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Assessment of current and future critical skills in the South African construction industry

Current and
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Abstract

Purpose – The role of skills development in attaining productivity and competitiveness in industry and global level cannot be overemphasized in the construction sector. The study aims to evaluate the critical skills needed in the construction industry.

Design/methodology/approach – A quantitative study was conducted, and data were collected using questionnaires distributed amongst construction professionals including project managers, construction managers, quantity surveyors, architects and engineers based in South Africa. The data amassed were analysed to output descriptive statistics. The skills were ranked according to the level of priority as perceived by the respondents.

Findings – Findings from the empirical data analysis established that the critical skills needed within the construction industry at present and in the future are health and safety competence, decision-making, leadership and problem-solving skills. On the other hand, public speaking, big data mining and Internet of things (IoT) were not considered to be critical.

Practical implications – These findings indicated that even with technological advancements, managerial skills are needed to ensure that projects are delivered successfully.

Originality/value – The study sheds more light on skills considered critical at present and which might be relevant in the future. The study signposts the importance of critical skills to an individual and the entire construction industry. Efforts can be made to ensure that relevant critical skills for high output are emphasized and planning can be made for future and predicted construction industry workforce needs.

Keywords Construction industry, Performance, Productivity, Skills shortage, South Africa

Paper type Research paper

1. Introduction

The construction industry and its workforce contribute immensely to the growth and long-term development of any economy (Chang *et al.* 2015; Ofori 2015). However, successful delivery of construction projects is impacted by skills shortage (Windapo, 2016). Skills shortage is rated a major risk of doing business in emerging economies, and the battle is likely to intensify globally and nationally (Landelahni, 2012). It is a problem that has a significant impact on time, cost and quality of a construction project (Ahmed *et al.*, 2020; Ceric and Ivic, 2020). Further, construction projects will be in high demand over the next coming years to cater for growing populations. Given the acceleration of the Fourth Industrial Revolution and digital technology era, efforts and strategies need to be intensified to ensure that delivery of projects is sustained (World Economic Forum (WEF), 2016). Competitive construction organizations make efforts to increase their skills to remain relevant (Ahmed *et al.*, 2020). The



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anticipation of future skills requirements of professionals in the construction industry therefore needs to be given attention.

The attention to critical skills within the construction sector both locally and globally is imperative to match the pace of technological advancement. The consequences of the skills shortage are manifold including low productivity, poor quality of projects, delays, higher costs and training and recruitment expenses (Ceric and Ivic, 2020). Further, in light of the peculiar challenges faced in construction operating environments concerning the ageing workforce and availability of resources, the need to focus on skills is paramount (Ofori, 2015). Skills development is also essential to address the opportunities and challenges to meet new demands of changing economies and new technologies in the context of globalization (International Labour Organization (ILO), 2020). Collective and personal skills of employees generally enhance professional success in every business and enable organizations to perform as desired for the benefit of the society at large. The urgency of skills development is a vital priority and integral part of the overall objective in increasing employment and economic growth, reducing poverty and improving the nation's international competitiveness. Accordingly, Maimela (2006) argued that the requirements of the multifaceted and changing economy, characterized by intensive use of information, complex technologies and a general rise in skills needs demand innovativeness and improvement in the level of applied competence. Therefore, there is a need for a skilled workforce to contribute to the economic growth and development of a country.

Efforts have been made to address the skills crisis globally. These include policy initiatives and acts, research and training. In the South African economy, the drive for skills development is a crucial priority as it facilitates competency and precision (Maimela, 2006). For this reason, the Skills Development Act (SDA) 97 of 1998 was formulated. The SDA (1998) stresses that employment services should create education and training programmes for the previously disadvantaged groups. This suggests that skills shortage should be evaluated from the tough conditions and constraints that developing economies face in their attempts to move up the value chain and not only from the high-skills strategy (Daniels, 2007).

