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Synthesising emerging issues within key futures study reports in construction

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Abstract

Most futures studies aim to help people to better prepare for their future by identifying and examining emerging future issues relevant to them. In the last decade, there have been a range of futures studies published by individuals and organisations within the construction sector and wider afield. Despite this, little has been done on synthesising and classifying the emerging issues and analysing the substantive content of these studies. A thorough search of futures study reports in construction has been conducted from which key reports were selected to be examined in detail. Content analysis was employed to identify emerging future issues which were then used to populate a matrix showing the relationship between the reports and the issues identified. This yielded 337 emerging issues, both internal and external to the construction industry which were classified under six major themes, namely 'technological', 'environmental', 'social', 'economic', 'governance' and 'construction industry'. Each is then discussed. The key characteristics of these issues, including the possible inter-connectivities among them are subsequently explained. The paper is concluded with a brief discourse on our future research work in this area and the possible associated methodologies to be employed.

Keywords: competitiveness, construction industry, future issues, futures study

1. Introduction

Construction is a unique industry. It is the backbone of a country's economy, contributing significantly to national GDP and providing employment to a large number of the working population. Construction is considered as an essential part of human being, even more so in the modern society of today. On the other hand, the construction industry has frequently been berated for its failure to meet customer demand and for its poor performance. Many people perceive that the industry lags behind particularly in adopting new technologies, working practices and processes to deliver products. Construction is considered to be ineffective at planning for the long-term future, and to

lack forward thinking [1]. Recent future-oriented reports and studies in construction have called for the industry to extend their orientation by looking ahead, beyond their next projects and to prepare themselves to respond to potential future events and trends.

There is a significant body of literature on futures studies. Generally, they look ahead or envision what the future will look like. These studies do not necessarily aim to predict what will happen, but aim to encourage thinking intelligently about the issues that will affect the future in order that they can be prepared for. They are frequently considered as an early warning system, a way for people and businesses to visualise the future some years (10 or 20 years) from now [2]. They are often made to promote a forward-thinking approach within companies in particular and industry in general. The methodologies employed by such studies vary, but can range from individual speculative narratives to a consensus building workshop and Delphi-based questionnaire surveys. Flanagan [3] argues that the majority of future studies tend to start from afresh without at first looking back at previous future studies. As a result, there is little effort to build on previous work and to evaluate what can be done better methodologically.

This paper reports on the initial stage of a large multidisciplinary collaborative research project aimed at developing possible future scenarios for the UK construction industry covering the next 20 years, in order to support the industry in delivering the future requirements of society and industry. The overarching aim of the research is to develop multi-level strategic frameworks and policies for sustained competitiveness in the UK construction industry. This multi-level approach should address the full spectrum of firms within construction including small subcontractors and suppliers, which are often overlooked by the industry's mainstream performance improvement agenda. The research is grounded on the real terrains, in which these multitude of firms operate through a thorough investigation of the current structural and cultural configurations of the industry. The research has reviewed a number of future studies and reports in construction and identified issues and/or drivers which may influence, and be pertinent for the future of construction. The paper describes the process and discusses the preliminary findings. The paper is concluded with a description of the implications of these findings as well as outlining on-going and future work.

2. Future studies and reports in construction

Historically, many reports have been produced since the 1940s to scrutinise the construction sector (see [4]). These reports vary in aim, scope, areas of focus, stakeholder and time orientations. The research selected 13 of the most significant reports, which constitute a representative sample of the many future construction related

reports. Two key reasons of inclusion were firstly that the reports were published relatively recently (with publication ranging from 1998 to 2005), and secondly by their potential importance to the sector as assessed by members of the research team. Seven reports focussed on the UK ([2], [5], [1], [6], [7], [8], [9]), and two make global comparisons ([10], [3]). A number of construction futures reports from other countries were also included such as those from Australia [11], the USA ([12], [13]) and Europe [14].

