



Research Article

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Implementation of Construction 4.0 in Nigeria: Evaluating the Opportunities and Threats on the Workforce

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Abstract

The aim of this study is to examine the opportunities and threats of construction 4.0 on the workforce. This study adopts a qualitative and quantitative survey research design. A purposive sampling technique was used to select forty (40) respondents which comprises of project managers and supervisors of ongoing projects selected across four states in Southwest Nigeria. Frequencies, percentage, mean, Bivariate Pearson and Kendall's tau b correlation of SPSS V23 were used in analysing the data collected. The result shows that there was a high level of implementation of Prefabrication and BIM. The study further revealed opportunities such as increased collaboration, creativity, workers' efficiency and a major threat which is retrenchment of workers. This threat is a resultant effect of construction 4.0 to the workforce. Also, the study reveals that manual jobs face higher threats under construction 4.0 compared to professional jobs. The study recommends the need for more sensitization of the work force for construction 4.0, re-skilling of the workforce and development of government policies to protect the work force against the major threat of construction 4.0 which is retrenchment.

Keywords: *Implementation, opportunities, threats, construction 4.0, workforce, Nigeria*

1. Introduction

Human resource is a key factor for driving innovation and growth in every sector of the economy. Similarly, in the construction industry, studies have shown that the expertise of workers is the main contributory factor for development and achievement of quality construction projects (De Silva *et al.*; Mitra and Tan; Gudienea *et al.* as cited in Silva and Warnakulasuriya, 2018). Globally, the construction industry is considered one of the highest employer of labour which engages the services of skilled and unskilled workers. (Kulkani, 2007; Windapo, 2016). However, recent developments in the industry, termed construction 4.0 (which evolved from industry 4.0) introduces new practices that will alter the various methods of construction and the workforce. Hence, several threats and opportunities are presented to the workforce through the implementation of the construction 4.0

technologies. Alalol et al. (2018) asserted that workers' definite skills, practice, and result based experience are enormously challenged by automation which is a major characteristic of construction 4.0. In line with this, Hirschi, (2017) opined that these changes might result in the eradication of thousands of jobs and occupations currently in existence. Brynjolfsson and McAfee (2014) further affirm that the industry will experience a revolution propelled by the emergence of new jobs and new methods of operations. Consequently, it becomes imperative for the workforce and management in the construction sector to be well informed of the opportunities and threats that comes with digitalization of the industry especially regarding to the workforce.

2. Motivation of the Study

While Nigeria is still at the infancy stage of implementing the digitalized construction industry, a good number of professionals are already aware of the new technologies and are enthusiastic about implementing them in Nigeria. The findings of Ezeokoli *et al.* (2016), reveals that professionals in the industry are pleased with their companies' keenness in transforming digitally and have viewed this revolution as a great opportunity to the industry. This will pose a number of threats respectively. Also, Oludimu (2017) affirm that some professionals in quantity surveying in Nigeria have publicized their eagerness to use Building Information Modelling (BIM) as a solution to the disquieting situation of collapsed buildings in Nigeria. On the other hand, considering the existing shortage of skilled personnel in the industry, there is need for a level of awareness on the part of management in order to plan for human resources. Prior awareness will help take advantage of the opportunities and manage the threats of construction 4.0. Based on the foregoing, there is need to explore the extent of implementation of these technologies in the Nigeria construction industry and the views of professionals on the threats and opportunities, most importantly on the workforce. It is observed that there is dearth of studies within this scope. Consequently, the researchers examined the perceptions of project managers and the supervisors on opportunities and threats of construction 4.0 on the workforce in the construction industry. This is intended to inform and guide the management, policy makers and other stakeholders in the industry on strategies for effective management of human resources in the construction industry.

3. Objectives of Study

The aim of the study is to assess the opportunities and threats of construction 4.0 on the workforce in the Nigerian construction industry with the following objectives: (i) investigate the extent of implementation of construction 4.0 in Nigeria, (ii) assess the opportunities of construction 4.0 on the workforce in the Nigerian construction industry (iii) assess the threats of construction 4.0 on the workforce in the Nigerian construction industry (iv) examined the jobs that are threatened by construction 4.0.

