and maintained, and especially, it will bring about new services as well as business opportunities and revenue models which disrupt the whole ecosystem and open up new value potential that can be created and captured by existing and new players(Wieland et al. 2017).Thus, ecosystems and business models within ecosystems appear to belong toa new scope of strategy analysis from the empirical perspective which is also setting new requirements for theoretical approaches applied in the research(Massa, Tucci &Afuah2017).

Business models provide a way to discuss value creation and capture in ecosystemic contexts. It is noteworthy that most of the earlier business model conceptualizations were targeted at the company level (i.e. firm-centric), thus being less suited for analyzing the interdependent and complex nature of business models in ecosystemic contexts. To address this importance, we open up the concept of ecosystemic business models and discuss the type of activities or interactions that are suited for actors in an ecosystem. We apply business modelsas a boundary-spanning unit of analysis (system-level concept) (Zott, Amit&Massa2011) from a conceptual perspective and as a vehicle to identify value potential from a practical perspective (Amit&Zott2010). Thus, to create an overview of the future 5G ecosystem, consisting of opportunities, actors and their activities, this paper seeks to answer the following questions:

1. What are the value potential antecedents and opportunities in the future 5G ecosystem?
2. How can the actorscreate and capture valueinthe future 5G ecosystem?

The first research question aims to identify the possible value creation and capture opportunities (entrepreneurship view) for actors in service/business, technology and regulation domains within the 5G ecosystem. By opportunity here we mean inexplicit market need and underused resources or capabilities that may propose possibilities for creating new value for the anticipated customers. The opportunity progresses into a business concept and grows into a business model which demonstrates the value and benefits that can be offered and delivered to the customers in a more detailed and explicit way (Ardichvili, Cardozo &Ray 2003).The second research question intends for creating an ecosystemic business model framework in which the actors can co-create and co-capture the opportunities (strategic and systemic view).

The empirical data was collected as a part of an action research project focusing on researching the future 5G ecosystem. For our analysis, we utilized a novel approach that enabled us to investigate the 5G ecosystem in a future-oriented fashion. Understanding the future correctly and meaningfully is vital when it comes to strategic planning and business modeling. Thus, we practiced action research as a foresight method to meet this need (Ramos 2002).

The structure of the paper is as follows. We start by a brief introduction and the reasoning of selecting the 5G context for doing research. We continue with a discussion on the concepts of business models and value potential and then the concept of business ecosystems and strategies. Next, we illustrate and explain our ecosystemic business model framework to be applied for data analysis. We continue by presenting our research method and approach, and then discuss the results. We end the paper by discussion and conclusion as well as suggestions for further research.

1.1. 5G as a context for research

The context of this research is the future mobile communication operator business which is at a turning point with the advent of the next generation networks known as 5G. The 5G networks are foreseen to be the driver for industrial and societal transformations and economic growth by offering gigabit mobile broadband services and supporting new types of applications connecting billions of devices and objects. The mobile operator business is commonly described through three interrelated perspectives of *regulation, business, and technology*, (i.e. value antecedent potential domains)(Ahokangas et al. 2013). Regulation shapes the rules, conditions and opportunities for operations on the market and influences the possible business opportunities that can be identified and built around the technology. The technology perspective considers the technical innovations in the development of new wireless networks. The business perspective is related to the nature of opportunities, and it is significantly impacted by the regulatory and technological developments.

So far, the emergence of new technology generations has not changed the dominant logic of the ecosystem where MNOs (mobile network operators) hold the dominant position through the use of spectrum assets they control to provide country-wide services. Although sharing economy, thinking in the form of spectrum and infrastructure sharing, is entering the telecommunications ecosystem (Yrjölä et al. 2016), the exact form of how sharing is going to be adopted and regulated

remains open, specifically regarding the local services. Parallel to the turmoil in the regulative domain, innovations such as virtualization and edge computing (Matinmikko et al. 2017) coming from the technical domain are shaping the way how mobile services are to be provided in the future. From the service perspective, the key change introduced by 5G technology is that services may turn local and context-specific in a way that has not been possible earlier with earlier technologies; thus, it is opening up new opportunities to innovative local players. Therefore, 5G creates challenging circumstances and grounds for research in these three domains.

