AHFE
International

The Futuristic Building Industry: Updating Skills-Set Required for Digital Transformation

Olushola Akinshipe, John Aliu, and Clinton Aigbavboa

cidb Centre for Excellence, Faculty of Engineering and the Built Environment, University of Johannesburg, Johannesburg, 2092, South Africa

ABSTRACT

The skills regarding the building profession have undergone various changes during the evolution in the building industry over the past century. Due to the advancements in the building sector, the inherent disciplines have developed a defined set of skills. This study explores the relevant skills in the building industry, comparing the current skills to the evolving skills to ensure the continued relevance of professionals in the futuristic building industry. In order to fulfil the aim of the study, a descriptive methodology was utilised through a quantitative approach. Data for the research was gathered through a survey of building industry firms in South Africa. The findings of this study highlight the current skills and the evolving skills in the building industry. Interlinkages are also explored between the current and evolving skills. It is pertinent to note that the multi-disciplinary nature of the building industry requires professionals to be equipped with valuable skills applicable and relevant in the professional world. In conclusion, It is pertinent to note that current, evolving, and future skills may transform from time to time. This makes it highly important for building professionals to update their skills from time to time in order to remain relevant in the digitally transformed 21st-century futuristic building industry.

Keywords: Digital transformation, Building industry, Skills-set, Digital construction building automation

STUDY BACKGROUND

The new technological revolution, themed the fourth industrial revolution, is fundamentally changing the way we work, live, and relate with each other (Aghimien, et al., 2021). The utilisation of the growing new technologies together with the merger of the physical, biological, and digital world are factors that characterise the fourth industrial revolution. (Ndung'u and Signe 2020). The technologies driving change in the fourth industrial revolution include artificial intelligence, virtual reality, 3D printing, new computational technologies, and robotics (Hossain and Nadeem 2019). These new technologies have not only satisfied the consumer's demand, but these technologies have improved many companies' overall sustainability and productivity whilst redefining the skills and competencies that are required for the company to be successful (Choudhary, 2019).

According to Buehler, et al. (2018), the building industry has been operating the same for 50 years, making it stubborn to change because it mainly relies on manual labour and business models and mechanical and technology and established operations, which resulted in stagnant productivity. The industry recently started to embrace these new technologies. This has gradually changed how real estate, infrastructure, and other built assets are being designed, constructed, maintained, and operated (Choudhary, 2019). Digital advancement is rising at an alarming rate, resulting in the way society lives and functions. Different industries have already embraced the fourth industrial revolution. However, despite the alarming rate, the building industry is still reluctant to adopt various technologies and innovations (Aghimen, *et al.*, 2021).

According to Oke et al. (2018), the building industry contributes the most to the overall global GDP, accounting for even more in developing countries. This would mean that the implementation of new-age technologies can significantly benefit economic development. Digitalisation has been widely acknowledged as an essential tool for accelerating economic growth and thus bridging the gap between developing and developed economies. The implementation of digitalisation is critical because the building industry contributes to the development of the economy (Oke et al., 2018).

Amaratunga, et al. (2011) believes that the roles and skills of building professionals are going to evolve in the future due to factors such as client focus, development and application of ICT, new generation professional capabilities, the rigour of research and its dissemination as well as practice size. It is worthy to note that professionals in the industry face challenges of equipping themselves with the new competencies for them to stay relevant in the future building industry (Tramontin & Haut 2016). Therefore, it has become quite necessary to update the skills needed for professionals to function seamlessly within the futuristic building industry. This study hence explores the relevant skills in the building industry. It succinctly compares the current skills to the evolving skills to ensure the continued relevance of professionals in the futuristic building industry.

METHODOLOGY

The theoretical review of this study surveyed the digital transformation in the building industry, exploring the distinctions between current and evolving skills needed to remain relevant in the futuristic building industry characterised by digital transformation. Given the aim of the study, the research was streamlined into a descriptive study, thus the survey method was deemed appropriate for collecting the primary data. The research adopted a quantitative model and thus a five-point Likert scale structured questionnaire was designed and used as the medium of collecting primary data with the sole purpose of achieving the aim of the study. Primary data was sourced from building industry firms in South Africa through an online questionnaire. The retrieved questionnaires were analysed using descriptive statistics and presented in terms of their ranked mean item scores in the succeeding section of this paper. In addition to the descriptive analysis, the Pearson Correlation was

used to establish the connections between the current skills and the evolving skills in the building industry.