4. Review of Related Literatures

4.1 Implementation of construction 4.0 to the construction Industry

Construction 4.0 which is formed from Industry 4.0 relates to the application of the fourth industrial revolution principles and tools in the construction industry. FIEC (2019) describes construction 4.0 as a division of industry 4.0 which simply emphasizes digitalization of the construction industry. This innovation can be explained as advancement in the digital and automated manufacturing environment ushered by the fourth industrial revolution (Osunsanmi *et al.*, 2018). Recently, the construction industry is swiftly implementing the Industry 4.0 related technologies such as Building Information Modeling, mixed, virtual and augmented reality (Hossain and Nadeem, 2019). FIEC (2019) state that digitalization of the industry has generated improvement in processes and technologies which include robotics, automation, prefabrication, 3D printing, drones and automated

controlled construction sites. Rastogi (2017), posits that these modern technologies such as virtual reality, Big data, analytics, cloud and others can solve many of the challenges connected with project modification, alteration and wastages which results in low quality, delay, dissatisfaction of customers and spill-over of budget. Although construction 4.0 is still at its early stage of implementation, several construction firms across the world are making efforts to swiftly implement some of the new technologies and tools of industry 4.0. This will help solve the existing construction related problems and deliver quality projects. For instance, drones or unmanned aerial vehicle with mount sensors have been used for construction projects of a single-story residential apartments building in Thailand (Anwar, *et al.*, 2018). The implementation involves the use of drone models and building information modeling at various construction stages to supervise the construction progress. Hence, this outcome showed that the use of drones significantly reduces the efforts required in conventional construction monitoring and reporting procedures. Furthermore, it creates an efficient work space planning, makes optimal to cut material flow blockage. It also provides convenient and smart ways of site control, better operations, planning and effective on-site modification (Anwar, *et al.*, 2018). Also, Building Information Model (BIM) technology was applied to a building model which involved the reconstruction of a four floor underground parking for students in the Polytechnic University of Turin in Italy (Vozzola and Massimiliano Lo Turco, 2014). Accordingly, the authors stated that the use of BIM permits the exchange of data using various measures, which provides tools and data for analysis and presents an accurate control of quality/management of documents. Furthermore, Rastogi (2017) reported that the implementation of construction 4.0 which involves the combination of technologies such as social media, analytics, beams, pre-fab of columns, slabs, slant roof, AAC blocks and mobility was applied to the construction of Panvel in Maharashtra, Indian. This application saved 50% in delivery time and also more than 5% in the total cost of the project.

4.2 The workforce in the construction industry

In the world labour market, construction personnel are assumed to be over 100 million, constituting 6-7 % of the world labour force (ILO, 2018). In Nigeria, the sector employs about 25% of the nation's workforce, making it the highest employer of labour after agriculture (Punch 2018). Globally, this industry is well known for its creation of jobs at diverse skills and various professional levels (Oseghale, *et al.*, 2015). According to the authors, every person giving appointment within the construction practice contributes significantly to their society and the nation at large. The labor force of the construction industry comprises of different classes of workers required at various levels of construction projects. These workers include the skilled, unskilled, craft administrative and managerial personnel (Essays, UK, 2018). Basically, the structure of the workforce in the construction industry is categorized into the skilled and unskilled workers (Ramana and Nallathiga, 2013; Griggs *et al.*, 2016). Skilled workers are those who have specific formal training or skills and based on their knowledge have the ability to give right judgment on their assignment, while the unskilled are workers who possess no definite skills and possible have no formal education (Riddell, 2017). However, highly skilled workers are described by their qualification in higher education from tertiary institutions and the capacity to perform complex tasks, creativeness and adaptableness to technological innovations (ILO, 2014). In the construction industry, the workforce classified as skilled workers have different abilities ranging from apprentices to trades administrator and supervisors (Liepmann as cited in (Zannah *et al.*, 2017). The general skilled workers who do not necessarily require a higher education qualification comprised the bricklayer, carpenter, welder, electrician, tiller, plumber, painter and the likes. Whereas, the highly skilled who are also recognized as the professionals include the land surveyors, architect, builders, mechanical, civil, electrical and structural engineer. Towards the completion of a successful project, the skilled workers are expected to possess skills, knowledge and training which can be acquired from educational institutions, center for vocational training, workshops and the construction sites. The work of the second category of construction worker, which is classified as the unskilled is considered informal and does not require any form of related training.