Extant studies have focussed on causes of skills shortage and ways to mitigate its impact in the construction industry (Ceric and Ivic, 2020) and specific skills needed by construction supervisors (Schwatka *et al.*, 2020; Zhang *et al.*, 2020), graduates (Besne *et al.*, 2020), artisans (Tshele and Agumba, 2014) and contractors in South Africa (Windapo, 2016). Although research has been conducted on skills shortages, it appears that few studies have investigated the totality of skills needed by construction professionals for the successful delivery of construction projects. This study therefore argues that a lack of understanding of the skills that may be required by construction professionals poses a challenge in efforts to devise potential solutions to the skills crisis.

The study posed the following question: what skills are needed at present and may be required in the future to ensure that construction projects are delivered successfully? Using data amassed from construction professionals in South Africa, the study evaluated the critical skills within the construction sector needed at present and also ascertained skills that might be needed in the future. It is envisaged that the awareness of the totality of critical skills needed currently and in future, given technological advancement and the Fourth Industrial Revolution, will be increased. Associated and relevant opportunities can be identified to further train and stimulate the construction industry.

2. Review of literature

2.1 Significance of skills development

Skills development is imperative within any institution as a management tool to echo individual training and improve the effectiveness of an organization's most vital resource (the workers) (Mopeli, 2014). The ultimate aim is to help in the ongoing adjustment of national economies and to develop the capability and resilience to adapt to future changes (Ofori, 2015). Mopeli (2014)

further states that skills development is an important element that ensures that employees perform their tasks to the level that the work requires. However, skills shortages prevail in all sectors of the market, with engineering and construction sectors suffering particular constraints on growth and effectiveness and thus impacting the industry and the entire economy.

2.2 Skills shortage in the construction industry

Across the world, crucial infrastructure schemes are competing for a dwindling skills pool amid fears that the skills shortage could delay projects in major markets (Landelahni, 2012). A recent study in the United States of America (USA) revealed that 80% of US contractors are finding it difficult to hire qualified general construction workers that represent the majority of the construction workforce and 45% reported that the local pipeline for preparing well-trained and skilled workers was poor (Brown, 2019). The shortage of skills is also a concern in the United Kingdom (UK) construction industry because it threatens efforts to meet the targeted delivery of housing infrastructure. According to the Royal Institution of Chartered Surveyors (RICS), the shortfall in the number of skilled construction workers in the UK is currently at its highest point since 2007, and this is partly as a result of the image that the industry portrays as an undesirable career path to potential employees (Sargent, 2020). Despite having contributed £138bn (US\$173bn) in value to the economy – nine per cent of the total – while employing around 3.1 m people, skills shortages, especially for construction project managers, supervisors, quality surveyors and related professionals, are worrisome (Chartered Institute of Building (CIOB), 2019). This is partly attributed to the ageing demographic that has led to increased pressures to attract and retain appropriately skilled workers, to continue adding to the value of the economy.

Other studies support that the skills shortage is a concern in Asian and African countries as well. In Asia, the skills of construction workers were related to their performance and fitness to be on the construction workforce in Bangladesh (Ahmed *et al.*, 2020). According to the authors, a skilled worker is one of the main fuels that run the construction industry and thus should have professional training, working experience and knowledge of building materials, codes and techniques. In an investigation of the causes of skills shortage in Croatia, Ceric and Ivic (2020) ascribed construction skills shortage to the complex and fragmented nature of the industry, which is further exacerbated by the subcontracting nature of the work and dominance of small firms that do not have established human resources management practices. Further, in a study that investigated skills shortage in the construction and wine industries in Argentina and South Africa, Lolwana *et al.* (2015) emphasized the need for skills development amongst young construction workers.

In South Africa, the situation is not different. It is acknowledged that the achievement of any business is greatly impacted by the skills and expertise of its team. The effectiveness of the team in completing contracts and projects is also impacted by their skills and expertise that could undermine productivity and expansion if skills are found to be lacking. The South African construction industry has grown considerably through the previous decade and has resulted in a shortage of skilled workers within the sector at all levels (Mopeli, 2014). The causes of skills shortage in the South African construction industry are insufficient practical exposure, closing down of training schools, migration of skilled workforce and fewer newly skilled employees coming into the construction industry, particularly within the younger generations (Mopeli, 2014; Tshele and Agumba, 2014). Other factors are economic conditions, shortage of first-level staff skilled at supervision and lack of basic education and compulsory certification (Windapo 2016). These can put pressure on any business and may result in a decrease in productivity and product quality (Windapo, 2016).