DIGITISATION AND DIGITALISATION

Hossain and Nadeem (2019) noted that the fourth industrial revolution transformed industrial production by implementing digitalised processes. The history of industrial development, economic and social changes and technological development have all had their fair share of having crucial impacts on skills needed in the workplaces. The most important of these has been technological development, which leads to innovative machinery inventions that have improved overall industrial production (Hossain and Nadeem, 2019; Alaloul, 2020). The concepts of digitisation and digitalisation hinge on this technological advancement. Digitalisation is an evolving topic of discussion within our industries, society, economy as well as academia. Digitalisation is usually misappropriated as digitisation, whereas the two are different concepts (Chapco-Wade 2018). Savic (2019) opined that the two terms, even though they are quite similar, have often been used interchangeably. Digitisation and digitalisation were distinctively distinguished by Chapco-Wade (2018) which defined 'digitisation' as the procedure of translating information from a physical format into a digital format and 'digitalisation' as the process of using digitisation in order to improve business processes.

Digitisation focuses on data conversion. Its goal is to create a digital format by converting paper documents, photos, films, microfilms LPs and VHS tapes into a digital format using encoding equipment and computers to reach this goal (Savic 2019). In academia, digitalisation encompasses all impacts on contemporary social life through digital media and digital communications (Chapco-Wade 2018). According to Gartner Glossary (2020), digitalisation is the process of transforming an activity into a digital operation by the use of digital technologies. Digitalisation is used to change a model which would result in value-producing opportunities and new revenues. Digitalisation focuses more on information processing, and its goal is to transform business operations and processes using automation, which is done by creating digital activities using Information Technology systems (Savic, 2019). Digitalisation refers to the new way of doing business through digitisation to influence business value chains, productivity, efficiency and organisational culture. Among other things, digitalisation also affects all economic sectors due to more usage of new technologies. Different industries, occupations and professions are potentially subjected to the changes brought about by digitalisation. The building industry is also going through a digital revolution, and in order to ensure continued efficiency and productivity, skills within the industry must evolve.

DIGITALISATION IN THE BUILDING INDUSTRY

The advancement of technology brings innovation which is a critical component regarding performance improvement within the building industry. There is a restriction regarding the operational activities within the industry that

cannot be executed due to the developing benchmarks of innovation globally (Aghimien, *et al.*, 2018). Dithebe et al. (2018) further stated that most clients within the building industry are reluctant to approve new and improved building techniques and creative building contexts that could positively and efficiently contribute to improving the building industry. Alaloul *et al.* (2020) further emphasised that digitalisation will benefit the building industry by ensuring tremendous optimisation in productivity by implementing these improved building techniques.

The building industry is currently facing a lack of skills shortage and a decline in productivity. Building Rader (2015) opined that digitalisation would be able to fill in these gaps. However, it has become a general source of anxiety within the building industry that implementing digitalisation techniques will lead to loss of human jobs to robots. However, professionals within the building industry are the least likely to be replaced by machines. This is because digitalisation is not exactly a science and model of natural human nature and intelligence (Dall'omo, 2017). Oke et al. (2018) reiterated that the building industry is notorious for sticking to what works and being restrictive to change, despite the rapid digital transformation around the world.

Tasks that are monotonous and repetitive can easily be automated to attain greater efficiency, increasing profits and ensuring faster service delivery. In recent times, numerous software packages have been developed to build industry professionals' use and benefits (RICS, 2017). The technologies behind these packages will ensure a digital way of carrying out professional tasks rather than the crude old ways. Technology offers the opportunity to work more efficiently, smarter and allows the ability to capture and analyse huge quantities of live data, enabling professionals to make more knowledgeable decisions that lead to better project outcomes (Aghimien, *et al.*, 2018). RICS (2017) states that digital services will have a disruptive and significant impact on the industry. However, it is bound to happen in any other professional industry. Since certain technologies are available to the client, they will expect that the professionals will add more value to outputs and results while harnessing the benefits of these tools. The past has also taught us that the mechanisation of one task does not mean that the profession disappears completely. The traditional role of building professionals is currently evolving, but it is far from obsolete (Aghimien, *et al.*, 2018).