4.3 The opportunities of construction 4.0 on the workforce in the construction industry

Construction 4.0 presents several opportunities to the workers in the construction industry. The development of new technologies in the construction industry without a doubt has a major effect on the workforce (West as cited in Cerika and Maksumic, 2017). Great prospects such as advancement in employee productivity, working conditions and environmental compatibility are accessible through the application of the new technologies, resources and tools of Construction 4.0 (WEF, 2016). Construction workers generally, carry out several activities and deal with, diversity of individuals, social, psychological and environmental factors which often sets limitations and affect the quality of their jobs. A large portion of the activities carried out on the construction sites such as cleaning and preparing the construction sites, loading and unloading the building materials, concrete mixing, backfills, scaffolding, digging of trenches are considered unpleasant and risky by the workers. However, the adoption of new technologies such as BIM, robotic, smart factories, will promote job satisfaction amongst the workers. This is made possible as some of the unpleasant aspects of the construction work will be carried out in partnership with a robot working as a coworker (FIEC, 2019). Another benefit that construction 4.0 offers to construction workers is that the automation of construction work will result in the reduction of the number of hours required by workers on a construction project (Pitroda and Rajgor 2013). In essence, automation of tedious jobs on the construction sites will reduce fatigue in workers, thereby enhancing their productivity.

Furthermore, workers in the construction industry, most especially the professionals will have more job offers at their disposal and these new job opportunities will surface as a result of implementation of the new technologies. Slowey *et al.* (2019) opined that automation of monotonous and redundant tasks through the use construction 4.0 technologies, avails the professionals in the industry opportunity to create a better and more meaningful workforce thereby increasing their skills and creativity. This is corroborated by Cerika and Maksumic (2017) who stated that the new introduced technologies will create the opportunity for new skills acquisition development which will result in specialization, improved innovation, competitiveness etc. Accordingly, new job opportunities such as “industrial data scientists” and “robot coordinators” will come into existence (Huang, Wu & Wang; Mihindu and Arayici; Perkins and Skitmore as cited in Alalol *et al.*, 2018).

Another significant prospect of construction 4.0 is that the new technologies offer a method of resolving the challenges of health and safety of workers on the construction site. This will help reduce accidents, loss of life and increase productivity in the industry. Pitroda and Rajgor (2013) opines that workers safety is an important reason for automating an industrial process, as automated systems often remove workers from the workplace, thus protecting them against hazards in the plant environment. Moreover, the use of new technologies such as drones and BIM minimises accidents by performing distant inspections and discover hazards which avails the construction teams the vital information required to ensure health and safety on the construction sites (Alomari, Gambatese & Anderson, 2017; Raphelson, 2019). When risks are minimized, the industry is assured of increased efficiency and productivity of the workers. Furthermore, digital technology also aids the workers job through access to current project information at any time. For example BIM affords team members the opportunity to share information, work together and perform better on the job through a more technological advanced process which can be accessed by any member of the team anywhere and anytime as against the traditional paper drawing method of work. This facilitates planning, coordination and sharing of project models, design and keeps all stakeholders well informed all through the course of the construction project (Hall, 2018).

