Is Standardised Schools the answer to the shortage of Primary School places in the UK?

Alex Opoku
Bartlett School of Construction and Project Management
University College London, UK

Sarah A. Mills[2]
[2]Willmott Dixon Construction Ltd.,Hitchin, UK

Keywords
Building Standardisation, Primary Schools, School Places, United Kingdom,

Abstract

Standardisation is claimed to be a major contributor to the government's plans for addressing the UK's school places shortage. There is now an array of standardised solutions available on the market, claiming to reduce timescales and costs and improved quality when compared to bespoke alternatives. This paper seeks to explore the benefits and disadvantages of standardisation in addressing the problem of primary school places shortage in the UK. Due to the exploratory nature of this investigation, a pragmatic research philosophy is utilised and mixed methods data collection techniques are employed. Quantitative data collection involves a survey with306 construction professionals; this has been consolidated using qualitative data collection in the form of nine semi-structured interviews. These results have been analysed individually and triangulated to provide a collective assessment. The research highlighted the influence that people and their perceptions have on the successful implementation of standardisation. Results have shown that a high level of misunderstanding exists around standardisation and its definition; this has an evident direct and indirect impact on how it may be perceived. Standardisation has shown to have a remarkable influence in reducing the cost and time required for delivering the construction of new primary schools. It is identified that a collaborative approach needs to be taken in addressing the problem of primary school places shortage and until all stakeholders work together the potential benefits of standardisation cannot be achieved.

1. Introduction

The UK government has been facing an uphill battle to meet demand for the ever-increasing number of primary school places required. To exacerbate the situation, the Department for Education (DfE) has to suffer a drastically diminished budget (Omigie, 2014) in a recovering economy where construction prices are growing quickly (Richardson, 2015). There are a number of explanations for what has caused this situation; some believe that it may have been caused by high birth rates and a new wave of immigration (Jeffreys, 2015), while others are claiming that poor planning and slow responses by the government are to be blamed (National Union of Teachers, 2015).An alternative yet troubling view on why so many places are needed was raised by the Department for Education and Skills (DfES, 2005) report stating that "only 14% of schools currently operate from buildings constructed since 1976.

The situation has intensified with the decision by the HM Treasury to schedule an average 17% real-term spending cut to Government departments between 2015 and 2019. A particular concern is that there is no commitment to protect the schools or education budget which had been previously ring-fenced by the Coalition Government (Omigie, 2014). It has been estimated that the budget shortfall will be £600 million in 2015-16, rising to £4.6 billion by 2018-19 (Omigie, 2014).This has the potential to have a drastic impact on the construction industry with schools and colleges making up a substantial amount of construction spending by the public sector in 2014; this equated to £4 Billion and was exceeded only by the housing and infrastructure divisions (ONS, 2015).

To amplify the situation, the government commonly has to purchase the land for new schools, paying market prices in urban areas where land costs are rising (Hayman, 2012; Fagent, 2016;

McMeeken, 2016). This is most apparent in London where 26% of the UK's primary school places are required (EFA and DfE, 2016). Additionally it is expected that 40% of the places will be achieved by expanding existing schools, this is more expensive per school place created than building new schools (Fagent, 2016). With tender prices forecast to rise by between 4-5% per annum over the next three years, the concern is that in its dogmatic approach to cost reduction, the government will end up ignoring basic market rules (Richardson, 2015).The rest of the paper is structure as follows; the first part provide a review of relevant literature on definitions,benefits and challenges to the adoption of standardisation in the delivery of primary schools by the UK construction industry. The second part presents a discussion of the adopted research methodology while the third section deals with data analysis, findings and discussions. The final part of the paper presents conclusions and novelty of the research.

2. The problem of primary school places and standardised school buildings

The school places deficit is becoming substantially worse with an expected quarter of a million new school places needed over the next three years (ONS, 2015) coupled with a 17% real term spending cut to government departments and rising construction costs (HM Government, 2011). The James Review (2011) into education capital was pivotal in the promotion of standardised solutions and although initially met with scepticism, this has since shown to be fundamental in providing a catalyst for the development of standardisation. Recognising the need to reduce the deficit and address the school places shortage, the government in 2010 launched a comprehensive review of all capital investment projects funded by the DfE. The review introduced a government initiative to move away from the expensive and inefficient Building Schools for the Future (BSF) scheme and promote "standardised design" for future UK school buildings (James, 2011). The approach that the government is now using to create additional school places is the 'Priority Schools Building Programme (PSBP) (McMeeken, 2016). This scheme has proven to be much more efficient and much better value for money claiming pre-construction time cut by half and costs by up to 40% (DfE et al., 2014). The use of standardised design was initially met with scepticism; however 18 months following the review local authorities and schools were more than twice as likely to accept standardised designs (Richardson, 2015).