2. Understanding business models and business ecosystems

In this section, we discuss how business models and ecosystems are interlinked. The aim of the discussion is to identify key dimensions to look at for answering our research questions. We claim that business models form the basis for understanding ecosystems, and present a business model-based view on ecosystems.

2.1. Business models and value potential

The origin of the concept of the business model goes back to the value creation and capture within the internet business and it was first discussed within the strategic management literature.The business model concept was considered nesting between a network and a firm to describe a firm's position within its value network (Amit&Zott 2001, Hedman&Kalling 2003,Turber 2015).The application of the business model as a value creation (i.e. value proposition, e.g. product innovation) and a value capture (i.e. profit potential or revenue logic/model) construct has been discussed in most of the business model literature (Shafer, Smith & Linder 2005, Zott&Amit 2011). It is argued that the business model describes the value a company offers to its customers and is a unified structure of the network of partners that can create, deliver and capture value within a value network (Morris et al. 2005, Osterwalder, Pigneur&Tucci 2005, Teece 2010).

Referring to Linder and Cantrell (2000), business models are the core logic of creating value for an organization meaning that the architecture of the business model is designed based on the value proposition that a firm can offer. In addition, the design of the business model demonstrates the architecture of its interdependent system that generates a competitive business strategy (Mayo & Brown 1999). Thus, the concept of the business model highly emphasizes the issue of creating value that can take different forms (tangible and intangible) for both firms and their customers (e.g. B2B, B2C value relation).

2.2. Business ecosystems and strategies

Moore (1993) first discussed the concept of the business ecosystem, where "companies coevolve capabilities around a new innovation: they work cooperatively and competitively to support new products, satisfy customer needs, and eventually incorporate the next round of innovations". Mäkinenand Dedehayir (2012) described a wide group of actors comprising business ecosystems including suppliers, system integrators, distributors, advertisers, finance providers (i.e. venture capitalists, corporate investors, governmental funding agencies, investment banks, etc.), universities, other research bodies, regulatory authorities, standardization authorities and customers. From the strategic perspective, Jansson et al.(2014) defined an ecosystem as a bundle of intertwined business models where the interconnected processes of value co-creation, co-capture, coopetition (i.e. cooperation and competition) and co-evolution prevail. Ecosystems are diversified which represent the integration of technological processes with organizational activities and displays the stability of the system. A digital business ecosystem as a type of ecosystem is a complex system and is the outcome of introducing digital networks. It can self-organize, adapt and sustain itself to different circumstances in the ecosystem (Galateanu & Avasilcai 2013).

In the organizational context, a business ecosystem underlines the roles played by the actors in the business network. In designing a business ecosystem model, identifying and defining the elements, the link between them and their position in a certain environment should be defined. For instance, in Moore's ecosystem (1993) model, which is based on a biological analogy, developing

robust relationships based on specific activities form the business ecosystem. This model rests on the enterprise vision and shows the internal or external design of an organization (Iansiti&Levien 2004).

An organization can pursue the strategies that are related to the characteristics and behavior of the actors in the ecosystem (Anggraeni, Den Hartigh&Zegveld 2007). As a result, in complex ecosystems, firms (two or more) should initiate more complex but advantageous relationships where they can coopete, i.e. cooperate and compete simultaneously and mutually,in different activities (Bengtsson&Kock 2000,Nalebuff, Brandenburger&Maulana1996). Coopetitive strategies enhance the dynamic development and competitive advantages of the companies that are cooperating within the same ecosystem. Moreover, it can help them to manage their resources beyond their existing business model which is a crucial fact in today's turbulent business environment (Chesbrough&Rosenbloom 2002).