4.4 The threats of construction 4.0 on the workforce in the construction industry

The digitalization of the construction industry presents several threats to the workforce. A number of authors have identified the loss of job as a key threat to the implementation of construction 4.0 (WEF, 2016; FIEC, 2019; Fahy, 2019). According to the report of WEF (2016), developments in technology will

lead to the fading of 7.1 million peoples' jobs in the period between 2015 and 2020. Moreover, personnel in the construction industry depends largely on specific skills, particular practice, technology preparation, and judgment based on experiences. This becomes extremely challenging when automated (Alalol *et al.*, 2018). Automation takes over the activities that ought to be performed by the workers, thereby putting the workers in a risk of losing their jobs. Osman and Canan (2018) posit that technological developments will change the composition of the workforce in the short run and partially cause unemployment. This is based on the view that the new technologies will require a highly skilled workforce with prominence on digital talent to operate (WEF, 2016). As a result, construction managers will have the preference to assign task to the most qualified for the job (Alalol *et al.*, 2018). Furthermore, the demand for new skills will increase social anxiety among the different cadre in the industry. Employees with higher skills will command better wages because of their level of expertise, while lower skills will be paid lower wages (Schwab, 2015). This can further lead to discontent among the employees who lack the skills required to meet the demand of the technology industry. Another risk that will be encountered by workers in the digitalized industry is the risk of cyber security. The construction industry, just like other sectors of the economy usually requires the services of stakeholders who are highly reliant on mobile devices and internet-enabled technologies to give out vital information's (Doss *et al.*, 2019). Information such as architectural drawings, building designs and specification makes the industry susceptible, if not adequately protected (Allied World, 2018). With the implementation of the new technologies such as web cloud, mobile platform as well as Internet of Things, the construction industry becomes exposed to great harm due to the decentralization of its activities with so many different stakeholders involved (WEF, 2016). Also, a possible risk that automation of construction works may pose is the risk of workers becoming slaves to automated machines and risk that the privacy of humans will be overrun by vast computer data networks. Consequently, workers will be at a risk if they are not adequately trained in ensuring the protection of confidential information (Allied World, 2018).

5. Methodology

The study adopted a survey research design to examine the perceptions of project managers and supervisors of construction projects with regards to; the extent of implementation of construction 4.0 and the threats and opportunities of construction 4.0 to the workforce in the Nigerian construction industry. The study surveyed sixteen (16) construction sites in four States, Southwest Nigeria. The areas covered in the study were the industrialized region currently involved in building constructions. The population of the study comprises of project managers and supervisors who are in charge of ongoing projects. A convenience sample technique was used to select forty (40) respondents on the construction sites. The study adopted both the quantitative and qualitative techniques which involved the use of questionnaire and interview in collecting the data. A structured validated questionnaire was used to obtain the required information from the target respondents. The questionnaire accessed the background information of the construction professionals, the extent of implementation of Construction 4.0 technologies in the selected construction sites, factors hindering the implementation the technologies, the perception of the professionals on the opportunities and threats of Construction 4.0 to the workforce. The interview accessed the views of project managers to get in-depth information and better understanding on the responses from the questionnaire. Data collected was analysed using frequencies, percentage, mean, Bivariate Pearson and Kendall's tau b correlation of Statistical Package Social Science Version (23).

6. Discussion of Findings

6.1 Background Information of the Respondents

The result of the background information of the respondents shows that majority 38 (95%) were male while 2 (5%) were female. Based on their educational qualification, 3 (7.5%) had a Ph.D, 8 (20%) had

a Master qualification, 22 (55%) were B.Sc/B.tech/B.eng holders and 7 (17.5%) had a Higher National Certificate (HND).The distribution of the respondents based on their status shows that 15 (32.5%) were structural engineers, 12(30%) were architects and 13(37.5%) were builders. The distribution of the respondents based on working experience shows that 2 (5%) have 1-5 years work experience, 15 (37.5%) have worked between 6- 10 years, 14 (35%) have 11-15 years working experience while 9 (22.5 %) have above 15 years working experience in the industry.