The format of construction futures reports vary, but they can be broadly classified into three types. The first type collates the views of industry practitioners regarding future concerns, often gleaned through 'knowledge capture' workshops or interviews, or using some form of opinion-generating tool such as the Delphi technique. These reports then present and feed back this information, often accompanied by some recommendations for future action (e.g. [7]). A second type involves the speculation and assertions of industry professionals or academics. These are less grounded in contemporary concerns and reflect the opinions of single individuals. Rather than a report style, these are often written as a description of a future scenario, such as a day in the life of a construction worker in 2025 (e.g. [15]). A third type reviews published reports, often organised around specific themes such as technological, demographic, economic and so on (e.g. [5]). Common to all of this work is the identification and discussion of a range of issues that might affect construction in the future, and their extrapolation into potential futures. For a detailed review and critiques of these reports, readers may wish to consult Harty *et al*. [16].

3. Identifying future issues using the principles of content analysis technique

The texts within 13 future reports were analysed using content analysis, which is a technique for gathering and analysing the content of text [17]. Content refers to words, meanings, pictures, symbols, ideas, themes, or any message that can be communicated and interpreted. Here, content analysis was utilised to extract future issues from the texts and assign them into categories [18]. Weber [18] described that there are no strict rules that govern the conduct of content analysis, instead the researcher must tailor their method to the requirements of his/her research by selecting specific techniques and integrating them with other methods, considerations and theories.

The analysis captured the content of the reports mainly in terms of ideas and issues which were considered to be important in the future or which are considered to be influencing the current positioning of the sector and which are likely to continue to do

so in the future. These future issues were subsequently grouped with similar issues or issues of similar concern. The categories were not imposed beforehand, but emerged as future issues were identified. That is, the issues were first compiled and subsequently grouped under several categories and sub-categories. The data were arranged within a tabular matrix depicting a relationship between categories, sub-categories, issues and the reports. A small section of this matrix is shown in Table 1. Some reports used different terms to describe similar issues, such as 'increase use of ICT' and 'heavy use of IT'; these were conflated into one issue, called 'ICT use' and placed in the same row (see first row of Table 1). The common terms were selected carefully so that they were fairly broad, but still encompass and reflect the core meaning of the terms derived from the original reports.

Table 1. A small section of the matrix depicting the relationship between the categories, sub-categories, issues and the future reports

Issues	Future Reports and Studies				Common Term	ID No.
	Sustainable Development and the Future of Construction Rotterdam, Bourdeu *et al.* 1998	Lessons for UK Foresight from around the World, Flannagan, CRISP, 1999	The future of the design and construction industry, CERF, c.2000	Strategic Research Agenda for the European Construction Sector, ECTP, 2005		
Technological						
ICT		Increase use of ICT	Heavy use of IT	Introduction of ICT at all levels	ICT use	1
		Increase speed and access to communication				
		Virtual reality advances	Greater use of virtual design and 3D		3D technology (VR, CAD)	2
			Involvement in 4D		Multidimensional modelling	3
					Knowledge management	4
		Increase use of network computer/ internet			Network and internet use	5
		Wire-free technologies for communication	Increased interconnection from pocket size phone	Wireless or mobile communication technology	Wire-free technology	6
		Use of sensors and communications systems			Sensor technology	7
		Use of GIS to monitor performance	Greater use of GIS to construct and track structure performance	New services offered by satellites for positioning and monitoring	GIS technology	8
		Death of distance with communication revolution				
Automation			Increased use of intelligent robots with visual and auditory sensors	Automation of construction plant and equipment	Robots use	9
			Increased use of sensor technology	Advanced monitoring techniques and wireless intelligent sensors	Sensors and control equipment in building	10
					Autonomous vehicle control devices (for vehicle convoys)	11
					GPS for traffic control, navigation, safety & accident avoidance	12
					Surveillance: data mining/ knowledge discovery tools	13
					Surveillance: biometric technology to identify and track individuals	14
					Development of radio frequency identification tags	15
					More interoperable information system	16
					Interactive comm and surveillance technologies for security	17
Off-site & standardisation		Greater use of standardisation	More prefabrication of components		Off-site & standardisation	18

Throughout the course of the analysis, it was found that many issues can be assigned into more than one category or sub-category. This is considered common in the analysis of data in the social domain as categories can overlap each other [18]. In this case, the researcher sought opinions from the team to check the validity and reliability of the categorisation process. The analysis of reports also reached a degree of 'theoretical saturation', where additional reports added little in the way of new issues and insights. In total, 337 issues have been identified. These were initially grouped into six broad themes, namely technological, environmental, human, economic, governance, and construction industry specific. Twenty seven sub-categories were derived from the process. They are shown in Table 2 and discussed in the following sections.

