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Curbing the Effect of Covid-19 Pandemic in the Nigeria Construction Industry through Digitalization of Operations and Processes

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ABSTRACT

Digitalization of the construction sector would ensure continuity of operations and protection of industry assets by reducing risks resultant from the COVID-19 pandemic. This study examined Covid-19 impact on the construction sector in Nigeria, identified digital technologies applicable to construction activities, and assessed the prospects and challenges of digitalization of construction processes in Nigeria. This quantitative study lasted eleven months, with a structured questionnaire administered to a stratified sample of 324 construction personnel chosen from a study population comprising Architects, Engineers, Builders, and Quantity surveyors with over 5 years of practice experience selected from small, medium and large construction contracting and consulting firms in Nigeria's six geopolitical zones. The study revealed permanent job loss, project abandonment, cost overrun, time overrun, claims, and litigation arising from construction disputes, as the most significant impacts of the pandemic on the industry. Building information modelling (5-7D), artificial intelligence and machine learning augmented reality, drones, wearable technologies, were identified as major digital technologies that would innovate traditional construction activities in response to the pandemic. The study revealed prospects of construction digitalization in Nigeria in the areas of research, innovation, commercial development, and marketing. Technological backwardness, low financial capacity, lack of government support, lack of public-private partnership was identified as the major barriers. The study concludes that digitizing the construction sector to curb the deleterious effects of the COVID-19 pandemic could be facilitated by the development of government policies and the establishment of supportive legislation.

Key Words: *Construction industry, Covid-19 pandemic, Digitalization, Operations, Performance*

1. INTRODUCTION

COVID-19 pandemic impacted several global economies adversely including loss of sectoral productivity with attendant socio-economic losses. Ozili, (2020) attributed the severity of the pandemic in Nigeria to weak institutions, and a lack of adequate social welfare packages to swiftly cushion the effect of the pandemic (p. 3). Furthermore, the global decline in oil prices also impacted economies and nations adversely owing to the low demand for oil in the international market (Ozili, 2020, p. 20)

The construction industry like other economic sectors was not spared and as such, suffered its share of the adverse effects of the pandemic. The industry is known for its significant contribution to gross domestic product (GDP) and the employment of a large pool of manpower. Generally, the construction industry has inherent challenges owing to the peculiarities of its operations and processes. Its activities are often complex

and dynamic, and this was further threatened by unforeseen risks arising from the pandemic. A major characteristic of the industry is its deployment of nearly all categories of workers in the performance of multifarious activities for effective project delivery. This, unfortunately, became impossible under the new normal due to the pandemic. The most significant consequences of the pandemic on the construction industry included suspension of projects, labour impact and job losses, time overrun, cost overrun, and financial implications, among several others (Gamil and Alhager 2020, p. 127). According to Ogunnusi et al., (2020), the pandemic led to the deployment of technological tools and an increase in off-site working (p. 124). Thus, this study adopts Rouse's definition for digitalization which was described as a 'way of transforming information into a digital format, through the organizing of information into distinct units of data that can be separately addressed' (Rouse 2017, p. 1). Digital transformation in the construction industry is summarily the integration of digital data into the project life-cycle (Kalirajan and Babu 2019, p. 98). The earliest adopters of digital technologies according to (Kalirajan and Babu 2019) have reshaped the entire architecture of project delivery (p. 91). Most industries have undergone a digital transformation and use of digital technologies in their operations. Halim (2010) noted that no industry could effectively overcome its growth challenges unless goals and strategies are driven by digital technology. Technology has transformed our way of living in all ramifications including construction activities (Mentsiev et al., 2020, p. 19). Aghimien et al., (2018), identified the most significant benefits derived from digitalization in the construction industry as time-saving in projects delivery, increase productivity, increase speed of work, and simpler working methods (p. 5). Expectedly, the adoption of digitalization in the construction industry is also faced with numerous challenges. Findings from the literature have shown challenges such as consistent fragments, unavailability of skilled labour, lack of adequate or absence of knowledge from one project to another (Livotov et al., 2019, p. 2 and Craveiro et al., 2019, p. 1) among several others have limited the adoption technological opportunities in the engineering and construction sector. Aghimien, (2019) identified the major challenges of digitalization as lack of technical expertise, finances, security, interoperability, fear and resistance. The major drivers of digitalization in the construction industry have been found to be in the area of research, innovation, government support, as well as a public-private partnership (p. 433)