6.2 Responses of the respondents on the extent of implementation of construction 4.0 technologies in the surveyed construction sites, Southwest, Nigeria

In this study a list of five main technologies of construction 4.0 which includes Building Information Modelling (BIM), Prefabrication, Drones, Robotic Construction and Green building were given to the respondents to indicate a “Yes” or “No” response.

Results in table 1 showed a scored mean ranking of the responses of the respondents with regards to the extent of implementation of construction 4.0 technologies. From the table, 80% of the respondents indicated that Prefabrication has the highest implementation among the construction 4.0 technologies with a mean value of (3.73), followed by BIM having a response rate of 75% with a mean value of (3.61) and 55 %of the respondents indicated the implementation of Drones for satellite imagery with a mean value of (2.65). Green Building and Robotics Construction were least among the implemented technologies of construction 4.0 with a response rate of 30 and 55% and mean value of (1.83 and 1.28) respectively. Hence, it can be deduced from the result, that there is a gradual level of implementation and construction 4.0 in the Nigerian construction industry in Nigeria.

6.2.1 Result from the interview on the extent of implementation of construction 4.0 technologies

Based on the views of the project managers, construction 4.0 is gradually being adopted with the highest implementation of Prefabrication and Building Information Modelling (BIM). According to the report, Prefabrication has been in existence for a while which is in form of a molding sample of a proposed project. According to the report, the project managers often persuade the clients on the need for prefabrication before commencement of the project. The BIM is mostly used by the Architects to design the projects for detecting the effect of any alteration made on the project. While Drones, Green Building and Robotic construction have low implementation on the construction site.

Table 1: Extent of implementation of construction 4.0 technologies in the selected construction sites, Southwest Nigeria

	N	Percent (%)	Mean	Ranking
	Frequency			
Prefabrication	40	.80	3.73	1
Building Information Modelling	40	.75	3.61	2
Drones for Satellite Imagery	40	.55	2.65	3
Green Building	40	.30	1.83	4
Robotic Construction	40	.18	1.28	5

Source: Research Survey (2019)

6.3 Responses of the respondents on the factors hindering the implementation of construction 4.0 technologies in the surveyed construction sites, Southwest, Nigeria

A Bivariate Pearson Correlation was used to access the factors hindering the implementation of construction 4.0 in Nigeria. From the Table 2, lack of awareness of construction 4.0 was ranked the

highest factor hindering the implementation of construction 4.0 with a p value of .024 and a r value of .906, followed by lack of government support (p= .031: r = .896), lack of required skills (p = .038: r = .774) and lack of access to loan/finance (p= .041: r = .719). Factors such as shortage of power supply (p = .047: r = .610), high cost of implementation (p = .051: r = .463), and lack of interest of the workers in the industry (p= .069: r = .322) were indicated by the respondents as the least factors hindering the implementation of the technologies. We can deduce from the result that low awareness of construction 4.0 is a major constraint that needs to address to promote the implementation of a digitalized construction industry in Nigeria.

6.3.1 Result from interview on the factors hindering the implementation of construction 4.0 technologies in the surveyed construction sites, Southwest, Nigeria

The project managers affirm in the interview session that there is moderate level of awareness of construction 4.0. According to the report, low implementation is as a result of reliance on manpower to get work done on site. Also, the ministries of works in charge of construction, who supposedly should be at the forefront in the acquisition of the technologies, are not showing commitment compared to the private companies. More importantly, lack of the skills was also reported as a limiting factor.

Table 2: Factors hindering the implementation of construction 4.0 technologies in the surveyed construction sites, Southwest, Nigeria

		Construction 4.0 Implementation	Lack of Awareness	Lack of Government Support	Lack of Interest of the Workers in the Industry	High Cost of Implementation	Lack of Access to Loan/Finance	Lack of Required skills	Shortage of Power Supply
Construction 4.0 Implementation	Correlation Coefficient	1	0.906	0.896	0.322	0.463	0.719	0.774	0.610
	Sig. (2-tailed)	.	0.024	0.031	0.069	0.051	0.041	0.038	0.047
	N	40	40	40	40	40	40	40	40

Source: Research Survey (2019)