The benefits of utilising standardised design are immediately apparent with a speedier design process resulting in earlier tenders (McMeeken, 2016) and drastic cost savings ranging from 30-40% (Covell, 2012; DfE et al. 2014; Ijeh, 2015).The fear is that, removal of some parts of the design process could lead to less innovation and will not lessen inherent industry obstacles such as planning approval (Geldard and Griffiths, 2011).The drive behind this strategy for the government is to allow the contractor to remain at risk to the design responsibility (James and Brown, 2013). However this raises questions over how much design development can take place before a project is no longer "standardised" and who should make these decisions. Considering its mass production aspirations and reacting to market forces, contractors rather than architects have shown themselves to lead in the execution, with companies such as Willmott Dixon, Wates' and Laing O'Rourke producing competing standardised school models for the education market (Geldard and Griffiths, 2011; Ijeh, 2015).

The UK government has had a big impact on driving standardisation within the construction industry and promisingly architects and contractors have invested hundreds of thousands of pounds in developing designs and building systems that will enable cost-effective, efficient construction of school places on a large scale (Richardson, 2015). However the recent "Baseline Guidance" specifying that schools "should be simple rectilinear forms and built for £1,465 per square metre (half the price of most BSFs)" (Gardiner, 2012) requires that some of these contractors have to revise their designs;with an unwelcome expense. This rigidity impedes efforts by individual firms to find solutions and questions whose responsibility it is to drive and monitor the success of implementing standardisation.

The biggest constraints to standardisation are the inherent inefficiencies of the construction industry such as its fragmentation, project-based nature and complexity (Hobday, 2000). For the government to continue to see the results it desires from standardisation, it will need to follow the Government Construction Strategy's (2011) advice in becoming an intelligent client by developing the art of standardized bulk procurement of schools, potentially driving direct relationships with materials suppliers as well as building contractors (Fargent, 2016).

3. Understanding the standardisation concept

Standardisation and the context of its use is the most determining characteristic since the term "standard" can refer to a wide variety of scenarios varying from a unit of measurement (definitional), to a regular set of practices or even a way of looking at the world (Russell, 2005). Understanding definitions is of vital importance because without clearly defined boundaries there may be misinterpretation and confusion leading to miscommunication of ideas and uninformed decisions. A prominent example of misperception relating to this area of research is the synonymous use within the construction industry of the terms "standardisation" and "pre-assembly", when it can be shown that they each have clearly distinguished and differing definitions (Craig et al., 2000; Construction Excellence (CE), 2007). Additionally the umbrella term has been applied to schools as demonstrated in the market availability of "standardised schools", in particular two products at opposing ends of the scale are the "kit of parts" developed by Laing O'Rourke versus the modular building developed by Persimmons (Talbot and Francis, 2012).The term Standardisation has been defined as;

"The "extensive use of components, methods or processes in which there is regularity, repetition and a background of successful practice and predictability" (CE, 2007:2) while the British Standard Institute define it as "something that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context" (BSI, 2011:6).

Each of these definitions shares two fundamental ideas, firstly that standards need to be something that can be repeated and secondly that it should be selected with the motivation for improvement. A key categorisation tool is to consider who has chosen the improvement outcome, this can vary from imposed national standards such as EU brick dimensions, to project specific measures for example on site quality assurance processes (CE, 2007). Design standardisation in particular has its own categorisation scale which denotes four distinct classifications for standardising design (Fox and Cockerham, 2000). The scale begins with 'bespoke solutions' which have no standardisation other than loose parts and materials followed by 'hybrid solutions' having standard sub-assemblies but bespoke interfaces. At the other end of the spectrum are 'custom designs', which have standard components up to assembly level and ultimately the most rigid form which is 'standard design' incorporating both standard components and connections (Fox and Cockerham, 2000).

4. Benefits and challenges to the adoption of standardisation in construction

The overarching benefit asserted by standardisation is a reduction in cost (Gibb and Isack, 2001; James, 2011; James and Brown, 2013). A notion which has been developed from Adam Smith's theory; that increasing returns results from division of the workforce (Smith, 1977). This is more commonly known as 'economies of scale' and suggests that the more of something you do, the more efficient you become at doing it and so less input will be required for the same or an increased output (Smith, 1977).In construction, capital cost savings arise due to the inherent simplicity and efficiencies in the design approach taken to standardised solutions, combined with the more limited availability of options leading to a reduction in design fees while making bulk purchase discounts viable (Talbot and Francis, 2012; CE, 2007).

Standardisation is considered as a means of reducing variation in product quality which results in cost savings by reducing uncertainty while also saving the time and effort consumers spend on searching (Gibb and Isack, 2001).One of the key theoretical foundations explaining this

phenomenon was the "*Transaction Cost theory*" first introduced by Coase (1937) and further developed by Williamson (1975 &1985).Transaction costs are brought about by the opportunistic behaviour of stakeholders to the contract and are influenced by three characteristics; asset specificity, frequency and uncertainty surrounding the transaction. Interestingly, cost savings resulting from standardisation have been exploited heavily in sectors such as retail and leisure (Covell, 2012). Another consideration is that standardised solutions claim to have "in-built" sustainability. It is not clear how this is effectively incorporated in practice since the most significant contribution is from a school utility bill perspective (Talbot and Francis, 2012).