1.1. Problem of the study

Most industries have undergone a digital transformation and use of digital technologies in their operations. However, the construction industry still lags in embracing this trend. Digitalization is vital in today's world due to associated benefits such as efficiency in operations. The current state of arts of technology applications in the construction industry includes Building Information modelling (BIM), Internet of things (IoT), Internet of People (IoP), Robotics, Virtual reality (VR), Augment reality (AR), Drone, 3D printing and several others (Kalirajan and Babu, 2019, p. 92; Bojarska and Wińska (2019), p. 1). Unfortunately, most developing countries of Africa are far behind in the use of digitalization in construction (Aghimien *et al*., 2018, p. 1).

1.2. Objectives of Study

1. To examine the impact of the Covid-19 pandemic in the construction sector in Nigeria.
2. To identify digital technologies applicable to construction activities in Nigeria.
3. To assess the prospects and challenges of digitalization of construction processes in Nigeria

2. METHODOLOGY

The study methodology utilized a structured questionnaire administered to a stratified population of 324 construction practitioners. This study population comprised Architects, Engineers, Builders, Quantity Surveyors, Project Managers, and Geo-informatics Surveyors with at least 5 years of practice experience selected from small, medium and large construction contracting and consulting firms in Nigeria's six geopolitical zones. 54 questionnaires were allocated to each geopolitical zone, making a total of 324. Google-form, email, and calls, aided questionnaire distribution and response. 280 questionnaires were

returned, with only 252 valid responses, thus representing a 77.78% success rate. The analysis of data employed descriptive statistics using Statistical Package for Social Science (SPSS - 23) together with Microsoft Excel 2013.

3. TABLES AND FIGURES

The demographics of the respondents showed that 40% of the respondents comprised Civil Engineers and Project Managers, while the remaining 60 % of responses came from Builders, Architects, Quantity Surveyors, and Land Surveyors. In addition, 21.4% of the respondents represented the South-Western zone (SW), 18.7% from South-Southern zone (SS), 15.9% from South-Eastern zone (SE), 10.3% from North-Eastern zone (NE), 15.9% from North-Western zone, and 17.9% from North-Central zone. The highest educational qualification of the respondents showed that 25% possessed National Diploma, 35.3% had Bachelor's degree, 25.4% had a Masters degree, while 14.3% had a PhD degree.

3.1. Research objective: 1

The first objective of this study seeks to examine the impact of the Covid-19 pandemic in the construction sector in Nigeria. Table 1 below shows the severity of the Covid-19 pandemic on the identified most significant variables in the construction sector. The table was plotted against the six geo-political zones of the country which comprises three states each. According to responses on a 5-point Likert scale, project cost overrun is the most affected due to the pandemic with a mean value of 7.04. This is due to the imposed lockdown and the consequential socio-economic effects that led to inflation of construction materials, and scarcity of labour. Mean values of 4.89 each were recorded for project time overrun and litigation arising from construction disputes. Again, just as the lockdown significantly affected project cost, the same was applicable to project time overrun as a lot of man-hours was lost. Construction workers (both skilled and unskilled) could not work, hence a continuous lag in construction activities over a long period of time.

