AN EXAMINATION OF THE EFFECTS OF THE COVID-19 OUTBREAK ON CIVIL ENGINEERING OPERATIONS IN THE NIGERIAN CONSTRUCTION INDUSTRY

www.akwapolyjournal.org
P-ISSN: 2536-6733 | E-ISSN: 2616-0773

Supported by: tetfund TERTIARY EDUCATION TRUST FUND
TETFund/DESS / POLY / IKOT-OSURUA/ ARJ /1-2)

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Abstract

COVID-19 is a global epidemic altering and disrupting the world's economic outlook. The construction industry, regarded as one of the primary economic development engines, is adversely hit. The epidemic is having a global impact on building and infrastructure projects, resulting in most developments and initiatives being halted. The COVID-19 epidemic is a substantial source of project delays in Nigeria. The paper assesses and discusses the impact of COVID-19 on the sector from the beginning to the present scenario to manage potential future risks and gather knowledge for ensuring futuristic planning to deal with such uncertainty as a result of the pandemic. This study's objectives are to determine how COVID-19 affected Nigeria's civil engineering operations and to reveal the steps taken to mitigate the harmful effects of the pandemic. The development of a quantitative measurement, which uses a qualitative approach based on summative content analysis with 18 participants from three different construction companies, is used to determine the frequency of critical variables in the data distribution to ascertain the impact. To combat the spread of COVID-19 during the Conditional Movement Control Order, Nigerian civil engineering firms are developing Standard Operating Procedures (SOPs). This paper will discuss the measures adopted.

Keywords: *COVID-19, construction industry, CMCO, SOP, hazard*

Introduction

The COVID-19 outbreak affected most industry organizations across different sectors and operations, as it has never occurred on such a global scale. The unprecedented situation has impacted communities and organizations, suppressing national and international economies in terms of productivity by posing difficulty in achieving their short and long-term goals. Unexpected COVID-19 possibilities halted nearly every country's economic activity. Several businesses, like e-commerce, unintentionally thrived during the pandemic due to the fundamental existence of its market operation achieved through accelerated digital transformation (Unctcad, 2021). while others faced severe weather like a hurricane, the construction industry was undoubtedly not left out as most activities must be performed on site and working from home may not be feasible (Nweke & Nouban, 2022).

The corona virus pandemic has affected many stakeholders in the sector, including contractors, customers, suppliers, and contractors, who have faced varying degrees of effect. The influence on both type and magnitude heavily depends on the organization's specific field and the underlying initiatives (Stiles et al., 2021). Nigeria, like many other countries, instituted a lockdown during the pandemic outbreak on 27th March 2020. However, partial demobilization of construction activities remained ongoing until 2nd April with specific reference to Lagos state, where all activities were suspended (Dada, 2020).

The coronavirus epidemic that has devastated the Nigerian construction sector is explored in this study. This would help in identifying various industry challenges caused by COVID-19.

Therefore, the construction industry should assess the population's willingness to adopt new civil engineering techniques. Practical strategies to regulate and manage construction operations notwithstanding the breakout of COVID-19 should be determined. Lastly, digital technologies should be explored to improve economic performance in Nigeria.

Impact of Covid-19 Outbreak on Civil Engineering Activities in the Construction Industry

The average annual real GDP of the Nigerian construction industry was 3.7% two years before the COVID-19 outbreak and 3.4% two years after it, respectively (NBS, 2022). During the COVID-19 year, the real growth rate decreased by 35.46% points in the second quarter compared to the same period a year earlier and a year later, when it was roughly 1% and 3%, respectively

(CBN, 2021). Construction projects and workers continued to feel the effects of COVID-19. Though most turned to working from home, the sector, not used to the new trend, faced many challenges as the current projects during this time frame suffered lesser productivity. There is a positive link between the financial support given by the employer and the increase in workers' productivity, but it does not guarantee satisfaction. Working-from-home employees' satisfaction and perceived productivity are more likely to be impacted by organizational and job-related factors than work habits and household traits (Baker et al., 2007). To have the same feel as if it were the office space, where a design engineer could interact and train others, human resource and technical support offered drives job satisfaction. In addition, regular online meetings and interactions should be done to keep that non-existent regular office setting.

The study conducted by Bsisu (2021) to evaluate and compare the long-term effects of office and site work as seen from the perspective of civil engineers showed that the foremost concern was the financial effect on the sector, followed by job losses, then legal challenges for a project currently being planned and ongoing. Additionally, the study looked into how working from home affected productivity and discovered that only 21% of engineers saw an increase, 32% saw a decrease, and 48% saw no change.

As a result of the COVID-19 epidemic, building businesses had to pay higher costs and salaries, in addition to dealing with additional challenges due to the movement management order (Wahab, 2020). Contractors also had to cope with contract postponements or higher expenditures in addition to other changes that needed to be done.