Moreover, scarce skills, in the parlance of the Department of Labor and the Sectoral Education and Training Authorities (SETAs), refers to an inadequacy of qualified and experienced people, currently or anticipated in the future, either (1) because such skilled

people are not available or (2) because they are available but do not meet employment criteria (Daniels, 2007). Inadequacy of skills may also be attributable to impractical recruitment practices, education and training imbalance, mobility and technology changes (Utting, 2010). With the degree of the world's competitiveness and technological advancement, the impact of skills shortages on the industry should continuously be anticipated and planned for to achieve effective productivity (Construction Industry Training Board (CITB), 2004). Regardless of an individual's profession, the world has become competitive and fast-tracking careers in professional fields are more important now than ever through the desired skills. Critical skills are needed by construction and allied engineering services employees to be productive and effective.

2.3 Tackling skills shortage in the construction industry

Continuous effort is necessary to attend to the problem of skills shortages in the construction sector world-over. Skills development is centre stage in addressing the opportunities and challenges to meet the demands of changing economies and new technologies in the context of globalization (ILO, 2020). The consequences of not addressing skills development issues are manifold. Consequently, skill requirements and shortages have been the foci of many investigations.

The study by Ceric and Ivic (2020) revealed measures to mitigate the resultant crisis in the construction labour market. The study, however, focussed on the retention of young workers with sufficient skills to cater for the ageing construction workforce. As such, graduate education programmes and informal on-the-job training were advocated. Likewise, political skill and emotional intelligence were prioritized in construction organization in the management of complex interpersonal relationships amongst project teams and stakeholders in Australia (Sunindijo and Maghrebi, 2020).

Further, leadership skills of supervisors were emphasized in improving safety record and culture in construction organizations in the USA and Nigeria, respectively (Okorie and Musonda, 2020; Schwatka *et al.*, 2020). Communication and hazard recognition skills were also investigated in the USA and Australia, respectively (Pandit *et al.* 2020; Zhang *et al.*, 2020). These studies suggested that safety performance on construction projects can be improved with enhanced communication patterns and hazard recognition skills of supervisors and workers. These attributes can be enhanced by induction and training. Further, training and literacy study on new technologies such as building information modelling (BIM) was advocated in a Spanish study to improve skills that students need to progress professionally in construction organizations post-graduation (Besne *et al.*, 2020). In a similar study, Lolwana *et al.* (2015) suggested measures to increase education, training and skills development for young construction workers in Argentina and South Africa, whereas Shang *et al.* (2020) proposed multiskilling of workers to improve performance of the construction industry in Singapore.

Skills development in the South African context is expected to address a broader issue including social, political and economic background where reconstruction and development still direct the highest status on the national agenda (Mohlala, 2011). According to Landelahni (2012), South Africa is not training enough engineers, artisans and technicians to deliver the R845bn government infrastructure projects in the pipeline. Developing and retaining key technical skills is essential if South Africa is to meet the challenge of building massive new infrastructure while upgrading existing services. Efforts such as legislative policies and construction education and training have been made to develop and retain critical skills in various sectors in South Africa. The objectives of the SDA were to develop the skills of employees, encourage employer and worker involvement in learning programmes and improve and ensure the quality of education and training in and for the workplace

(SDA, 1998). This offered an institutional framework to formulate and implement national, sector and workplace approaches to develop and improve skills in the South African context (Grawitzky, 2007). The implementation of the SDA is however hindered by workplace dynamics, inadequate performance of the Construction Education and Training Authority (CETA), low employer participation, financial limitations and corruption of SETAs. Further, skills have been developed through formal and informal education and training as firms seek to enhance their employees through comprehensive human capital development programmes to accomplish business objectives and core values and for sustainable growth (Maimunah and Lawrence, 2008).