Thus, ecosystems are highly complex, interdependent, cooperative, competitive, and convolutional in pursuit of new innovations (Iansiti& Richards 2006). For that reason, understanding the complexity of the ecosystem and systemic analysis of interaction between ecosystem elements is very crucial in designing different types of ecosystems.

2.3 Ecosystemicbusiness models

Adner (2006) suggested that when working together, a business ecosystem allows companies to create value that no single company could have created alone.An ecosystemic business model includes the ideas of open innovation (Chesbrough,Vanhaverbeke&West2014), expanding the boundaries of a company toward coopetition.One of the influential and practically-oriented web business model typologies was presented by Wirtz, Schilke and Ullrich (2010) who coined four key business models: connection, content, context and commerce business models (i.e. 4C model). The 4C model (Figure 1) helps to simplify the value creation and capture processes in the Web 2.0 context. As a value creation system, it offers consistent categories and enables engaging stakeholders and value offering (Conte 2008).

The 4C's have also been seen as a nested and layered model, where these layers are seen as inter-connected and the upper layer models are being enabled and sustained by the lower layer models. This business model layering can be applied to either a single layer (from an individual company perspective) or any combination of layers as an ecosystem as exemplified by Yrjölä et al. (2016) in the telecommunications context. Thus, the 4C model describes the structure of the ecosystem and how different layers and models interact. The actors of the mobile ecosystem are device and infrastructure manufacturers, MNOs, service providers, multiple content providers, premises owners, regulators, etc.

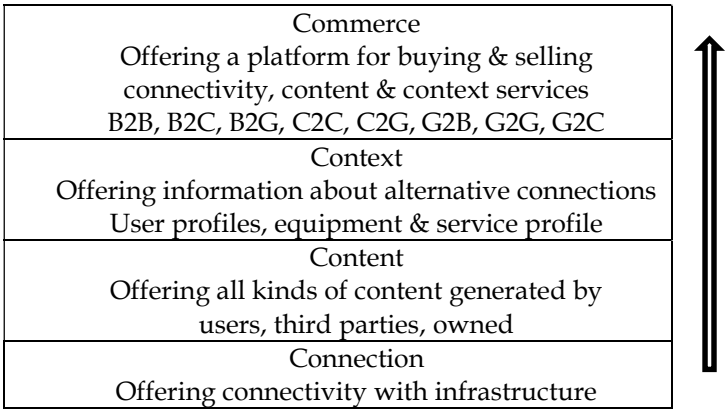

Figure 1: The 4C Business Model in the 5G context (modified from Wirtz et al. 2010 and Yrjölä et al. 2016)

In the 4C model (Figure 1), a *connection-oriented* business model is concerned with monetizing services related to connectivity like infrastructure provisioning. The *content-oriented* business model is concerned with monetizing content-related services including all sorts of online contents (audio, video, text etc.) which are accessible for the end user conveniently. Such content can be owned by the 1) service provider, 2) third parties, or 3) users. The *context-oriented* business model concerns monetizing the information that already exists on the internet regarding networks, user profiles, place, time, data, devices, etc. and provide relevant and useful context for the content. The *commerce-oriented* business model monetizes any services related to the previous layers (i.e. connection, content and context). Multiple types of communication including business (B), consumer (C), and public/government (G) is possible for selling the services.

3. Research method and approach

3.1 Action research as a foresight method

To make sense of the future 5G ecosystem value creation and capture, we practiced the action research method in a way that can activate the future thinking of the participants through visioning. Action research focuses on achieving a particular goal or outcome; generating a new form of understanding and searching for particular knowledge in a participative way (Coughlan &Coghlan 2002,Reason & Bradbury 2001).Within management science, action research creates knowledge that can influence action and leads to accelerating organizational change and improvement through the contextualization of models and tools (Bahari, Maniak& Fernandez 2015).