Time is intrinsically the second most prominent benefit of standardisation and a major component in assessing the success of a construction project. This has been substantially agreed upon by both the construction industry and other sectors (James 2011; Covell, 2012; Talbot and Francis, 2012). Time needs to be considered at various stages in a project such as procurement, design and construction phases of a programme. Procurement time is a key consideration for any client, but in particular for the public sector (HM Government 2011; Gardiner, 2012). The availability of frameworks for these public sector bodies, such as Scape Framework (2016) and the Southern Construction Framework-SCF (2016) provide dramatically reduced procurement timescales. For example the Scape framework claims 20 weeks savings on projects over £5 million. Additionally by reducing the number of competitors bidding for frameworks, many of the transactions costs associated with contracting the works are removed (Talbot and Francis, 2012).

A disadvantage of standardised designs is that, design decisions generally will have to be made earlier than for conventional construction, and critical information needs to be established sooner. A major contributor to the headline time savings is as a result of utilising pre-assembly with the benefits of increased efficiency and speed (CE, 2007), in addition to reduced design time (Talbot and Francis, 2012). These benefits will heavily depend on what concurrent construction methods are being used on site and whether the pre-assembled items impact on the critical path. Unless a contractor has large stock of complete parts in storage, pre-assembly may lead to the problem of storage, especially when moving towards volumetric and modular categorisations. The 2011 Construction Strategy reported that for the public sector to embrace the advantages of efforts such as standardisation, it must become an 'intelligent client' and reward the industry by considering planning applications for schools as a priority, working with the industry to help move schemes forwards rather than creating roadblocks (HM Government, 2011; Gardiner, 2012;James and Brown, 2013).

Quality is stated as a key benefit of standardization closely following time and cost; whereas time and cost have (at least on the surface) very measureable scales upon which to pass judgement, quality is 'in the eye of the beholder' and purely based on perceptions (Gibb, 2001). Quality is also deemed to be a contributory factor when considering value for money hence it is thought that consistent quality is fundamental to client satisfaction (Gibb and Isack, 2001). Pre-assembly benefits are thought to impact directly on the number of defects and amount of rework required (directly impacting on both cost and time). One of the key considerations to maximise the benefit of pre-assembly and off site fabrication is to utilise it for the purpose of minimising the number of trade interfaces, this will allow for improved build ability and a reduction in time spent snagging since a level of quality check will already have been conducted (Gibb and Isack, 2003).

A major contributor to this success is the ability to undertake the process of continuous learning utilising 'lessons learned' from project to project to continually develop and improve design (Covell, 2012; James and Brown, 2013). Additionally standardisation leads to improvement through a shortening of the learning curve (Edum-Fotwe *et al*., 2004); reducing training requirements at two distinct phases. Firstly, for the operatives undertaking the construction and secondly, for the customers using the end product (Gibb and Isack, 2001; Covell, 2012). This being said there are fears that "off-the-shelf" designs can result in less innovation (Robinson et al., 2012), resulting from a stable and unchanging system (Kondo, 2000). Social and environmental benefits of pre-assembly are

a consequence of bringing the construction site into the factory; here the environment can be controlled to create a safer, healthier and less wasteful working environment (CE, 2007).

5. Research Methodology

Standardisation although well established in the manufacturing industry is relatively less explored when considered in a construction context. A pragmatic research philosophy is identified as most appropriate for this study because the research is concerned with a multivariate data set where both observable phenomena and subjective meanings can provide acceptable knowledge (Creswell, 2009; Saunders et al., 2012). Pragmatists recognise that there are many different ways of interpreting the world and undertaking research, in particular it is accepted that no single point of view can ever give the entire picture since there may be multiple realities (Saunders et al. 2012).Multiple method of data collection utilises both qualitative and quantitative data and is selected because it is highly suited for a pragmatic research philosophy since it considers a multiple reality perspective (Saunders et al., 2012). The additional use of data triangulation allows the researcher to overcome weakness or intrinsic biases present in selecting just one form of research method (Knight and Ruddock, 2008).The first round of primary data collection is quantitative with a goal of uncovering relationships between variables (Saunders et al., 2012). This is followed by semi-structured interviews with the intention of both validating the survey results and justifying meaningful conclusions (Knight and Ruddock, 2008; Robson, 2011).

The relevant population for this study are the construction industry professionals in the UK. In particular a focus is placed upon individuals with experience in the Education sector projects. A large sample size is required for quantitative research to allow reliable statistical analysis and non-probability sampling using a snowball method is used. However, a purposive sampling was utilised for the qualitative data to allow selection of interviewees based on their willingness to participate, accessibility for the researcher and most importantly their expertise. Due to the volume of data collected, Statistical Package for the Social Science (SPSS) Statistical software was used to help in conducting econometric analysis of the data while data from the semi-structured interviews are transcribed and a combination of both content analysis and researcher interpretation is used to form conclusions (Creswell, 2009).