However, although the above efforts have been made, the problem of skills shortage persists in the construction industry. Attention to the relevant skills that should be harnessed at present and retained to create future value and ensure the sustainability of the industry is paramount. Moreover, engaging in thinking that meets the needs of local regions is essential (Chan and Dainty, 2007). On this premise, the current study evaluates critical skills needed in the construction industry, at present and in the future in South Africa. A review of literature on critical skills is presented in the succeeding section.

2.4 Critical skills needed in the construction industry

A review of the literature was conducted to identify critical skills relevant to the construction sector, in addition to the skills identified in the preceding sections, including communication, leadership, cognitive skills to identify hazards and general knowledge of construction industry issues. According to Daniels (2007), critical skills are of two groups, namely: generic skills (for example, problem-solving and learning to learn; language, literacy or numeracy skills and working in teams) and particular occupational skills required for performance within that occupation (which accounts for the problems that emerge when a firm experiences technological change or reorganizes production methods). Planning, team management, communication, organizing, leadership, delegation and problem-solving skills were identified in Derrick (2020). The importance of soft skills for future construction managers, in addition to the knowledge and ability to apply construction techniques and methods and perform cost estimation techniques (hard skills), was emphasized (Carstens, 2016). These soft skills include personal aptitudes such as self-management skills, emotional intelligence, stress management skills, workplace ethics and workplace professionalism; interpersonal skills (social intelligence, communication, collaboration and workplace diversity skills) and problem-solving and decision-making skills (conflict resolution, planning and organizing skills) (Carstens, 2016). Likewise, Sunindijo and Zou (2011) categorized the skills needed in the construction industry into general management, project management, construction management and political skills. These include, *inter alia*, conceptual and problem-solving skills, technical and analytic abilities, administrative and documentation skills, communication, leadership, conflict resolution, flexibility and team-building skills.

Other studies reflect that innovative technologies and abilities including Internet of things (IoT), big data and cyber-physical systems will be indispensable to improve inefficiencies, overall productivity and business value on project and construction management in the future (Batravi and Percudani, 2017; Gbadamosi *et al.*, 2019). Further, the use of social media to support training, teamwork and project management contributes to improved communication, knowledge management and employee development (Hysa and Spalek, 2019). Additionally, the ability to respond to sustainability issues is a managerial concern and driving force in green construction (Chang *et al.*, 2015).

The current study adopts these views on critical skills to determine those needed in the construction industry at present and which might be relevant in the future. The succeeding section presents the methods adopted to achieve the objective of the study.

3. Research methods

3.1 Research design

The objective of the study was to establish critical skills needed at present and in future in the construction industry. To accomplish this objective, a quantitative descriptive design was employed using a questionnaire. Quantitative research uses measurable variables so that numbered data can be analysed using statistical procedures (Creswell, 2014). A questionnaire survey enables statistical data to be collected in a standardized way and analysed with a definite research objective (Roopa and Rani, 2012). Therefore, this study used statistical data to answer the research question: what are the critical skills needed in the construction industry at the moment and in the future?

3.2 Instrument development

A questionnaire was developed from a comprehensive review of multiple databases including Scopus, Science Direct and Google (Bramer *et al.*, 2017; Stratton, 2016). A search of the Scopus database was conducted to identify literature relevant to the topic. The Boolean search included keywords in the following thread: TITLE-ABS-KEY (skills) OR TITLE-ABS-KEY (skills AND development) AND TITLE-ABS-KEY (construction AND industry). The materials were reviewed to extract relevant information on the skills crisis and possible solutions. A further review was conducted on construction education and training from Science Direct to complement the information from Scopus. Further, hand-searching using Google was used to identify existing legislative policies on skills development in the context of the South African construction industry. The studies included in the comprehensive review were suitable for providing insight into the skills problem and answering the research question (Stratton, 2016). A total of 22 critical skills within the construction industry were identified.