Foresight enables prospective thinking and improves the knowledge required in action research. On the other hand, profound understanding of practical action research enables the enhancement of future-oriented present action and behavior for foresight thinking. Thus, foresight and action research are two sides of the same coin, meaning that they have the same aim but two different ways of reaching it. Thus, action research theories and practices are associated with two research streams in foresight: 1) knowledge creation and 2) action-oriented foresight practice (i.e. the interactive development of a relationship between "conceptual engagement with future and action in present" (Floyd 2012).

We identified the value potential opportunities through the process of visioning. Visioning as a foresight method entails goal setting and creating a direction to the future that we are committed to. Visions help strategic planning for the future; ensure goals are driven by the values of the organization and points up to the participation and power of the stakeholder (Bezold et al. 2005).We see strategy as a visionary process, i.e. vision is "a mental representation of the strategy" which guides ideas (Mintzberg, Ahlstrand&Lampel 1998, 124). Emergent strategies (i.e. pattern recognition without specific planning) are formed through informal visioning; here the strategy is seen as a perspective. Through the process, participants used their insight, intuition, experience and wisdom to form the strategies (entrepreneurship school). Strategy as vision is associated with an image and a sense of direction through which leaders can adapt their experiences. This indicates that entrepreneurial strategy is intentional and careful in "sensing the direction and emergent in its details" for adaptation (Mintzberg, Ahlstrand&Lampel 1998, 125).

3.2. Research design

3.2.1. Data collection process

The data was collected through a workshop with two telecom companies' representatives; a technical research center and university scholars(i.e. nine experts altogether) who were from different parts of the wireless communications ecosystem. They were selected through an interview process regarding their specialties in the field. The aim of the workshop was to detect the value potential (i.e. value creation and capture) opportunities for the actors in 5G. After selecting the core group of participants, the visioning process began by understanding the future through identifying trends, variables, and change factors, and thinking in possible and preferablefutures (within the next

3-5 years due to rapid changes in telecom industry) to detect the opportunities (i.e. assessing the external environment).

The experts described their preferable future concerning what value potential opportunities can be identified or created and captured for operators in 5G in detail and more objectively to fulfill their goals and set the direction for reaching them. They were asked to identify regulation, technology and business related factors that influence the operator role in 5G. Then, the actors were asked to create shared value creation and capture opportunities by drafting their statements on post-it notes and pasting them to a flip chart as it is shown in the picture 1. In the next step, we categorized the key elements of the vision statements into three groups of service, technology and regulatory-related value potential as is illustrated in Figure 2.

Picture 1: Value potential antecedents and opportunity exploration within 5 G ecosystem

During the process, the actors were asked to consider the future in which their visionary outcomes successfully perused and described the results and the paths to that visionary state. The analysis of the discussion on the visionary value creation and capture opportunities as cooperative and competitive strategic activates within the 5G ecosystem is illustrated Figure 3 (see section 4).

3.3. Data analysis

3.3.1. Description of the identified value potential opportunities in the 5G ecosystem

To make sense of the data, we first looked at the antecedents and opportunities emerging from the service, technology and regulation domains. In the business and service-related value proposition domain (Figure 2), new 5G network technologies were seen to provide the playground for innovative business models based on the offering of high-quality wireless connectivity (i.e. 'service offering business model'). Connectivity (e.g. mobile, cable or fixed), context-specific and hybrid business models can be offered by operators for new customer types, for example, within IoT (Internet of Things)and public safety domains.