Table 2. Categories, sub-categories and number of issues identified

Category	Sub-category	Number of Issues
Technological	ICT	8
	Automation	9
	Off-site & standardisation	1
	Material	8
	Medicine	3
Environmental	Sustainability	19
	Settlement	18
	Demography	5
	Climate change	4
	Infrastructure	9
	Land	4
	Water	2
	Energy	11
	General	7
Human	Education	7
	Skills & training	20
	Employment	12
	Social	7
	People and Society	38
Economic	General	13
	Business	52
	Crime	3
Governance		25
Construction Industry-specifc	Structure & Process	20
	Supply chain	2
	Design	12
	Building	11
	R & D and innovation	7
	Total	337

4. Discussion of issues

As it is not possible to discuss each individual issue given the length of this paper and the number of issues, the following paragraphs discuss recurring or common issues within the categories and their possible implications.

4.1 Technological

Technological advances have provided enormous opportunities for humanity in the past and, as suggested by the reports, will remain to do so in the future. The 'Technological' category encompasses 'Information and Communication Technology' (ICT), 'Automation', 'Off-site and standardisation', 'Material' and 'Medicine' sub-categories.

Issues within the ICT sub-category suggest a future trend of greater adoption of existing technologies such as three-dimensional virtual reality and CAD, networking and internet use, wire-free, sensor and GIS technologies. These should not be seen as mere artefacts, but as significant changes requiring adaptation of existing working practices to utilise potential benefits. Similarly with the 'Automation' category, the use of sensor and surveillance technologies could free humans from the drudgery of routine tasks, but only with significant transformation of practice and ways of working.

Many reports saw the potential of off-site prefabrication and standardisation as a way to improve performance in the sector. CIRIA [2] indicates the considerable ramifications of prefabrication and standardisation in terms of the use of robots, removal of trade barriers, and the changing role of the profession. The move to off-site production requires different skills from the workforce as well as new manufacturing technologies and materials. Advances in medicine allow people to live healthily for longer, which reconfigures demographic profiles and requirements of our society.

4.2 Environmental

All reports envisioned the importance and increased need for sustainable activities in the future. This includes establishing environmental standards, use of recycled materials, and the reduction of pollution (land, water, air) and waste. Changing public perception is also recognised as driving the wide-sweeping move to a sustainable modern society. This is in itself is a significant driver of change. Many firms could move towards sustainable practices as this public perception may influence their market position and potential sales. Environmental ethics and economic rationality will remain two key considerations for decision making in the future.

The growth of city settlements are likely to pose many emerging problems and changes in many countries. The provision of affordable housing for key workers with low income in London has triggered the development of suburban areas and provoked contemplation of other issues such as effective use of available land, transport provision and infrastructure investment [9]. Efficient transport would also permit people to live in rural areas whilst working in cities. The higher earning potential of working in the capital could attract young workers to move to the city, with the effect of increasing the average age, and hence changing the social requirements of rural areas.

The changing demographic profile is a key challenge for the future. The ageing population is an increasingly critical issue in the developed world, especially in Europe. As people age and retire, a new injection of people into the workforce is needed to maintain existing levels and expectations of economy prosperity. In the developing world, the increase of population would raise questions about their ability to sustain quality of life. Skilled and high quality workforce from developing countries may

provide a much needed supply for the developed countries. This will bring the notion of 'borderless world' where technology and economic imperative encourage free and on-going movement of people as well as emphasising a global economy. This trend would shift the social fabric and political arrangements, for instance immigration policies which would certainly need to be reviewed.

The issue of global warming and climate change has exploded in recent years, resulting from and in wide publicity and media interest. Increased global warming (or the threat of it) could impose new restrictions on the use of energy and materials on projects. This introduces additional requirements (such as whole life cycle, reducing waste, changing established design codes, increasing costs of insurance) and (client) demands that contractors have to meet. Contrarily, global warming and climate change could create new opportunities for construction, including schemes to construct new flood defences and enhance existing ones, and infrastructure projects exploiting alternative energy sources, such as tidal power, wind turbines and nuclear power stations.