6. Data collection and Analysis

6.1 Quantitative data collection and analysis

The questionnaire was distributed to approximately 500 construction professionals covering a variety of disciplines, 306 were returned providing a response rate of 61%; this is comparatively high signifying a well-designed survey. Data analysis was carried out to understand the research participants who took part in study by categorizing responses both by demographic (where in the supply chain participants classify themselves) and discipline. As shown in Figures 1a & 1b, for both of these figures there is a substantial variety within the respondents, providing increased confidence with results since this indicates less chance of bias. As much as 50% of respondents are main contractors while 22% are from the subcontractor background. In terms of respondents' discipline, 34% are professionals from the commercial sector with 20% from the operations/planning discipline.

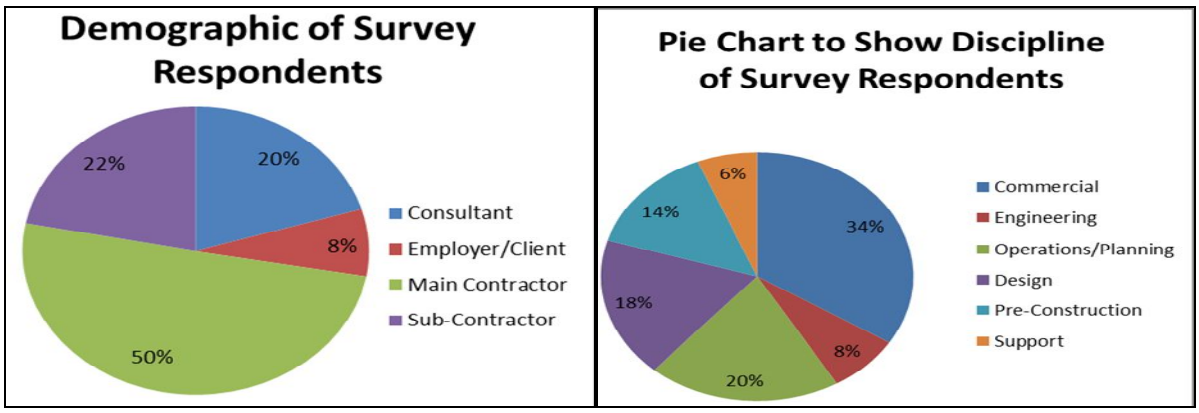
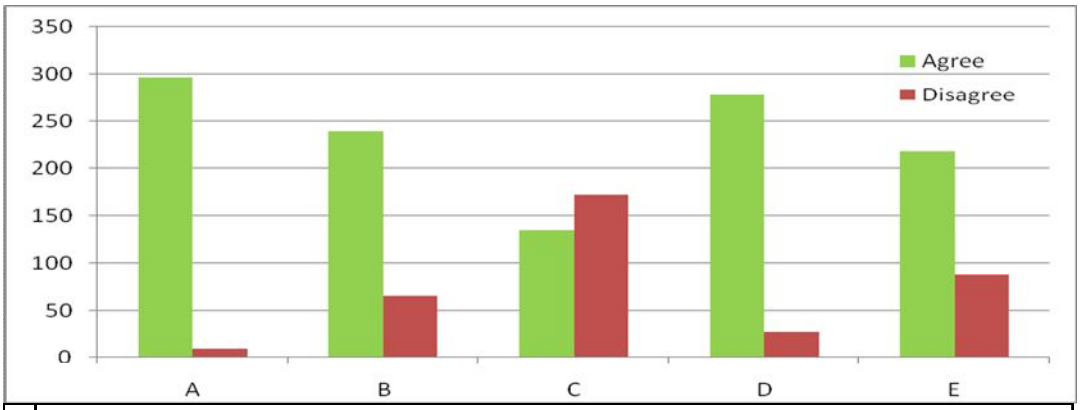


Figure 1a: Respondents' Demographic Figure 1b: Respondents' Discipline

Construction industry professionals understanding of standardisation

To establish respondents' understanding of standardisation, a series of five definitions are presented from literature review and participants are asked to select the level to which they agree or disagree using a 6-point likert scale with no neutral value. To specifically address the central tendency bias a combination of method has been utilised to combine total "agree values" and compare these against all "disagree values" (i.e. for 'statement A' agree value is 42+185+70=297 and disagree value is 1+3+5=9). The result is presented in Figure 2.



	Key
A	Standardisation is the extensive use of components, methods or processes in which there is regularity and repetition and a background of successful practise and predictability
B	The most important area for standardisation is actually the interfaces between the components rather than the components themselves
C	Standardisation and Per-assembly are interchangeable terms
D	Standardisation can be thought of in terms of "template" or "repeat" design
E	Standardisation implies a singular design solution for widespread implementation

Figure 2: Level of respondents understanding of Standardisation

The most interesting observation is for statement C ('standardisation and pre-assembly are interchangeable terms'). Although the modal value for "disagree" is at 30%, the results highlights that, the difference between total "agree" versus "disagree" of just 12% is too small to have any confidence in an answer. However for statements A, B, D and E confidence is improved with the number of "agree" responses are at least 40% higher than "disagree".