6.4 Responses of the respondents on the opportunities of construction 4.0 to the workforce in the construction industry

Findings from the study in Table 3 shows that majority of the respondents agreed that the implementation of construction 4.0 presents opportunities such as increase collaboration facilitation of harmonious relationships with other professionals, with a mean of 3.87 and standard deviation of 1.567, increase creativity and innovation among the workers (M=3.61:Stan.Dev =.884), reduce fatigue due the automation of tedious jobs (M=3.55: Stan. Dev =.902), reduce the time spent on monotonous job (M=3.21:Stan.Dev =.812) and increase workers' efficiency. The findings reveals that the workforce in the industry stands to gain a lot in the adoption of the modern technologies of construction 4.0. This can be justified by the fact that the introduction of modern technologies will eradicate most of the tedious jobs which is a major characteristic of construction work.

6.4.1 Result from interview on the opportunities of construction 4.0 to the workforce in the construction industry

The report from the interview session corroborates the questionnaire responses which highlighted that the increase in knowledge and innovation through the introduction of new technologies and techniques in the construction industry will enhance workers efficiency.

Table 3: Opportunities of construction 4.0 on workforce in the construction industry

	N	Mean	Std. Deviation
	Valid		
Increase collaboration and facilitate harmonious relationships with other professionals	40	3.87	1.567
Increase creativity and innovation among the workers	40	3.61	.884
Reduce fatigue due the automation of tedious jobs	40	3.55	.902
Reduce the time spent on monotonous job	40	3.21	.812
Increase workers' efficiency	40	3.01	.757

Source: Research Survey (2019)

6.5 Responses of the respondents on the threats of construction 4.0 to the workforce in the construction industry

A Kendall's tau b correlation test was carried out to access the perception of the project managers and supervisors on the threats of construction 4.0 to the workforce (Table 4). The result reveals that Retrenchment of workers ($p = .019$; $r = .787$) was ranked as the major threat of construction 4.0 on the workforce, followed by health and safety impact ($p = .028$; $r = .675$), Redundancy ($p = .032$; $r = .519$). However threats such as infringement of privacy ($p = .043$; $r = .507$) and high cost and time of acquiring required skills ($p = .047$; $r = .500$) were considered the least threats. From the result, it can be deduced that the workforce in the construction industry will face the threat of loss of jobs which is also a major prediction for industry 4.0. Moreover, jobs that can be automated will certainly lead to redundancy of the workers involved.

6.5.1 Result from interview on the threats of construction 4.0 to the workforce in the construction industry

The project managers and supervisors affirm in the interview session that the greatest threat of construction 4.0 to the workers is the unavoidable reduction of workers with emphasis on the manual workers. According to the report, some of the construction sites have acquired and intends to acquire some technologies such as block molding machine, paint sprayers and already missed concrete machine, which has led to 50% reduction in manual workers.

Table 4: Threats of Construction 4.0 to the Workforce in the Construction Industry

		Construction 4.0 Implementation	Retrenchment	Redundancy	Health and Safety Impact	High cost and time to acquire skills	Infringement of privacy
Construction 4.0 Implementation	Correlation Coefficient	1	0.787	0.519	0.675	0.500	0.507
	Sig. (2-tailed)	.	0.019	0.032	0.028	0.047	0.043
	N	40	40	40	40	40	40

Source: Research Survey (2019)