Responses to energy crises could mean the seeking of alternative technological solutions but also changing and adapting different lifestyles (for instance in moving towards less energy intensive domestic practices). Energy crises can be instigated through cost escalation or political imperative, as well as the gradual exhaustion of natural resources. The political expediency to use alternative energy sources is intensified in light of the instability of many locations where the most of the remaining oil reserve resides. Nuclear power was cited as a prominent solution, but the production of fuel for nuclear fission is not without its environmental impacts, for instance in terms of CO_2 emission (a demonstration of the inter-connectivity between these issues), and disposal of nuclear waste is a dangerous undertaking even without considering the poor public image of nuclear power. It also raises issues to do with vulnerability and security of the power stations from for example terrorist threats.

4.3 Human

This category embraces individual, social and societal related issues. Issues within the 'Individual' sub-category concern education, skill and training, and employment. Reports envision that the shift from specialists to a generalist education will be intensified with a more educated workforce engages in long-life learning. Current knowledge is obsolete quicker than ever before, especially in the face of the many new influences on construction discussed here, encouraging people to acquire more flexible, softer and transferable skills. The emphasis may shift towards creativity, and a balance between hard and softer skills, mainly encompassing people management and technology and innovation-based skills.

Increasing emphasis on integration and collaborative working would weaken professional barriers, encouraging the notion of a multi-disciplinary and skilled workforce. This owes a great deal to increasing reliance on information technology which is believed to reshape the skill requirements of the future. The emergence of 'knowledge workers' reinforces the growing importance of knowledge management which retain explicit and tacit knowledge for performance improvement. Long-life employment may disappear, to be replaced by short contract-based work tied to regular performance evaluation and measurement. Workers will increasingly needed to be mobile, adaptable and flexible. Time and space for working are becoming less relevant. A shortage of skilled workers looks likely to remain to haunt the sector in foreseeable future.

Revolutionary changes will propagate to the very fabric of society in the future. The reports suggest that people are becoming more individual, independent and self-sufficient, reducing the size of typical households. Increasing people mobility would continue the trend of multi-religion and multi-cultural societies. Fast pace world induce many people to think 'not enough time'. The notion of 'play hard and work hard' is increasingly relevant. These all impact on the provision of the housing, buildings and infrastructure in which work and play are conducted.

4.4 Economic

Reports foresee both bright and bleak futures of the world economic. The bright future scenarios describe increased prosperity of the developed world with higher disposable incomes for individuals. On the other hand, poverty and underdevelopment in many parts of the developing world continue to plague efforts to improve quality of life. The gap between the rich and poor may widen at local, regional and global levels. Many believe that a struggle between the have and the have-nots will continue, manifested in the vulnerability and security of the modern globalised world.

Generally, globalisation benefits the economies of the developed world, especially in terms of consumption, where the price of manufacturing goods is becoming more affordable than ever before. Although the shift of production to low cost economies will continue in foreseeable future [9], globalisation may eventually bring about a level playing field as the economies of developing countries improves. For some, globalisation represents potential threats, but concentration on developing a highly skilled workforce and supporting infrastructures provide opportunities for (West) European countries to focus on higher technology development and research. In comparison to manufacturing, the construction sector may not seen to be as severely impacted by the shift to low cost economy because the workforce has to be where the building is erected.

The future will see the increase of privatisation of public services and private investment. Few large firms and brands could come to dominate global market, leaving small firms to specialise themselves (e.g. on niche market/services) whilst relying on more local business networks. The growing importance of intangible assets will elevate the value of human capital and shift company success criteria to social and environmental performance. Public and stakeholders' opinions are paramount to the future existent of the firms, and hence significantly influence corporate decision making. E-commerce will continually diffuse through business sectors and layers of supply chain. The dark side of this is the growth of ICT-enabled crime.

4.5 Governance

Regulations and policies at local, regional, national and international levels will partly, if not significantly, influence the future world as well as our ability to shape our own future. Growing environmental concern has led to the introduction of regulations and/or policies to reduce the impact of our activities to the environment, such as the Kyoto commitment, pollution taxes and restrained car use policies. Planning and building regulations will play critical role in the development of the future built environment. Interventions through policies of employment, labour market, training and skills would help to secure sufficient supply of future workforce. The propensity to conduct business globally will require the establishment and/or adaptation of regulatory arrangements at international level.