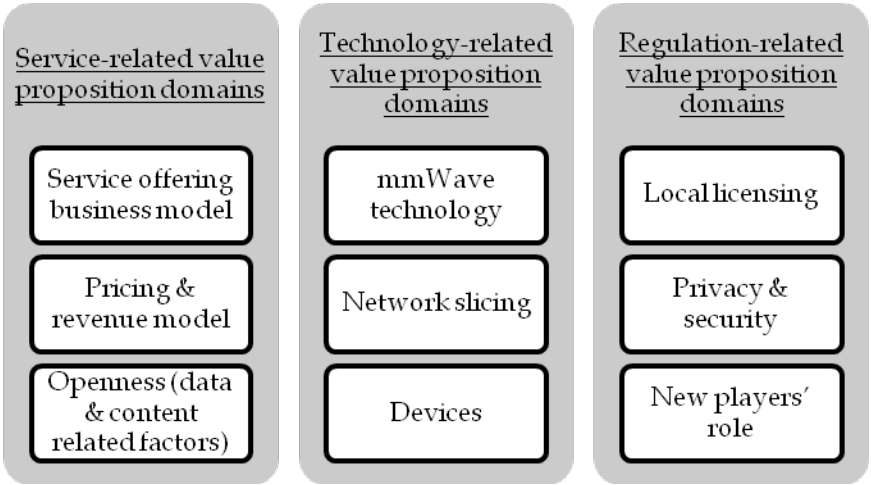

Figure 2: Value potential antecedents and opportunities in service, technology and regulatory domains

Pricing models can be based on privacy services, for instance, consumers may be willing to pay to avoid advertisements. Future users can pay by bit coins, bonus schemes, or real money ('pricing and revenue model'). The investment needs can be reduced by using common hardware both in radio access and core networks. Local content and consumer data ownership and usage rights become important, which ranges from accepting all conditions to paying for privacy ('openness'). The fragmented quality of experience (QoE) needs may lead to different types of networks which may not all be cost-effective.

As a technology, 5G requires deep vertical service knowledge for data management. In the technology-related value potential domain, 5G was seen to connect versatile end users and machine to machine devices providing high data rates and low delays for new services with enhanced quality of service, such as virtual or augmented reality. 5G networks will be seamlessly integrated into today's heterogeneous networks of 2G, 3G, 4G and Wi-Fi. Therefore, network management operating in higher millimeter wave frequency bands will be very challenging and new technical capabilities will be needed ('mmWave technology').

Technical developments in 5G enable sharing-based operations including network slicing and deployment in higher frequency bands. Network slicing enables new vertical offerings and allows the renting of required infrastructure resources for service provisioning without the need for acquiring the operator's own high-cost infrastructure ('network slicing'). New devices with exceptional capabilities that need lots of adjustment and adaptation will be manufactured which create a 'cloud challenge'. The existing infra assets will be located close to the consumer ('devices') and big data analytics and subscribers' data assets need security and management.

In the regulation-related value proposition domain, regulators were expected to start to favor sharing-based approaches against exclusivity. Local licensing with less stringent requirements was seen to trigger deregulation and open the market for entrants. Higher frequency bands require new 5G licensing models for granting local access rights ('local licensing'). The licenses could be extended regarding time, space, frequency or spectrum according to demand. There is a need for controlling the authenticity of the relationships and cooperation, data security and privacy and the use of customer data are important issues related to defining the regulation ('privacy and security'). Rules to govern the building of indoor cells in facility owners' premises lead to determining new legislation. Competition regulation e.g. merger-acquisition as well as pro-competition for opening the market to new players will enable new roles that actors can play in the ecosystem ('new player's role').

4. Result

In this section, we describe how the value potential opportunities that we identified in the previous section can be grasped cooperatively, competitively or competitively in the 5G ecosystem through a conceptual framework constructed of the 4C business model (horizontally) and the technological-functional model (vertically); it shows the dynamics of collaborative activities in an ecosystem and enables understanding the relationships in telecommunications technologies, which hare highly influenced by regulation as a crucial factor in examining how the ecosystem is expected to change in the future.

When formulating cooperative strategies (for value creation potential) and competitive strategies (for value capture elements) against existing and emerging business models and business functions within 5G, an interesting notion can be made. Although the layering of the connection, content, context and commerce business models was found, new strategies (i.e. competitive) for value opportunities emerged and formed between the models while connecting the existing models with new models. A similar trend was seen to unfold from the technical-functional layer. We analyzed them as the areas where the actors can cooperate, compete and coopete with each other(Figure 3).The vertical layers (i.e. infrastructure and devices, operator's activity and data application) are interconnected and served by the upper and lower layers. For instances, the infrastructure and devices layer is expected to provide error-free communications across a network which is needed for operators to run their activities to obtain efficient data for analysis. The horizontal layers that are related to the 4C model were discussed in Section 2.3.