Table 1: The Impact of Covid-19 in Nigeria's construction sector

Geopolitical Zone of Respondent		Project Cost overrun	Project time overrun	Permanent job loss	Project abandonment	Claims	Litigation arising from construction disputes	Financial risks
NC (FCT, KW, NG)	Mean	7.69	4.88	4.21	4.09	4.48	4.88	4.31
	Std. Dev.	1.019	.328	1.081	1.362	.773	.328	1.104
NW (KD, KN, SO)	Mean	7.48	4.89	4.21	4.15	4.47	4.89	4.35
	Std. Dev.	1.037	.311	1.069	1.292	.762	.311	1.027
NE (BU, AD, GB)	Mean	6.77	4.92	4.25	4.19	4.52	4.92	4.42
	Std. Dev.	.815	.277	1.032	1.234	.714	.277	.945
SE (AB, EN, IM)	Mean	6.75	4.89	4.21	4.15	4.47	4.89	4.35
	Std. Dev.	.899	.311	1.069	1.292	.762	.311	1.027
SS (RV, DE, ED)	Mean	6.79	4.89	4.20	4.17	4.44	4.89	4.36
	Std. Dev.	.832	.318	1.079	1.274	.785	.318	.987
SW (LG, OY, OG)	Mean	6.72	4.88	4.18	4.15	4.47	4.88	4.31
	Std. Dev.	.940	.325	1.090	1.295	.758	.325	1.061
Total	% of Total N	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	Mean	7.04	4.89	4.21	4.15	4.47	4.89	4.35
	Std. Dev.	1.007	.312	1.063	1.284	.755	.312	1.024

3.2. Research objective: 2

The summary Table 2 below plotted against the six geo-political zones shows that Building Information Modelling (BIM 5D, 6D, 7D) is the most applicable according to respondents with a mean value of 4.90. This is followed by cloud-based project management and virtual meetings with mean values of 4.87 each. Other notable digital technologies with high mean values are; wearable technologies, drones, and GPS for construction applications. Furthermore, respondents were asked to match the selected digital technologies with the generic project life-cycle (Project initiation – project planning – construction – monitoring & control – closing). Figure 1 below shows the descriptive statistics of the respondents. The majority of the

respondents strongly agreed that BIM (5D-7D), drones, virtual meeting, cloud-based project management, internet of things (IoT) & robotics and GPS for construction application are applicable in every phase of the project life cycle. However, wearable technologies, bionic suits, and smart equipment are mostly applicable from the construction phase to the closing phase. In addition, respondents strongly agreed that augmented, virtual & mixed reality (AR, VR, MR), artificial intelligence (AI) & machine learning are applicable at the project planning and design phase. The essence of the applicability of digital technologies in the construction industry concerning the pandemic is mainly the adaptation into the new normal – which involves observing the Covid-19 preventive protocols set by the different governments of the world.

Table 2: Identification of digital technologies applicable to Nigeria's construction industry