Benefits and Disadvantages of standardisation

Respondents were asked to rate the top three most influential benefits and disadvantages of standardisation from a selection of ten options identified in literature. The results are illustrated graphically in Figures 3 and 4 respectively. The most influential benefit of standardisation according to the findings is "reduced construction programme" (49%) closely followed by "reduced defects" (47%) with "reduced construction costs" and "reduced waste" (38%) sharing third position. The chosen benefits generally speaking fit into the measurement criteria of time, cost and quality showing an agreement with earlier findings. When considering the disadvantages however the most frequently selected options are "reduced design flexibility" (65%) and "limited product choice" (53%) which are more concerned with the process of standardisation rather than the outcomes. Additionally these were the most represented disadvantages identified from the literature review providing confidence in their significance.

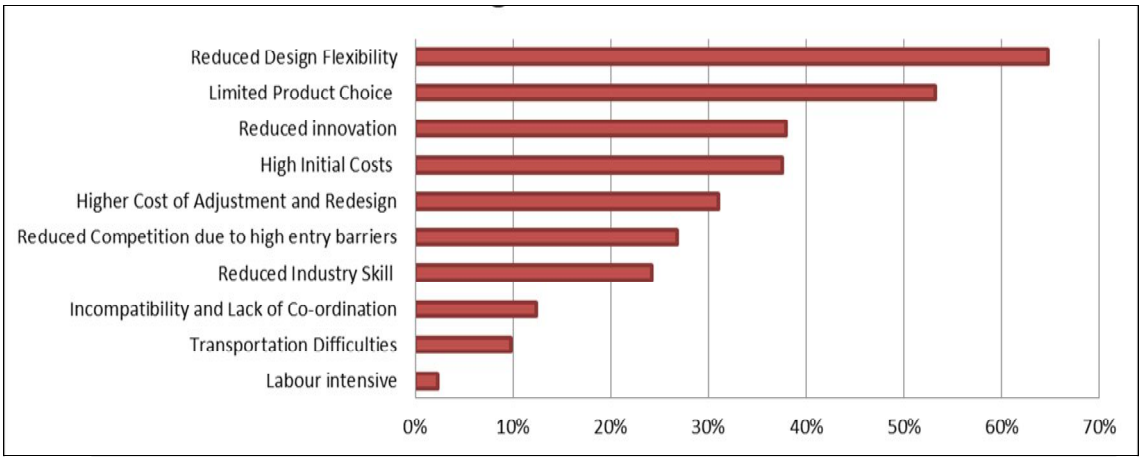


Figure 3: Most influential benefit of standardisation

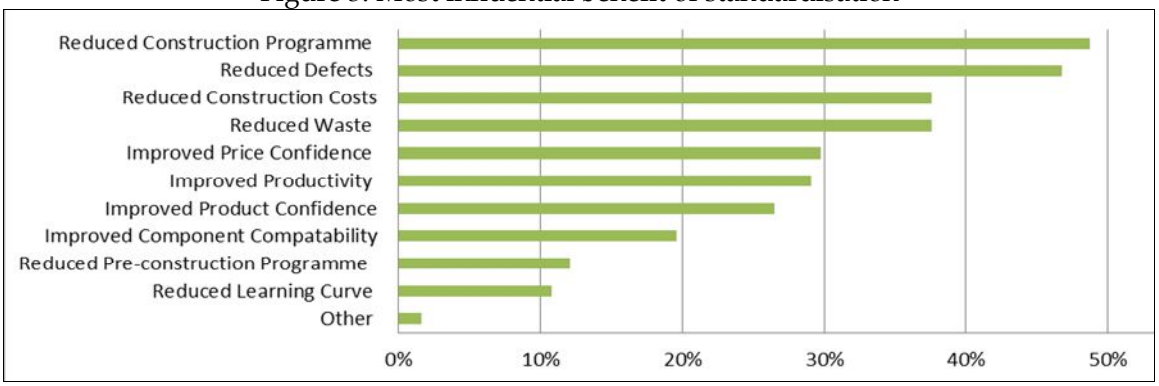


Figure 4: Main disadvantages of standardisation

6.2 Qualitative data collection and analysis

Qualitative data was collected through semi-structured interviews with a range of industry professions as summarised in Table 1. Purposive sampling was use in selecting the interviewees based on their expertise and experience. Each interviewee was issued with the questions ahead of time to allow them to feel confident in their ability to answer. The interviews varied from 10-20 minutes in length, they were recorded and transcribed and then checked by the interviewees to confirm accuracy and validity of responses (Opoku et al., 2016). The process of transcribing interviews was completed personally by the researcher rather than utilising software, this was a laborious and time-consuming process but enhanced the researcher's ability to identify common themes and patterns for later coding. Qualitative coding was used to organise the raw contextual data which is highly unstructured. The design of the interview meant that all interviewees were asked the same questions which were then open to interpretation.