The data application layer (on the vertical axis) provides any local services such as positioning, customer profiles and peer-to-peer payments (p2p). In the operation layer, 5G could open the mobile ecosystem for new players to provide services and get access to a local low cost spectrum. Context specific content, personalized content, context data and location data are the service information that can be offered through different layers of the 4C model. Prosumerism, where local service providers buy and sell services, is a way of monetizing operation activities in the commerce business model. Infrastructure and devices could be used or shared for energy consumption, providing new virtualized assets and services such as context data locally for new customers. In this layer, network slicing is a way of monetizing the infrastructure.

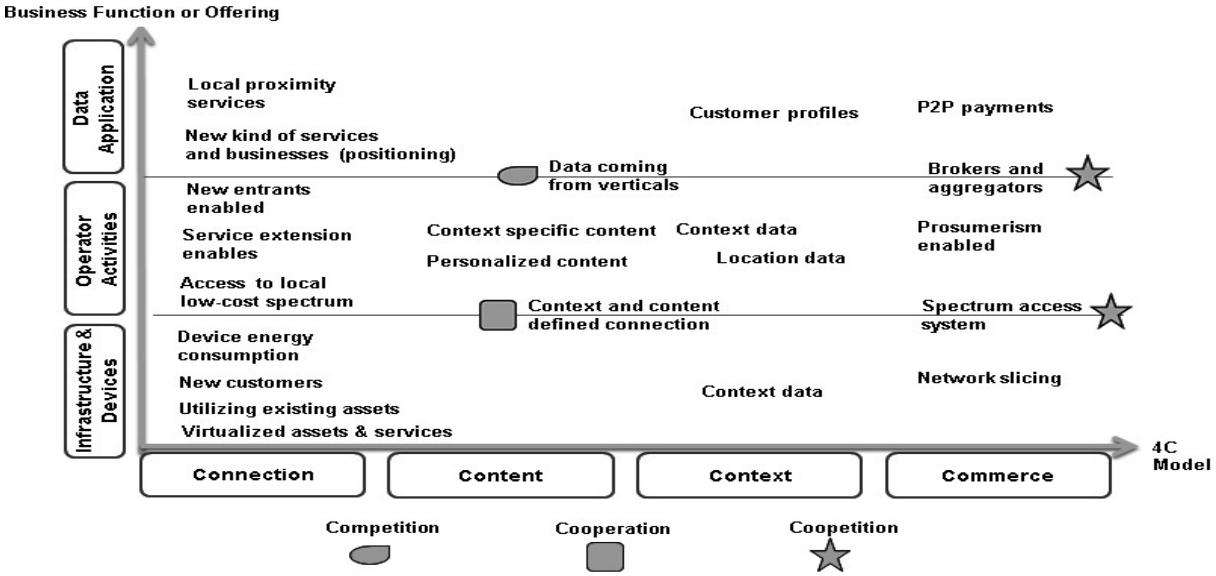

Figure 3:Ecosystemic business model framework for 5G

From the technical perspective, operations in shared spectrum bands require a spectrum access system or platform to connect the infrastructure and devices for operation and from the business perspective this value can be monetized through collaborative-based models which lead to establishing *competitive* activities. As shown in Figure 3, in the business layer and commerce domain

the actors, brokers and aggregators need to share the information related to spectrum users and providers in order to provide more innovative and efficient services for the end users through utilizing the full potential of spectrum resources; densification of the infrastructure and profit making. Context and content defined connection service provisioning is an example of a strategy that requires *cooperation* and collaboration between multiple partners. Content can be provided by the users, third parties or the service providers which requires connectivity through infrastructure and reveals information about the time, location, server and history of the service provider. In addition, vertical-specific data (i.e. providing multiple solutions for multiple customers) is used to provide novel services and monetary schemes within the vertical technological solutions which trigger *competition* among the actors.