6.6 Perception of the respondents on the jobs threatened by Construction 4.0

Table 5 shows the perception of the respondents (project managers and supervisors) on the jobs that might be threatened as a result of construction 4.0. For the skilled professional jobs, the results indicate a moderate threat of the jobs which include Electrical Engineer (M=3.47: Stan.Dev =.877), Architect (M=3.25:Stan.Dev =1.032), Structural Engineer (M=3.20:Stan.Dev =.992), Project Managers (M=3.15: Stan. Dev=.864), Builder (M=3.02:Stan.Dev =.1000), Mechanical Engineer (M=3.00: Stan. Dev =.934), Civil Engineer (M=3.00: Stan. Dev =.877). However the Quantity Surveyor’s job (M=2.77: Stan. Dev =.1000) faces a low threat of construction 4.0. For the manual jobs, the Bricklayers, Painters, Bulldozer & Truck Drivers and Iron benders face a high threat of construction 4, 0 with a mean of (M=4.85, Stan. Dev= 1.251), (M=4.35, Stan. Dev=1.391), (M=4.25; Stan. Dev = 1.314) and (M= 3.84:Stan.Dev=1.264) respectively, while jobs such as Carpenters (M=3.62: Stan. Dev =1.005), Electricians, (M=3.45: Stan. Dev =1.239) and Welders (M= 3.55:Stan.Dev=1.451) face a moderate threat of construction 4.0 Overall, the results shows that the professional job are moderately threatened (M=3.11), while the manual jobs are highly threatened by construction 4.0. We can therefore infer from the result that both the professionals and the manual workers face a degree of threats. However, the manual workers are more threatened than the professionals as majority of the manual workers especially in Nigeria are unlearned. This is believed to be a major challenge to the acquisition of knowledge and skills required for construction 4.0.

6.6.1 Result from interview on the jobs threatened by construction 4.0

Based on the response of the respondents, the manual jobs are highly threatened compared to the professional jobs. According to the report, manual jobs have a high probability of being automated and that majority of the manuals workers possess no form of education, training which makes it difficult to understand the operations of the technologies.

Table 5: Construction Jobs that might be threatened by Construction 4.0

Skilled Jobs			Unskilled Jobs		
	Mean	Std. Deviation		Mean	Std. Deviation
Project manager	3.15	.864	Bricklayers	4.85	1.251
Quantity Surveyor	2.77	1.000	Crane Operators	3.425	1.152
Structural Engineer	3.20	.992	Bulldozer & Truck Drivers	4.25	1.314
Mechanical Engineer	3.00	.934	Painters	4.35	1.391
Electrical Engineer	3.47	.877	Iron Benders	3.84	1.264
Architects	3.25	1.032	Electricians	3.45	1.239
Builder	3.02	1.000	Carpenters	3.62	1.005
Civil Engineer	3.00	.877	Welders	3.55	1.451
Grand Mean	3.11		Grand Mean	3.92	

Source: Research Survey (2019)

7. Conclusion and Recommendations

The introduction of new technologies ushered by the fourth industrial revolution to the construction industry presents diverse opportunities and threats to the workforce. This study assessed the views of the project managers and supervisors, who are in charge of the projects. The study has been able to establish that there is gradual implementation of some of the new technologies such as prefabrication and BIM, while the use of drones, green building and robotic on constructions have not been implemented. With respect to the factors hindering the implementation of these technologies, the

major causes identified are lack of awareness of construction 4.0, government support, funding and skills to appropriate the technologies. Moreover, in respect to the opportunities of construction 4.0 to the workforce, the workers in the industry stand to benefit a lot such as increased collaboration, harmonious relationships with other professionals, creativity innovation, workers' efficiency and reduction in fatigue and time. On the other hand, retrenchment of workers is considered a major threat of construction 4.0. With regards to jobs that are likely to be threatened by construction 4.0, the manual jobs face a higher threat while professional jobs face a moderate threat. Without a doubt, introduction of technology threatens the labour force, which is to be expected by total implementation of construction 4.0. Therefore in light of low implementation of construction 4.0, there is need for more sensitization of construction 4.0 through seminars and training programs organized by various professional bodies and collaboration with the educational institutions. Also the government has a role to play in acquisition of these capital intensive technologies and sponsorship of personnel to acquire the essential skills needed to operate the technologies. In reference to the threats which centers mainly on retrenchment of workers, the managements in the construction industry need to devise programs for re-skilling of both the professionals and some categories of manual workers whose job cannot be automated. In addition, the government needs to formulate policies to support the implementation of the technologies in the area of finance and workers protection against retrenchment.

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