CURRENT TRADITIONAL SKILLS WITHIN THE BUILDING INDUSTRY

The typology and level skills required regarding professions in the building industry have undergone various industrial evolution changes over the past centuries. With recent advancements in the building industry, professionals must update their skillset and acquire a newly defined set of skills to keep up with the fast-evolving world (Amaratunga, *et al.*, 2011). Building professionals' distinctive skills and competencies are intricately linked to strong building science, engineering, and management skills, which provide the basis for delivering quality standard-built environment products (Aghimien, *et al.*, 2018). Delivering quality products in the building industry requires ardent

forecasting, analysing, controlling, planning, accounting, and management skills. These competencies lie within the contractual and financial control of the building project and the development of soft skills. Skills and competencies required to optimally function as a built environment professional are better learnt at tertiary institutions by studying towards various built environment degrees (Dada and Jagboro, 2012). Competent building professionals are expected to embody a range of knowledge, skills and understanding and apply these expectations in a range of contexts and organisations. Professionals are expected to possess and perfect communication skills, analytical skills, synthesis, managerial skills, quantification skills, documentation skills, interpersonal skills, appraisal or evaluation skills, computer literacy, and self-development and leadership skills (Tramontin & Haut 2016).

Working in the building industry requires an understanding of technical aspects related to construction over the whole life of a building or facility. In addition, knowledge and understanding of budgets, quantities, material, measurements, and contracts are vital as professionals are usually involved in various services, from consultancy to contract management. RICS (2017) further mentions eight mandatory competencies that building professionals need to possess: communication and negotiation, client care, conduct rules, ethics and professional practice, data management, conflict avoidance, management and dispute resolution procedures, health and safety, team working and sustainability. Everyone in the building industry has now access to technology because of the continuous development rate of information technology. A qualified building professional needs to be computer literate with numeracy skills. Pairing both good IT and numeracy skills with the ability to analyse the content of complicated documents are important skills vital in the building industry (Aghimien, *et al.*, 2018). Good communication skills are also required because it is important to be able to express your opinion on paper as well as verbally. Writing comprehensive and precise reports and the ability to relate complex information to different kinds of people is also important in the building industry (Aigbavboa, *et al.*, 2016). Given the multi-disciplinary nature of the building industry, negotiation skills are incredibly important as it is an initiative to make positive decisions. Solving problems is also a skill that a quantity needs to have (Aigbavboa, *et al.*, 2016).

The dynamic nature of the building industry has allowed numerous changes to its skillset over the years. With the changes and the increase in skills requirement, the field requires lifelong learning for professionals to survive the competitive labour market. Hence Table 1 presents the analysis of the current skills required in the building industry.

These findings correlate to the previous studies as reported by Tramontin and Haut (2016), which stated that competent building industry professionals are expected to embody a range of knowledge, skills and understanding and apply these expectations in a range of contexts and organisations. They are expected to possess spectacular communication, analytics, synthesis, managerial, quantification, documentation, interpersonal relations, appraisal or evaluation, computer literacy, self-development and leadership. Futhermore, RICS (2017) highlighted eight mandatory competencies for professionals in the building industry to include; communication and negotiation,

Table 1. Current skills required in the building industry.

Current Skills	Mean	Std. Deviation	Rank
Computer Literacy Skills	4.32	.848	1
Analytical skills	4.18	.889	2
Managerial Skills	3.95	.854	3
Client Management Skills	3.95	.971	3
Data Management Skills	3.91	1.106	5
Self-development Skills	3.88	1.070	6
Leadership skills	3.86	.915	7
Conflict Avoidance	3.84	.902	8
Communication skills	3.82	1.255	9
Negotiation Skills	3.79	1.130	10
Evaluation Skills	3.60	1.050	11
Interpersonal Skills	3.56	1.134	12
Quantification skills	3.44	1.053	13
Documentation Skills	3.33	1.170	14

client care, conduct rules, ethics and professional practice, data management, conflict avoidance, management and dispute resolution procedures, health and safety, teamwork and sustainability.

EVOLVING SKILLS WITHIN THE BUILDING INDUSTRY

The roles and skills of building professionals will evolve in the future due to factors such as client focus, development and application of ICT to build, graduate capability, research and its dissemination. Professionals face challenges of equipping themselves with the new competencies for them to stay relevant in the future building industry (Thayaparan, *et al.,* 2011). Currently, clients expect building professionals to be more flexible and broader in their professional advice. They tend to turn to professionals for advice on issues as general as procurement management, engineering cost estimates of preliminary designs without drawings or designs (Seah, 2017).

The core competencies of built environment professionals have changed as compared to the past. Evolving competencies will likely be more inclined to meet clients' demands and global IT advancement. The complex concepts of contemporary society, information technology, and innovation evolving at a fast pace will ultimately affect project delivery systems. These factors are some of the reasons for the evolution of certain skills, especially those related to BIM, strategic management, whole life costing, and financial auditing (Tramontin & Haut, 2016). Other factors that drives transformation are clients' attitudes and needs. The industry is changing into a managerial industry, the change in markets and business practices and the impact of information technology as drivers for diversification and its ability to expand the range of services offered by the industry (Aghimien, *et al.,* 2018).