Zamani et al. (2021) employed an open-ended interview to carry out a qualitative study to identify the construction challenges facing their activities post-COVID-19 and the practical mechanisms used to solve them with the owners and project managers of 20 contracting companies in Malaysia. He noted that the problems were operational and financial, comprising the project timeline, reduced labour, logistics, late payment, increased project cost, and reduced number of projects.

Another study carried out by Okerie & Olatunde (2022) in Lagos state, Nigeria, used a purposive sampling technique among 36 categories of respondents, broken down into two cadres of senior management and junior site workers in 6 construction firms comprising SMEs and large enterprises to discuss the use of thermometers, the attitude of construction workers towards using the face mask,

social distancing and hindrance to productivity together with obstacles to reducing COVID-19 in the Nigerian construction industry. The study found that the SMEs needed more resources and critical knowledge than the larger, more resourceful enterprises. Compliance of the large firms in using nose masks showed a positive trend due to strict rules, whilst the smaller firms did not. Social distance non-compliance was evident in both firms. Simultaneously, Timilsina et al. (2021) noted the same issues as Zamani et al. (2021) did. However, they also added a problem with institutions, brought on by inadequate support, a lack of special packages, and support from specialized organizations. They proposed the government and regulatory bodies' inclusiveness in supporting Nigerian construction firms as a solution. A qualitative convenience sampling technique was conducted with 13 respondents involving contractors, consultants, and clients with a cumulative experience of 129 years to know the challenges they encountered on construction projects and the methods used for practical project sustainability. The study found and classified the problem into financial and operational challenges, as done by (Zamani et al., 2021), though added managerial difficulties and health and safety issues to the operational challenges.

Table 1. Showing The Annual Real GDP in (Naira) of Activity Sector in Nigeria (CBN,2020)

YEAR	ICT	CONSTRUCTION	REAL ESTATE
2018	8527.66	2605.29	4471.86
2019	7355.31	2652.54	4366.35
2020	8525.16	2448.72	3963.59
2021	9145.6	2524.39	4053.08
2022	10126.35	2638.93	4213.07

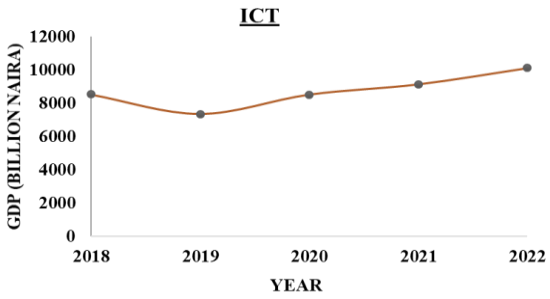


Figure 1. Chart Comparing the Annual Real GDP of Activity Sector in Nigeria

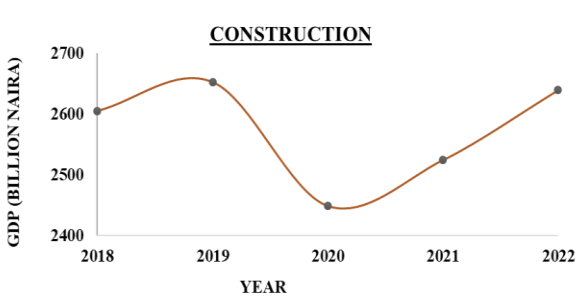


Table 1 shows the Annual real GDP of 3 activity sectors of the Nigerian economy (CBN, 2022). It is evident that there was a decline in activity of the construction and real estate sector, as a result of the global pandemic, but the ICT sector showed a growing trend associated with rapid digitalization of the sector which benefited from the 4th industrial revolution.