Ref.	Job Title	Project stakeholder	Years of exp.	Background information	Interview of method
A	Associate Architect	Consultant	13	Specialises in designing schools, both bespoke & standardised options	Face-to-face
B	Associate Architect	Consultant	8	Specialises in designing schools, both bespoke & standardised options	Face-to-face
C	Structural Engineer	Manufacturer	16	Specialises in designing steel frames for standardised schemes including schools	Telephone
D	Design Manager	Contractor	13	Manages design for all types of education construction including standardised options	Face-to-face
E	Product Director	Contractor	15	Responsible for innovation including the development of standardised options	Face-to-face
F	Headteacher	Client (end user)	2	Currently working from a standard model school and involved in the construction of a new build school. Previous experience in managing extensions	Face-to-face
G	Project Manager	Client (Local Authority)	30	Involve in the procurement and management of new built school projects	Face-to-face
H	Design Manager	Manufacturer	30	Involved in the design, manufacture and installation of pre-assembled modular class rooms	Telephone
I	Procurement Manager	Client (Local Authority)	27	Responsible for the procurement and management of variety of projects including education, commercial and retail sectors	Face-to-face

Table 1: Profile of Interviewees

Understanding standardisation

The interviews demonstrated that a variety of accepted definitions are understood within the construction industry with many respondents accepting multiple definitions while emphasising their view that, it is a difficult concept to define. In particular it is common for interviewees to define standardisation by how they feel others perceive it, such as through the eyes of the customers the interviewees work with. Additionally many chose to describe standardisation through its limitations or appearances:

"My understanding of [standardisation] is a 'standard package' of the build so you've got more restrictions in terms of what you can do, (…) more of what I call an "Ikea school". (Interviewee F).

Although this is a narrow view in comparison with the definitions that have been uncovered by the literature review, it highlights how an end user and those involved with implementing standardisation perceive it. If the sentiment of the answers are considered (how positive or negative they are) it is shown that the majority of answers provided are neutral with some positive sentiments but minimal negative coding found.

Benefits and challenges of standardisation

Content analysis was conducted on the responses to question of benfits and disadvantages of standardisation. The results highlight that an almost balanced argument has been presented for positive compared to negative opinions. However a high portion of responses were mixed, highlighting the complexity of this topic. In particular it was surpising to find that the concept of disadvantages of standardisation was not simply answered but instead challenged:

"I don't think there is a disadvantage, I think there is a perceived disadvantage in the fact that it's not marketed right, we don't have the evidence to convince people to go with it" (Interviewee 'E').

This outlook was not unique and was further justified by Interviewee 'I' with the use of a car analogy:

"I don't think there are disadvantages; there are challenges in getting people to buy into the standardised product. People have their own unique preferences, so you have the challenge of getting buy-in to that standard solution" (Interviewee 'I').

The overarching theme present in the benefits however is a warning against over-reliance on these outcomes, phrases such as "*if used correctly*" (Interviewee 'D') and "*If you do it right*"(Interviewee 'E') precede stated benefits alluding to occurrences of benefits not being achieved.

7. Findings and discussions

The research explored the meaning of 'standardisation in the context of the construction industry". The literature review uncovered a vast array of definitions summarising these to two fundamental ideas present in a definition of standardisation; firstly, that standards need to be something that we can repeat and secondly, that they are selected with the motivation of improvement. This notion was tested during the quantitative round of data collection by asking respondents to what level they agreed or disagreed with the statement, "Standardisation is the extensive use of components, methods or processes in which there is regularity and repetition and a background of successful practise and predictability". An overwhelming majority of 97% agreed with this (more than any of the alternative definitions proposed). Additionally interviewees were asked "what do you understand by the term 'standardisation'?" and these two notions of repeatability and improvement were frequently cited. This gives confidence in accepting these two concepts as the fundamental foundations upon which a more comprehensive definition for standardisation can be developed.

Improving and developing on this definition of standardisation has shown to be problematic and highly complex. The questionnaire highlighted a level of confusion amongst industry professionals with over 70% agreeing with the following two statements; "the most important area for standardisation is actually the interfaces between the components rather than the components themselves" and "Standardisation implies a singular design solution for widespread implementation". However, the statements contradict each other in the sense that one promotes a single solution and the other multiple. This sentiment was mirrored during the interview process with a variety of interpretations posed, however interviewees 'B', 'E', 'F' and 'I' all remarked that a variety of definitions exist and that not everybody truly understands it.

There is the synonymous use of the terms "standardisation" and "pre-assembly" within the construction industry. This concept was tested during the quantitative data collection reinforcing the divide amongst the industry with 44% agreeing that the terms are interchangeable. This confusion was reflected during the interviews with many describing their understanding by conveying the limitations and restrictions standardisation holds. A suggestion for this is that only parts of the process are seen or considered and instead a scale similar to that of pre-assembly needs to be developed and circulated within the industry to allow for a better understanding of potentially improves perception and uptake of standardisation. Further investigation is required into its

understanding in relation to the construction industry specifically in order to establish how best to utilise its benefits for all stakeholders. Once a unified definition/meaning is established, relevant measures need to be agreed for time, cost and quality attributes of standardisation.