Professionals in the industry have noticed that acquiring more extensive skill sets will enable them to deliver more significant benefits to clients. For instance, value management and risk analysis and management of the services being offered to achieve client objectives are now part of professional

Table 2. Evolving skills required in the building industry.

Evolving Skills	Mean	Std. Deviation	Rank
Conducting Feasibility study	4.11	.772	1
BIM Management Skills	3.96	1.133	2
Analytical Skills	3.93	.904	3
Risk Analytic skills	3.89	.939	4
Problem-Solving Skills	3.86	.915	5
Data Management Skills	3.82	.805	6
Strategic Management Skills	3.79	1.031	7
Technical and Managerial Skills	3.72	.796	8
Whole Life Costing Skills	3.72	1.065	8
Technical Auditing Skills	3.65	.954	10
Financial Auditing Skills	3.65	.855	10

responsibilities (Cunningham 2014). According to Zan (2019), the skills required for these evolving roles will include an overall understanding and knowledge of the property market to forecast future needs and potential demands correctly. Forecasting helps in advising on alternative uses of resources as well as return on capital investment. Controlling, analysing, forecasting, evaluating and problem-solving are essential skills that will grow professionals into better managerial individuals. Technical and managerial skills are crucial skills for an effective manager on a given project (Zan, 2019). Data analytical skills such as the ability to understand and manage data and the ability to convey such data consciously and ensure that building professionals are suitable for the role of a value manager. Professional roles in the building industry continue to evolve in response to the rapidly changing business environment and client expectations. Professionals are required to respond to the core, basic and evolving skills in order to stay relevant (Tramontin & Haut, 2016). Hence Table 2 presents the analysis of the evolving skills required in the building industry.

These findings of the current study are in correlation to studies as conducted by Zan (2019), which highlighted the skills that peculiar to evolving roles include an overall understanding and knowledge of the property market in order to properly forecast and plan for future trends of physical assets as well as succinctly adjudicate on alternative uses of resources as well as advice on return of capital investment. Tramontin & Haut (2016) further stated that controlling, analysing, forecasting, evaluating, and problem-solving are essential skills for proper project management. Digital transformation is one reason for the evolution of certain skills, especially those related to BIM, strategic management, whole life costing, and financial auditing. Actively developing skill sets in these areas of competencies will enable industry professionals to deliver greater benefits to clients and increase project objectives accomplishment.

With the multi-disciplinary nature of the building industry, professionals must be equipped with valuable skills applicable and relevant in the professional world. Relevant and applicable skills that promote professionalism in the building industry include communication, analytical skills, synthesis,

managerial skills, quantification skills, documentation skills, interpersonal skills, appraisal or evaluation skills, computer literacy, and self-development and leadership skills. The findings show relevant connections between the building industry's existing abilities and evolving skills, thereby indicating a solid causal-effect relationship. It is worthy to note that evolving skills and current skills are strongly interlinked and that current, evolving, and future skills may transform from time to time. This makes it highly important for building professionals to update their skills from time to time in order to remain relevant in the digitally transformed 21st-century futuristic building industry.

CONCLUSION

The skills regarding the building profession have undergone various changes during the evolution in the building industry over the past century. Due to the advancements in the building sector, the inherent disciplines have developed a defined set of skills. Traditionally, building professionals are expected to embody a range of knowledge, skills, and understanding. They must be able to apply these expectations in a range of contexts within an organisation. With the multi-disciplinary nature of the building industry, professionals must be equipped with valuable skills applicable and relevant in the professional world. Relevant and applicable skills that promote professionalism in the building industry include communication, analytical skills, synthesis, managerial skills, quantification skills, documentation skills, interpersonal skills, appraisal or evaluation skills, computer literacy, and self-development and leadership skills. It is pertinent to note that current, evolving, and future skills may transform from time to time. This makes it highly important for building professionals to update their skills from time to time in order to remain relevant in the digitally transformed 21st-century futuristic building industry.

REFERENCES

Aghimien, D. Aigbavboa, C. Matabane, K. (2021) Impediments of the fourth industrial revolution in the South African construction industry. In: Collaboration and integration in construction, engineering, management and technology. Cham: Springer; 2021. p. 223–227. https://doi.org/10.1007/978-3-030-48465-1_37

Aghimien, D. Oke, O. Aigbavboa C. (2018) Digitalisation for Effective Construction Project Delivery in South Africa. Contemporary Construction Conference: Dynamic and Innovative Built Environment (CCC2018). Coventry, UK.