5. Discussions and conclusions

We applied the business model concept as a system of interdependent activities that captures the drivers of the value creation of the firm and creates value by exploiting opportunities. The architecture of the activities answers the questions about how the activities are linked, who performs them, how the firm mingles with suppliers, partners, customers, and who they are (Zott&Amit 2010). Each dimension of a business model can be considered as a system, for instance, a value creation system. Explicit application of the system perspective provides a more holistic approach to the business model (Jensen 2013). In order to create a business model we need to first understand the business environments, then create a system vision and finally generate the model. The architecture of a business model within the contextual domain discusses business strategy and within the conceptual domain illustrates the strategy map.

Ecosystems are highly complex and the complexity of creating competitive strategies is due to the contrasting logic that cooperation (common interests) and competition (different interest) are constructed on. Cooperation among competitors is beneficial since their resources and capabilities can be merged to be used in competition with other actors. Intense competition on the other hand is a strong incentive and drive for companies to innovate and enhance their competitive advantage (Bengtsson&Kock 2000). However, understanding the patterns of activities and events that alter a relationship is of paramount importance since it can improve the strategic management of the relationships as well as the firm's analytical capability (Bengtsson and Kock 2014).

In this paper, we identified the value potential antecedents and opportunities for 5G ecosystem actors (Figure 3). For instance, in the service domain, different offerings (e.g. high quality connectivity) and pricing models based on privacy as well as multiple kinds of billing systems were identified. In the technology domain, network management with mmWave technology opens up opportunities for providing service solutions and enables sharing-based operations like network slicing. In the regulatory domain, opportunities such as local licensing and merger-acquisition were identified. In the next step, we designed an ecosystemic business model framework (Figure 4).We described that brokers and aggregators have a coopetitive strategic relationship. Cooperation among the actors is beneficial for offering context and content defined connection services and vertical-specific data leads to competition in creating efficient and advantageous monetary schemes. By answering the research questions, we could build an overall image of the future 5G ecosystem which can be beneficial for the actors in the wireless telecommunications industry (practical implication). 5G as an innovative technology is just a few years from being upon us (2020+) and it requires new business models for creating value proposition opportunities within a rich ecosystem of service providers, utilizing resources and capabilities and adapting resources to demands strategically.

We built a theoretical framework that linked:1) entrepreneurship theory on opportunity or business concept creation that emphasizes the understanding of needs and resources and how they match together and recombine to deliver superior value (Ardichvili, Cardozo & Ray 2003), 2) value- and systemic-based view of the business model architecture (Zott&Amit 2010); 3) organic ecosystem theory (Moore 1993) and 4) coopetition strategies (Bengtsson&Kock 2000). We appliedthese theories

to a new context which is complex, ambiguous and uncertain by nature to create a new framework that can increase the analytical capability of telecom companies in examining their ecosystem. Through action research, we aimed at creating a team of organizational bodies, multiple experts and stakeholders to improve the current situation by identifying new opportunities and business models. Action research helps the actors to define the real problem, create relevant knowledge and leaning, take action and interpret their action based on the generated knowledge and learning outcomes(Ramos, 2002).

6. Research limitations and direction for further research

One of the limitations of this research can be identified in the research method. Visions are not concrete enough and it can be impossible to imagine outcomes for unknown futures. Creating a shared vision and commitment, on the other hand, limits the managers to move only in a certain direction and to continue with what they already know and fail to notice the changes. It is advisable to combine visioning with other methods like scenario planning to foster creative thinking. Visionary scenarios create a rich conversation among the participants about values and visions (Bezold et al. 2005).

We suggest applying the created framework to a real life organizational context in order to assess the robustness of the strategies and appropriateness and adjustment of the framework. The current framework addresses a limited number of actors and their key activities; therefore, it would be beneficial to develop the building blocks of the current business model to cover a wider range of actors with detailed activates and relationships with regard to value creation and capture opportunities as well as coopetitive strategies.

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