Thereafter, closed-ended questions on the critical skills were developed (Hasan *et al.*, 2011). A fixed set of responses on a five-point Likert scale ranging from 1 = very low, 2 = low, 3 = not sure, 4 = moderate and 5 = very high was provided (Roopa and Rani, 2012). Closed-ended questions allow respondents to select from a predetermined set of alternatives which can be easily coded and analysed (Hyman and Sierra, 2016). Although the closed-ended questions constrained responses, statistical data on the perceived importance of specific skills in the construction industry at present and in the future were amassed.

3.3 Data collection

A population of construction professionals based in South Africa was targeted for the study. Purposive sampling was used to identify participants based on their experience and involvement in the construction industry. The respondents were approached at an annual construction industry event in South Africa in 2018. Purposive or judgemental sampling strategy allows for the deliberate selection of persons in particular settings or events to provide relevant information on the subject (Taherdoost, 2016). With verbal consent from the organizers and participants, the questionnaire was self-distributed during intermittent breaks over two days.

A total of 75 construction professionals, including project managers, construction managers, quantity surveyors, contractors, architects and engineers participated in the study. However, 73 completed questionnaires were deemed valid for inclusion in the analysis.

3.4 Data analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS). The data were screened for missing values using minimum and maximum scores. The missing values

were excluded listwise, and as such, observations that had incomplete information for any variable were removed from the analysis (Curley *et al.*, 2019).

Descriptive statistics including mean and standard deviation (SD) were applied to describe the data. Mean scores (MS) showed the average (sum divided by the number) of the observations, whereas SD values represented the dispersion and variability of responses from the mean, with larger values indicating more variability (Curran-Everett, 2008). Further, the ranking of the critical skills as perceived by the sampled respondents was undertaken based on the mean. This was necessary because the researchers were interested in establishing priority amongst the set of critical skills based on the level of importance sought on a Likert scale (Lavrakas, 2008). The results are presented in the next section.

4. Results

The findings of the study are presented in this section in line with the objectives of the study – to evaluate critical skills needed at the moment and those that may be needed in the future to successfully deliver construction projects.

4.1 Critical skills needed at the moment

The results on the critical skills needed in the construction industry at the moment are presented in Table 1. Notably, all the 22 ranked critical skills had MS between 3.3973 and 4.5890, indicating that the respondents deemed that the skills were mostly between “moderate” and “very high”. Health and safety competence (MS = 4.60) ranked highest, followed by decision-making (MS = 4.45), problem-solving (MS = 4.45), leadership (MS = 4.40) and teamwork (4.30) ranked the highest, indicating that the respondents considered these to be relevant and therefore should be prioritized in the construction industry at present.

| Critical skills | Mean score (MS) | Standard deviation (SD) | Ranking |
|-----------------------------------|-----------------|-------------------------|---------|
| Health and safety competence | 4.6027 | 0.77710 | 1 |
| Decision-making | 4.4521 | 0.92858 | 2 |
| Problem-solving | 4.4521 | 0.97241 | 2 |
| Leadership | 4.3973 | 1.07677 | 3 |
| Teamwork | 4.3014 | 0.98157 | 4 |
| Communication | 4.2055 | 0.86537 | 5 |
| Contracts and documentation | 4.1918 | 1.02276 | 6 |
| Negotiation | 4.1644 | 0.94301 | 7 |
| Stress handling | 4.1370 | 1.04503 | 8 |
| Interpersonal relations | 4.0000 | 0.89753 | 9 |
| Sustainability and green building | 3.9589 | 1.13576 | 10 |
| Emotional intelligence | 3.9041 | 1.00228 | 11 |
| Delegation | 3.8493 | 0.98137 | 12 |
| Motivational | 3.8082 | 1.02276 | 13 |
| IT skills | 3.7945 | 0.94220 | 14 |
| Report writing and presentation | 3.7945 | 1.02685 | 14 |
| Building information modelling | 3.7808 | 1.10863 | 15 |
| Marketing and sales | 3.3699 | 1.11189 | 16 |
| Internet of Things | 3.3151 | 1.24585 | 17 |
| Big data mining | 3.2192 | 1.12109 | 18 |
| Public speaking and chairing | 3.2192 | 0.98948 | 19 |
| Social media | 3.0959 | 1.24905 | 20 |
| Valid <i>N</i> (listwise) | 73 | | |

Table 1.
Critical skills needed at
the moment

On the other hand, social media (MS = 3.10), public speaking and chairing (MS = 3.22), big data mining (MS = 3.22), as well as IoT (MS = 3.32) were ranked the least relevant skills. However, the SD values mostly above 1.0 indicated that the respondents' opinions differed on the relevance of these skills in the construction industry at the moment.