Geopolitical Zone of Respondent		AR, VR, MR	Drones	Wearable technologies	AI and Machine Learning	BIM (5D - 7D)	Bionic Suits	Smart Equipment and Telematics	GPS for construction application	3D printing	IoT and Robotics	Cloud-based Project Management	Virtual Meeting
NC (FCT, KW, NG)	Mean	4.27	4.62	4.82	4.38	4.87	4.36	4.62	4.60	4.38	4.47	4.87	4.87
	Std. Dev.	1.136	1.029	.535	.936	.505	.981	.806	1.095	1.051	1.160	.344	.344
NW (KD, KN, SO)	Mean	4.30	4.70	4.85	4.40	4.90	4.40	4.65	4.70	4.40	4.50	4.85	4.85
	Std. Dev.	1.067	.911	.483	.928	.441	.928	.736	.966	1.033	1.086	.362	.362
NE (BU, AD, GB)	Mean	4.35	4.77	4.88	4.50	4.92	4.46	4.65	4.77	4.50	4.58	4.88	4.88
	Std. Dev.	1.018	.815	.431	.860	.392	.905	.689	.863	.949	.987	.326	.326
SE (AB, EN, IM)	Mean	4.30	4.70	4.85	4.40	4.90	4.40	4.65	4.70	4.40	4.50	4.87	4.87
	Std. Dev.	1.067	.911	.483	.928	.441	.928	.736	.966	1.033	1.086	.335	.335
SS (RV, DE, ED)	Mean	4.32	4.74	4.87	4.36	4.91	4.40	4.68	4.74	4.34	4.47	4.87	4.87
	Std. Dev.	1.024	.846	.448	.965	.408	.901	.695	.896	.069	1.080	.337	.337
SW (LG, OY, OG)	Mean	4.28	4.67	4.83	4.43	4.89	4.37	4.63	4.67	4.43	4.48	4.87	4.87
	Std. Dev.	1.089	.952	.505	.882	.462	.958	.760	1.009	1.002	1.128	.339	.339
TOTAL	% of Total N	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	Mean	4.30	4.69	4.85	4.40	4.90	4.39	4.65	4.69	4.40	4.49	4.87	4.87
	Std. Dev.	1.061	.914	.482	.912	.443	.928	.735	.969	1.019	1.088	.338	.338

Figure 1:
Digital technologies and the project lifecycle.
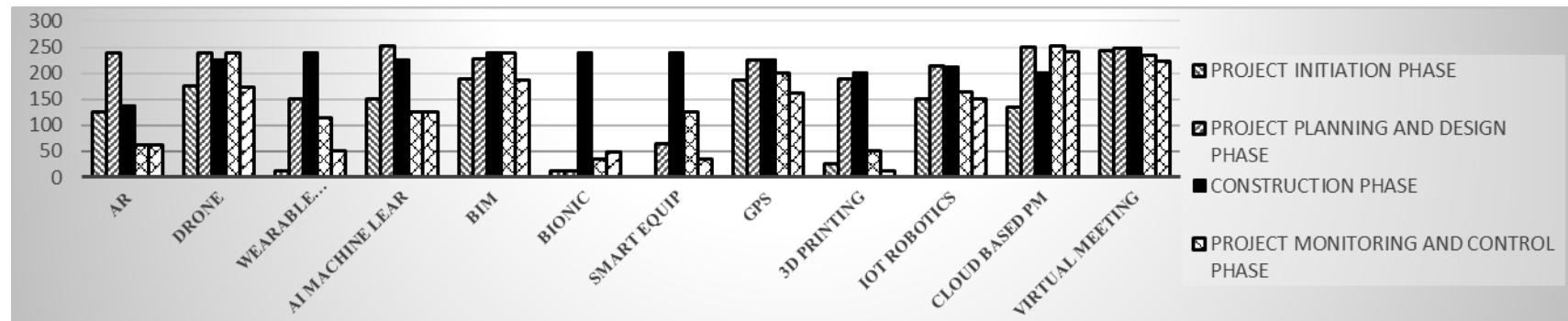
3.3. Research objective: 3

Table 3 below presents the results of the descriptive statistics based on a 5-point Likert scale on the possible drivers of digital technologies in the Nigerian construction industry. The most significant prospect was commercial development with a mean value of 4.90, followed by research, public-private partnership, and innovation with mean values 4.65, 4.69, and 4.40 respectively. Furthermore, the identified challenges hindering the adoption of digital technologies in Nigeria's construction industry are shown in Table 4 below. The majority of the respondents strongly agreed that cyber threats, technological backwardness, lack of government support, and low financial capacity are the most prevalent challenging factors affecting the adoption of digital technologies in Nigeria.

Table 3: Prospects of digitalization in Nigeria's construction industry.