The questionnaire asked participants to choose the three most influential benefits and disadvantages from ten options. The results show that, "reduced construction programme" is the most influential benefit of standardisation. Interviews supported this notion with some specifically promoting programme benefits (Interviewees B, F and G), while others instead endorsing learning and efficiency (Interviewees A, E, F and G) as the best benefit of standardisation. However a conflicting view was posed by interviewee 'I' who argued that since schools have no commercial opportunity for creating income, delivering a school early has no advantage and may even be a disadvantage since it will require maintenance from the point of handover. Hence it could be argued that the benefit of time lies in confidence and consistency to complete something for an expected date (September for schools) and not necessarily speed.From the interviews the three key-words identified when discussing disadvantages were 'limitations' (A, F, H), 'inflexibility' (B, E, G) and 'perception' (B, D, E) this reinforces the top two disadvantages stated in the survey of 'reduced design flexibility' and 'limited product choice'. Another interesting perspective was introduced by interviewee 'I' who stated that there is 'no disadvantages but challenges'; an opinion which could explain the lack of disadvantage discussion present in the literature.

8. Conclusions and recommendations

The study revealed that the level of knowledge that construction professionals have on standardisation is incomplete, leading to incorrect assumptions and a poor perception of standardisation generally. The literature review identified an imbalance in the existing body of knowledge to discuss the benefits of standardisation more readily than the disadvantages. It was surmised that this may be because those who fund or commission research into standardisation do so with an aim of promoting its use because they may have something to gain. Interestingly the top three voted disadvantages of standardisation are all subjective answers considering choice, flexibility and innovation. This was reinforced by the interview round of data collection, further confirming that disadvantages are centred on subjectivity and perception. Standardisation has shown to have a remarkable influence in reducing the cost and time required for delivering a new school. The industry has shown itself to be very well developed at setting, measuring and comparing objective attributes such as time and cost, however substantially less advanced when considering more subjective matters such as how the customers feel about the products. The study shows that in order to truly promote the benefits of standardisation a joint approach will be required with designers, contractors, clients and manufacturers all working in partnership to develop successful solutions.

References

BSI, 2011. A standard for standards-Principles of standardization, [online] Available at: http://www.iso.org/sites/PEG/docs/PEG%20Documents/04_bs02011.pdf, [Accessed April 2016].

Coase, R. H. 1937. The nature of the firm, *Economica*, 4(16), 386-405.

Constructing Excellence (CE) 2007. Off-Site production, [Online] Available from: http://www.constructingexcellence.org.uk/pdf/fact_sheet/preassembly.pdf, Constructing Excellence (CE), [Accessed April 2016].

Covell, A. 2012. Standardisation-A way forward for school buildings?' [Online] Available at: https://www.fgould.com/uk-europe/articles/standardisation-way-forward-school-buildings, [Accessed April 2016].

Craig, A., Laing, R. and Edge, M. 2000.Title: The social acceptability of prefabrication and standardisation in relation to new housing, 16th IAPS Conference, 161.

Creswell, J. W. 2009.Research design:qualitative, quantitative, and mixed methods approach (3rd ed.), London: Sage Publications

Department for Education and Skills (DfES)2005.Departmental Investment Strategy 2005-08, Department for Education and Skills (DfES) [online] Available from: http://dera.ioe.ac.uk/6526/1/DIS_20051.pdf, [Accessed April 2016].

Department for Education (DfE),Education Funding Agency (DFA), and Laws, D. 2014. Education spending, Department for Education and Education Funding Agency, [online] Available at: https://www.gov.uk/government/speeches/education-spending, [Accessed March 2016].

Education Funding Agency (EFA) and Department for Education (DfE) 2016. School capacity: Academic year 2014 to 2015, [online] Available at: https://www.gov.uk/government/publications /school-capacity-academic-year 2014-to-2015, [Accessed April 2016].

Edum-Fotwe, F.T., Gibb, A.G.F. and Benford-Miller M. 2004. Reconciling construction innovation and standardisation on major projects', Engineering, *Construction and Architectural Management*, 11(5), 366–372.

Fagent, M. 2016.Making extra school places adds up, [online] Available at: http://0-www.building.co.uk.lispac.lsbu.ac.uk/communities/construction/education-and-healthcare/making-extra-school-places-add-up/5073223.article, [Accessed: April 2016].

Fox, S. and Cockerham, G. 2000. Matching design and production, *The Architects' Journal*, 9 March, 50–1.

Gardiner, J. 2012.Has the Construction Strategy been a success?, [online] Available at: http://0-www.building.co.uk.lispac.lsbu.ac.uk/has-the-construction-strategy-been-a-success?/5038630.article, [Accessed: 11 April 2016].