4.2 Skills needed in future

Table 2 shows the ranking of the different skills needed in the future. As evinced, the recorded MS were all above 3.0, with values ranging from 3.3973 to 4.5890, suggesting that respondents deemed that these skills will be very relevant in the future. The top-ranked skills included health and safety management (MS = 4.59), decision-making (MS = 4.52), leadership (MS = 4.50), problem-solving skills (MS = 4.48) and sustainability (4.45), which all recorded mean values above 4.0, indicating very high relevance in the future as perceived by the respondents. The recorded SD scores were mostly below 1.0, indicating that the respondents agreed that these top-ranked skills would indeed be critical in the construction industry in future.

On the other hand, public speaking and chairing ranked the least (MS = 3.40), followed by big data mining (MS = 3.85), IoT (MS = 3.86) and social media (MS = 3.86) ranked the least relevant skills for the future. However, the SD values mostly above 1.0 indicated that the respondents' opinions differed on the relevance of these skills in the construction industry's future.

5. Discussion

The participants agreed that health and safety competence is essential, not only now but also in the future. Sufficient knowledge of special tasks to be undertaken and risk management plans to effectively supervise sites is important. This cannot be overemphasized with the

Table 2.
Future skills

| | Mean score (MS) | Standard deviation (SD) | Rank |
|-----------------------------------|-----------------|-------------------------|------|
| Health and safety competence | 4.5890 | 0.89498 | 1 |
| Decision-making | 4.5205 | 0.95902 | 2 |
| Leadership | 4.5068 | 1.01548 | 3 |
| Problem-solving | 4.4795 | 0.97339 | 4 |
| Sustainability and green building | 4.4521 | 0.89816 | 5 |
| Negotiation | 4.3973 | 0.87781 | 6 |
| Teamwork | 4.3425 | 0.94603 | 7 |
| Contracts and documentation | 4.3425 | 0.94603 | 7 |
| Building information modelling | 4.3288 | 1.02814 | 8 |
| Communication | 4.3288 | 1.00076 | 8 |
| IT skills | 4.2740 | 0.96120 | 9 |
| Stress handling | 4.0959 | 1.05626 | 10 |
| Emotional intelligence | 4.0411 | 1.08575 | 11 |
| Report writing and presentation | 4.0274 | 1.02703 | 12 |
| Motivational | 3.9863 | 1.04739 | 13 |
| Interpersonal relations | 3.9452 | 1.07871 | 14 |
| Delegation | 3.9178 | 1.15173 | 15 |
| Marketing and sales | 3.8904 | 1.08732 | 16 |
| Social media | 3.8630 | 1.23957 | 17 |
| Internet of Things | 3.8630 | 1.33661 | 17 |
| Big data mining | 3.8493 | 1.24355 | 18 |
| Public speaking and chairing | 3.3973 | 1.17544 | 19 |
| Valid N (listwise) | 73 | | |

incidence of coronavirus disease 2019 (COVID-19) because organizations need to continuously find ways to train and induct employees. Site managers must have sufficient experience and ability to undertake their duties in relation to health and safety management on construction sites (Bryson, 2020).