Geopolitical Zone of Respondent		Research	Innovation	Commercial development	Marketing	Public-private partnership
NC (FCT, KW, NG)	Mean	4.62	4.38	4.87	4.36	4.62
	Std. Dev.	1.029	1.051	.505	.981	.806
NW (KD, KN, SO)	Mean	4.70	4.40	4.90	4.40	4.65
	Std. Dev.	.911	1.033	.441	.928	.736
NE (BU, AD, GB)	Mean	4.77	4.50	4.92	4.46	4.65
	Std. Dev.	.815	.949	.392	.905	.689
SE (AB, EN, IM)	Mean	4.70	4.40	4.90	4.40	4.65
	Std. Dev.	.911	1.033	.441	.928	.736
SS (RV, DE, ED)	Mean	4.74	4.34	4.91	4.40	4.68
	Std. Dev.	.846	1.069	.408	.901	.695
SW (LG, OY, OG)	Mean	4.67	4.43	4.89	4.37	4.63
	Std. Dev.	.952	1.002	.462	.958	.760
TOTAL	% of Total N	100.0%	100.0%	100.0%	100.0%	100.0%
	Mean	4.69	4.40	4.90	4.39	4.65
	Std. Dev.	.914	1.019	.443	.928	.735

Table 4: Challenges of digital technologies in Nigeria's construction industry.

Geopolitical Zone of Respondent		Technological backwardness	Low financial capacity	Lack of government support	Lack of public-private partnership	Cyber threat	Lack of top management support	Fear of unemployment
NC (FCT, KW, NG)	Mean	4.62	4.62	4.60	4.13	4.64	3.98	3.51
	Std. Dev.	1.029	1.029	1.031	1.358	.802	1.282	1.236
NW (KD, KN, SO)	Mean	4.70	4.70	4.70	4.15	4.70	4.05	3.50
	Std. Dev.	.911	.911	.911	1.331	.723	1.251	1.261
NE (BU, AD, GB)	Mean	4.77	4.73	4.77	4.23	4.77	4.16	3.58
	Std. Dev.	.815	.827	.815	1.243	.652	1.179	1.206
SE (AB, EN, IM)	Mean	4.70	4.70	4.70	4.15	4.70	4.05	3.50
	Std. Dev.	.911	.911	.911	1.331	.723	1.251	1.261
SS (RV, DE, ED)	Mean	4.72	4.74	4.74	4.09	4.70	4.02	3.45
	Std. Dev.	.852	.846	.846	1.365	.689	1.267	1.299
SW (LG, OY, OG)	Mean	4.67	4.67	4.67	4.17	4.70	4.04	3.52
	Std. Dev.	.952	.952	.952	1.314	.743	1.252	1.225
TOTAL	% of Total N	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	Mean	4.69	4.69	4.69	4.15	4.70	4.04	3.50
	Std. Dev.	.914	.914	.914	1.317	.723	1.240	1.238

4. CONCLUSION

The study concludes that digitalizing the construction sector to curb the deleterious effects of the COVID-19 pandemic is imperative due to the numerous benefits. The findings of this study generally showed a high perception level of the application of digital technologies in the construction industry in Nigeria. However, the major challenge is the adoption/implementation of digital transformation in the construction industry. The main aim of the study was to examine the impact of the Covid-19 pandemic in the construction industry, determine the applicability of selected digital technologies, as well as assess the prospects and challenges of digitalization of construction processes in Nigeria. Findings showed that the Covid-19 pandemic has led significantly to project cost overrun, project time overrun and litigation arising from construction disputes. In

addition, findings also showed selected digital technologies applicable to each project life cycle. Finally, findings showed the most prevalent prospects (commercial development, research, and public – private partnership) and challenges (cyber threat, technological backwardness, lack of government support) of digitalization in the construction industry in Nigeria.

5. RECOMMENDATION

The study recommends the following;
1. Review of existing construction industry tertiary education and professional certification curricular to include digital transformation and digital technologies,
2. Retraining of construction personnel through workshops, seminars, and conferences,
3. Governmental support in digital construction policy enactment,
4. Public-private partnerships for large scale investment in digital construction products.

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