Geldard, A. and Griffiths, S. 2011.Should standardisation be the future of school design? [Online] Available at: http://www.bdonline.co.uk/should-standardisation-be-the-future-of-school-design?/5012830.article, [Accessed April 2016].

Gibb, A. G. F. 2001. Standardization and pre-assembly- distinguishing myth from reality using case study research, *Construction Management and Economics*, 19(3), 307-315.

Gibb, A. G. F. and Isack, F. 2001.Client drivers for construction projects: Implications for standardization, *Engineering, Construction and Architectural Management*, 8(1), 46-58.

Gibb, A. G. F. and Isack, F. 2003.Re-engineering through pre-assembly: Client expectations and drivers', *Building Research & Information*, 31(2), 146–160.

Hayman, A. 2012.Education: Space exploration, [online] Available at: http://0-www.building.co.uk.lispac.lsbu.ac.uk/education-space-exploration/5042032.article, [Accessed April 2016].

Hobday, M. 2000. The project-based organisation: an ideal form for managing complex products and systems?', *Research Policy*, 29,(7-8), 871-893.

HM Government, 2011.Government construction strategy, [online] Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/61152/Government-Construction-Strategy_0.pdf, [Accessed April 2016].

Ijeh, I. 2015. Modular assembly forest school, [online] Available at: http://0-www.building.co.uk.lispac.lsbu.ac.uk/buildings/modular-assembly-forest-school/5059575.article, [Accessed February 2016].

James, S. and Brown, E. 2013.Review of Education Capital: Progress Update London, UK: Department for Education.

James, S. 2011. Review of Education Capital, [online] Available from:
https://www.education.gov.uk/consultations/downloadableDocs/James%20Reviewpdf.pdf, [Accessed November 2015]

Jeffreys, B. 2015.The anxious scramble to get a school place, [online] BBC News, Available at:
http://www.bbc.co.uk/news/education-32333911, [Accessed April 2015].

Knight, A. and Ruddock, L. (eds.) 2008.Advanced research methods in the built environment, Wiley-Blackwell

Kondo, Y. 2000.Innovation versus standardization, *The TQM Magazine*, 12(1), 6–10.
McMeeken, R. 2016. School's out of Space, RICS *Modus* (April), pp. 34–35.
National Union of Teachers 2015. School places crisis, [online] Available at:
https://www.teachers.org.uk/edufacts/school-places-crisis [Accessed April 2016].
Omigie, J. 2014.The department for education budget after 2015, Available at:
https://www.aoc.co.uk/sites/default/files/The%20Department%20for%20Education%20budget%20after%202015.pdf, [Accessed April 2016].
ONS 2015.Construction statistics annual tables' [online]Available at:
https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/datasets/constructionstatisticsannualtables, Office for National Statistics [Accessed April 2016].
Opoku, A., Ahmed, V. and Akotia, J. 2016.Choosing appropriate Research Methodology and Methods, in: V. Ahmed, A. Opoku, and Z. Aziz, (Eds.), Research Methodology in the Built Environment: A Selection of Case Studies, London: Routledge, pp. 32-49
Richardson, S. 2015.Cost of meeting school places crisis could hit £18bn' [online] Available at: www.building.co.uk/news/cost-of-meeting-school-places-crisis-could-hit-18bn/5073200.article, [Accessed April 2016].
Robinson, A. Gibb A. and Austin, S. 2012.Standardisation of specification driven buildings with serial and repeat order designs In: Smith, S.D (Ed) Procs 28th Annual ARCOM Conference 3-5 September 2012, Edinburgh, UK, Association of researchers in Construction Management, 57-66
Robson, C. 2011.Real world research: A resource for users of social research methods in applied settings', (3rd edn.), London: John Wiley & Sons.
Russell, A. L. 2005. Standardization in history: a review essay with an eye to the future, The standards edge: Future generations, pp.247-260.
Saunders, M., Lewis, P. and Thornhill, A. 2012.Research Methods for Business Students, 6th editionHarlow:Ed Financial Times/Prentice Hall,
Scape, 2016. 'Scape - public sector built environment specialist', [online] Available at:
http://www.scapegroup.co.uk/ [Accessed: 4 May 2016].
Southern construction framework (SCF), 2016. Southern construction framework (SCF), [online] Available at: http://www.southernconstructionframework.org.uk/pages/home-scf.html, (Southern Construction Framework (SCF), [Accessed: 4 May 2016].
Smith, A. 1977. An Inquiry into the Nature and Causes of the Wealth of Nations, Chicago, IL: University of Chicago Press.
Talbot, D. and Francis, S. 2012.Cost Model: Standardised School Solutions, [online] Available at: http://www.aecom.com/deployedfiles/Internet/Capabilities/Program,%20Cost,%20Consultancy/Cost/Schools_CM_17Feb12.pdf, [Accessed April 2016].
Williamson, O. E. 1975. Markets and hierarchies: Analysis and Antitrust implications, pp. 26-30, New York: The Free Pres.
Williamson, O. E. 1989.Transaction cost economics, *Handbook of industrial organization*, 1, pp.135-182.