Aigbavboa C, Oke A.E & Mokasha M.D, (2016), Implementation of Skill Development Act in the South African Construction Industry, Available at: https://www.researchgate.net/publication/30975984. [Accessed: 20 July 2020]

Alaloul W.S. Liew M.S. Zawawi N.A.W.A. & Kennedy B. (2020). Industrial Revolution 4.0 in the construction industry: Challenges and opportunities for stakeholder. Ain Shams Engineering Journal. Vol 11 (pp225-230). Available at: https://www.sciencedirect.com/science/article/pii/S2090447919301157

Amaratunga, D. Thayaparan, M. and Malalgoda, C. (2011) Built Environment Lifelong Learning Challenging University Responses to Vocational Education: Lifelong University for the Built Environment. Bellcurve: University of Huddersfield

Buehler, M. Buffet, P.P. Castagnino, S. (2018) The Fourth Industrial Revolution is about to hit the construction industry. Here's how it can thrive. World Economic Forum. Available at: https://www.weforum.org/agenda/2018/06/construction-industry-future-scenarios-labour-technology/

Building Rader (2015) Digitalisation of the Construction Industry: Building Information Modelling. Construction Data, Construction Industry Market Research. Available On: https://Buildingradar.Com /Construction -Blog/Building-Information-Modeling/

Chapco-Wade, C. (2018) Digitization, Digitalization, and Digital Transformation: What's the Difference? Available at: https://colleenchapcowadesafina.medium.com/digitization-digitalization-and-digital-transformation-whats-the-difference-eff1d002fbdf

Choudhary M (2019). Benefits of Digitalising construction industry. Available at: https://www.geospatialworld.net/blogs/benefits-of-digitalizing-construction-industry/

Cunningham T. (2014). The Work and Skills Base of the Quantity Surveyor in Ireland-An Introduction. Available at: https://arrow.tudublin.ie/cgi/viewcontent.cgi?article=1034&context=beschreoth [Accessed: 20 September 2020].

Dada J.O. & Jagboro G.O. (2012). Core Skills Requirement and Competencies Expected of Quantity Surveyors: Perspectives from Quantity Surveyors, Allied Professionals and Clients in Nigeria. Available at: https://pdfs.semanticscholar.org/2f1c/e44564d917f626055f6926cb7dfb1c87d53e.pdf

Dall'omo, S. (2017) Driving African Development through Smarter Technology. African Digitalisation Maturity Report, 1–45.

Dithebe, K., Aigbavboa, C., Oke, A and Muyambu, M.A. (2018). Factors influencing the performance of the South African construction industry: A case of Limpopo province. International Conference on Industrial Engineering and Operations Management, Pretoria/ Johannesburg, South Africa

Gartner Glossary. Digitalization. Information Technology Glossary. Available at: https://www.gartner.com/en/information-technology/glossary/digitalization

Hossain M.A. Nadeem A. (2019) Towards Digitizing the Construction Industry: State of the Art of Construction 4.0. Interdependence between Structural Engineering and Construction Management: Chicago, USA

Oke A, Aghimien D, Aigbavboa C, Koloko N. (2018) Challenges of digital collaboration in the South African construction industry. Paper presented at: Proceedings of the International Conference on industrial engineering and operations management; 2018 March 6–8; Bandung, Indonesia.

RICS (2017). Associate Assessment Quantity Surveying and Construction. Available at: https://www.rics.org/globalassets/rics-website/media/qualify/pathway-guides/qs-andconstruction-pathway-guide-associate-rics.pdf

Savic, D. (2019) From Digitization, through Digitalization, to Digital Transformation. Available at: OnlineSearcher.net

Seah E. (2017). A vision for the future role of cost engineering and quantity surveyors. Available at: https://surbanajurong.com/

Thayaparan M., Siriwardena M., Amaratunga D. & Malalgoda (2011). Lifelong Learning and the Changing Role of Quantity Surveying Profession. Available at: https://www.researchgate.net/publication/267917487_lifelong_learning_and_thechanging_role_of_quantity_surveying_profession

Tramontin V. & Haupt T.C (2016), The Evolving Competencies of Quantity Surveyors. Available at: : https://www.researchgate.net/publication/315777551

Zen K. (2019). Top 10 Evolved role of Quantity Surveyor: Simple Guide. Avaialble at: https://qstuts.com/evolved-role-of-quantity-surveyor/