RESEARCH METHODOLOGY

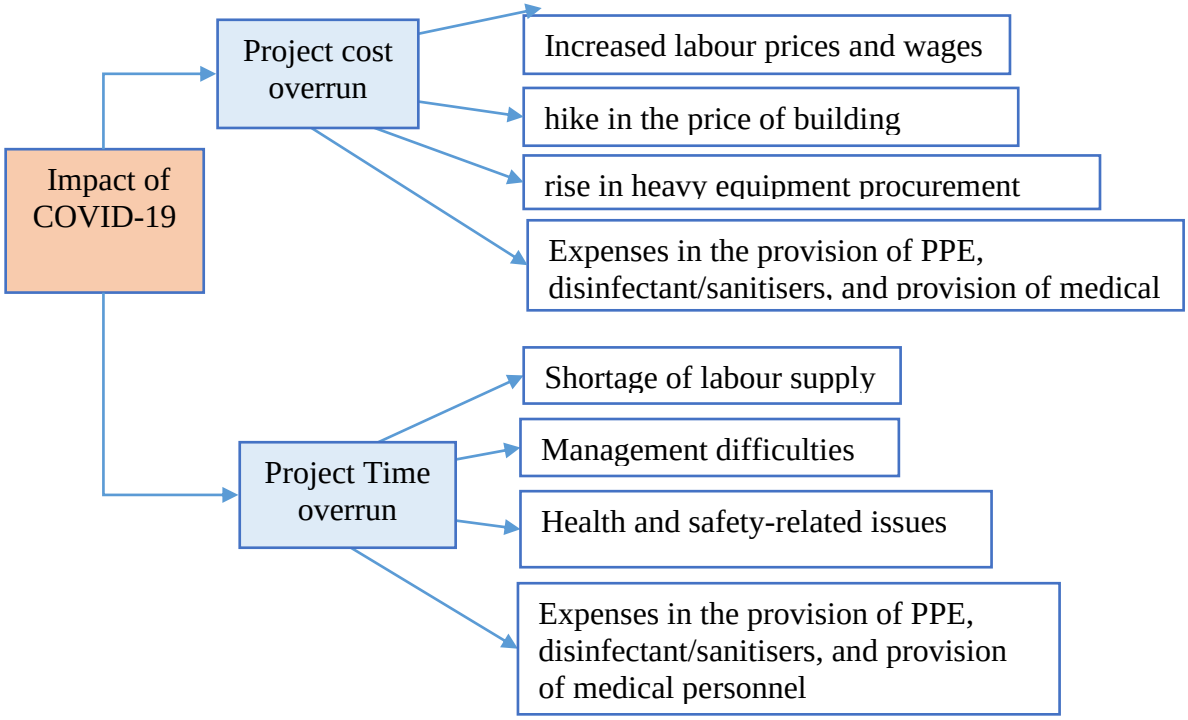
The research method involves using the literature that is currently available to identify the most common variables that affected project performance during the COVID -19 pandemic. following this, a qualitative-based approach is used to break down these variables into subthemes, to more clearly understand how each affected different construction projects. 18 participants were interviewed across 3 different civil engineering construction companies, as shown in Table 2. Open-ended and phone interviews were chosen to enable findings on qualifications and years of experience. Due to the nature of related findings, the participants selected cut across all positions. Grade A and B construction companies operating in Akwa Ibom State are used in the study, which is based on the classification of Nigerian contractors according to their technical and financial capacity (BPP 2007).

The focus of the research did not just identify the dependent variables that impacted construction projects due to COVID-19 but provided an in-depth study, showing in the hierarchy which variable affected the project cost and project time. Additionally, to fully comprehend how construction firms have reacted to the COVID-19 outbreak during the new normal, the qualitative approach further studies how effective social distancing, hygiene and sanitation, and education/ awareness creation through the use of sub-themes. The methodology, variables, and sub-themes are presented in Table 3

Table 2. Demographics of the Respondents

Interview/Gender	Type of operation	Position	Experirnce	Registration
P1 (M)	civil engineering works	Human resource manger	13	N/A
P2 (M)	civil engineering works	Project manager	30	COREN
P3(M)	civil engineering works	Site Engineer	14	COREN
P4 (M)	civil engineering works	Project manager	20	COREN
P5 (M)	civil engineering works	Chief surveyor	18	NIQS
P6(M)	civil engineering works	Assistant project manager	25	N/A
P7 (M)	civil engineering works	Site Engineer	12	COREN
P8 (M)	civil engineering works	Quantity Surveyor	15	NIQS
P9(M)	civil engineering works	Human resource manger	17	N/A
P10 (M)	civil engineering works	Safety officer	10	COREN
P11 (F)	civil engineering works	quality assurance manager	10	N/A
P12(M)	civil engineering works	Site Engineer	8	COREN
P13(M)	civil engineering works	Safety officer	15	ISPON
P14 (M)	civil engineering works	Chief Engineer	15	ISPON
P15 (M)	civil engineering works	Project manager	10	COREN
P16 (F)	civil engineering works	Chief Nursing Officer	20	RN/RM
P17(M)	civil engineering works	Chief Driver	15	N/A
P18(M)	civil engineering works	Safety officer	14	ISPON

Figure 2. Flow chart of the variables studied to address the challenges caused by COVID- 19 on project performance