A few key events happening in the past such as terrorists attack (9/11) and China's open door policy in 1986 are seen to have wider influence on the future. Public opinions and NGOs will also play their role. The reports also recognised possible future unanticipated incidents such as wars, which lead to dramatic change for the future of human beings.

4.6 Construction Industry Specific

The reports suggest a need for greater integration of construction and design processes in the future. People are also becoming aware of the rise of managerialism, performance measurement and targets. Advanced technologies and discoveries could alter the structure and cultural fabric of the sector. ICT can enable greater collaboration and co-operation between parties, moving from supply chains to supply webs/clusters. Enhanced prefabricated components could alter site operations and open wider opportunities to improve performance and health and safety records. More educated clients could play greater role in the processes, demanding better performance from firms as service providers. Participants in these processes may realise benefits and added value from having to collaborate with others, heralding the efficacy of true partnering and strategic alliances to cure the chronic mishaps of adversarialism within the industry.

Requirements for the design of the built environment will further evolve in step with changing needs of stakeholders and users. Briefing processes could include a broader range of stakeholders of the present and future, and public acceptance of the design could become critical. As is happening elsewhere, ICT will permeate the process and production of design artefacts even more so than today. Paper-based information exchanges may be a thing of the past. Lifestyle and social issues (e.g. individualism and the growth of single parent families) will downsize housing and accommodation needs. Houses could be more intelligent, flexible, adaptable and environmentally efficient, resulting from these changing attitudes and regulations.

5. Conclusions and Future Work

Thinking about and planning for the future is a complex exercise. The reports reviewed in this research suggest that different people envisage very different 'pictures' and suggest different factors/issues of importance. The issues collated in this research as reviewed in this paper, represent fragmented snapshots of possible futures. The issues themselves have many facets and dimensions. Some refer to potential events (e.g. acts of terrorism, London Olympics 2012) and trends (e.g. growth in services decline in manufacturing and agriculture, smaller households), specific artefacts or tools (e.g. 3D technology, robot use), processes or practices (e.g. recycling and reuse of building materials, knowledge management), problems (e.g. pollutions, rising sea levels), measures or facts (e.g. demography profile, traffic volumes), and ideal outcomes or goals (e.g. improved quality of life, environmentally efficient houses). The scope of issues varies from those at operational level (e.g. building regulations, planning control policies) to those at abstract/ higher level (e.g. sustainability, urbanisation). Some are specific to the UK (e.g. North and South divide, cheap housing initiative £60k), Europe (e.g. ageing population, European single market), or global (e.g. climate change, greater outsourcing to low cost economies) domains.

Although these reports identify and discuss a range of issues that might affect construction in the future, a useful exercise in its own right, they fail to address the complexities and uncertainties of both the present and the future, or to explore the connections between global, local, construction-specific and more wide-spread issues [16]. Furthermore, a 'good' or 'bad' future is contingent upon the perspective of the stakeholders. For example, 'global warming' might lead to stricter regulations, but also more development of infrastructures for introducing and exploiting alternative energy sources. It could also lead to a boom in the tourist industry and the emergence of a wine industry in Britain. Inter-connectivities between these issues are crucial for generating a

better understanding of the future and for building dynamic capabilities to proactively respond to the potential challenges ahead.

Future research will develop maps of the complex interconnections between these issues. This would make possible a more holistic view of potential chains of causal relationships which permit stakeholders of the future to introduce well-informed policies and intervention strategies whilst also considering their potential knock-on effects. The aim is to develop a number of alternative multi-level future scenarios based on verified future issues and validated interconnections between them, using a series of multidisciplinary workshops across various stakeholders of the future of construction. The information produced through the research will be used to develop an interactive IT tool which can be used by industry stakeholders to simulate scenarios and enhance their abilities to think about longer time horizons. Rather than achieving a consensus, this will stimulate discussion, debate and raise questions amongst multiple construction stakeholders. This exercise could certainly bring positive benefits in terms of engaging the sector in processes to shape a better future for all. Ultimately, this could allow them to have a better control over their futures.

Acknowledgements

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