Further, the findings that decision-making, leadership and problem-solving skills were prioritized as critical skills at present and in the future were not surprising. These are aspects that still need to be prioritized, even with technological evolution and advancements, to ensure that projects are delivered successfully. This view corresponds with findings in Sunindijo and Zou (2011), where leadership and decision-making skills were vital for project managers in their effort to bring project teams together and lead them to deliver set goals. The need for decision-making and leadership skills has also been emphasized, especially in the incidence of black swan events and hazards, which pose risks and have unprecedented impacts across industries and cultures (Nafday, 2009; Black-Swan, 2020). The implication of this is critical at this time and in the future. With the current uncertain environment presented by the COVID-19 pandemic, the indeterminate times and years to come demand that organizations make conscious decisions about impacts on current and future projects. It is paramount that employers adjust the ways of accessing and assessing education and training of their workforce to include a broad range of soft and hard skills such as communication, critical thinking, technical and specialized industry expertise and core business skills (WEF, 2020). Formal and informal training can help to address the skills needs in construction organizations, as was the case in Croatia (Ceric and Ivic, 2020).

Furthermore, while teamwork was considered amongst the top-five critical skills at present, sustainability and green building competencies were deemed critical for the future. The finding on sustainability and green construction aptitudes was also observed by Chang *et al.* (2015). Skills associated with abstract reasoning and problem-solving are essential for “green” jobs that require engineering, technology and technical skills necessary to successfully perform and bring organizational changes in the construction industry (WEF, 2015). Therefore, there is a need to invest in these critical skills deemed relevant in future in the construction industry.

On the other hand, social media, public speaking and chairing, big data mining and IoT were ranked the least relevant skills in the future. These findings were surprising, given that these are the skills needed in this era of the Fourth Industrial Revolution (Gbadamosi *et al.*, 2019). The results could be explained by the fact that the construction industry has been generally slow in adopting new technologies and there is thus a danger of productivity being stagnated or reduced over the coming years (Castagnino *et al.*, 2016). With the rapid rate of technological development, the Fourth Industrial Revolution demands a new way of thinking and innovativeness with the digital world. Organizations that automate and mine large volumes of data in complex projects are getting ahead (Marcus, 2015).

The study's findings suggest that in general, the respondents agreed with managerial skills in the construction industry. This conforms with the study of Maimunah and Lawrence (2008), which highlighted that through comprehensive human capital development programmes for employees, several integrated skills critical to a firm can be acquired and harnessed. Further, the findings suggest that comprehensive development programmes can be put in place to further support these skills and ensure improved efficiency and productivity in the construction industry. Changes need to be made on a granular skill-cluster level as future skills requirements in the digital space are needed to upgrade relevant (digital) skills and provide the appropriate training (WEF, 2016). Moreover, companies should invest in intensive training during employment schemes to cater to workers' inadequate skills in certain trades. Education and training increase insight and help in the development of skills and competencies such as creativity, critical analysis of accepted practice and understanding

6. Conclusion

The study sought to establish the critical skills needed in the construction industry at the moment and in the future. The objective of the study was achieved. The study was conducted amongst construction professionals in South Africa. Findings indicated that health and safety competence, decision-making, problem-solving and leadership ranked the highest on both aspects (at present and in the future), while IoT, big data mining and social media ranked the least on both as well. However, teamwork, sustainability and green construction aptitudes were ranked amongst the top five at present and in future, respectively. It is envisaged that these findings will inform the development of relevant strategies to plan for the future and uncertainties concerning construction labour and productivity.

To meet the needs of the construction sector now and in the future, given developments such as the Fourth Industrial Revolution, it is critical to identify new and emerging skills requirements to ensure that the industry remains relevant and responsive in its capacity to contribute to economic needs nationally and globally. Skills development initiatives should incorporate access to education, training and innovation systems to be able to cater to the different construction industry needs and produce highly skilled individuals for the sector. This will enhance employability pathways and ensure that individuals and organizations have the requisite skills base to implement and deliver construction and infrastructure projects. Collective and personal skills of employees generally enhance professional success and productivity in every business including the construction fraternity and should be critically promoted.

The limitations of the study warrant mention. Given the number of respondents, the findings of the study may not be generalizable to the entire South African construction industry. Further studies could therefore engage a larger and more representative study population to confirm or refute these findings. Additionally, further studies could adopt alternative or complementary techniques to investigate the perceptions of construction professionals and the relative importance of the skills.

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