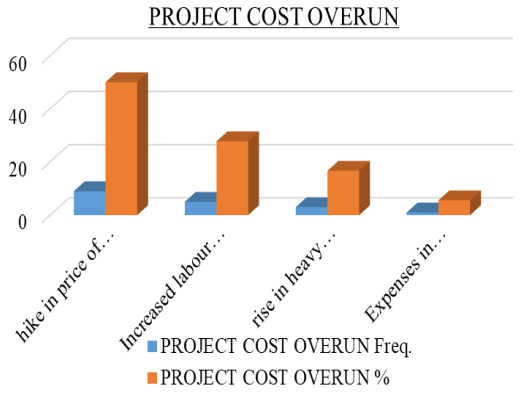


4.0 RESEARCH FINDINGS

PROJECT COST OVERUN		
Sub theme	Freq.	%
hike in price of building materials	9	50
Increased labour prices and wages	5	28
rise in heavy equipment procurement cost	3	17
Expenses in provision of PPE, disinfectant/sanitizers and provision of medical personnel	1	5.6
Total	18	100

PROJECT TIME OVERUN		
Sub theme	Freq.	%
Shortage of labour supply	8	44
Lack of funding	5	28
Management difficulties	3	17
Health and safety related issues	2	11
Total	18	100

Table 3. Variables studied to determine the effectiveness of the response



Variables Studied Under the New Normal	Sub-Theme	Frequency	%
Social distance Complaince	In office complex	10	56
	on-site	7	39
	In transport vehicles	1	5.6
	TOTAL	18	100
Testing of Workers	Temperature checks	17	94
	Testing of workers	1	5.6
	TOTAL	18	100
Hygiene & Sanitation	Hand washing	12	67
	Hand sanitizers	3	17
	cleaning of touched surfaces	2	11
	use of spray disinfectants	1	5.6
	TOTAL	18	100
Educating Workers/Awarness Creation	Awareness meeting	11	61
	Awareness on group platforms	4	22
	Use of Covid posters	2	11
	Stickers	1	5.6
	TOTAL	18	100

Figure 3. Chart comparing variables with sub-themes

Discussion of Findings

Impact on Construction Activities

Construction activities in the country slowly ended on March 25 2020, and a total halt of all site activities and a sit-at-home order was issued on April 2, 2020. The sector was allowed to resume activities with stipulated guidelines and regulations on May 4 2020 (Statehouse, 2020).

Noncompliance rendered the standard operating procedures linked to the movement control order ineffective. Interviews with study participants and observation of procedures revealed the relationship between noncompliance and enforcement weakness as well as between misinterpretation of information and noncompliance Azlan et al. (2022) as a setback to curb the spread in construction sites. To address the former, capability, opportunity and motivation better known as the COMB system should be applied, since low motivation is the main obstacle to compliance, enforcement is acceptable because it increases the incentive to engage in the desired behaviour Michie et al. (2011) and the later through government representatives, educating the public not just through media channels, but through official social media handles and live broadcast with top ranking representatives especially in this era where online contents is used to spread fake news and myths about COVID-19.

According to the dependent variables that were divided into subthemes, it can be seen that the increase in the cost of labour and the increase in the price of building materials, which together account for 78% of the project's total cost, had a significant impact on contract reviews. The increase in the price of cement from 2500 to 4500 naira also had a significant impact.

The delay in the completion time of construction works depended on labour shortage, funding, and difficulty managing the current situation, which cumulatively stood at 89%. The limited movement posed transportation and supply challenges as workers needed more time to arrive at the site. Workforces from other countries cannot travel due to tight restrictions and transportation difficulties. Further embossment of projects by the government and clients was stalled by the uncertainty surrounding the pandemic, as no new directives were issued. Supervision of construction works by consultants exposed the project to opportunistic claims.

With inadequate management of the uncertainty surrounding the client, contractor, and supplier chain during the pandemic which stood at 17% through

supervision. The client wants his project completed at a given time frame, the contractor wants to make a profit, the supplier wants to get rid of materials with expired shell life to minimize loss, and the safety requirement of the project can be compromised.

Effectiveness Ff The Response To Covid-19 by Construction Companies Under the New Normal

Social Distance Compliance

The study shows the compliance of social distancing to a favourable degree of 56% in office complex environments but lesser compliance of 39% on-site and very low on transit. Interviews with some participants indicated that the presence of CCTV cameras and Managers around the premises and laid down laws for defaulters allowed for compliance in the office environment. Observance of social separation is an effective tool if properly followed. In the Eastern Cape Verde province of South Africa, where noncompliance caused a spike, 80% of recorded infections in the region were caused by burial ceremonies held elsewhere (Jaja et al., 2020). Guidelines rolled out without the education of the workers remain a key component of mitigating spread. This was observed in places where social distance guidelines should have been capitalized with large amounts of site spaces, as both skilled and unskilled labour did not fully understand the 1m gap if 2m is not viable (CLC 2021), which could significantly reduce the spread.

Testing and Health Screening of Workers

This Ministry of Health's policy of using thermal scanners is followed through, and health screening is required for employees with a body temperature higher than 38°C. Additionally, all international and local personnel had to pass COVID-19 wellness exams to ensure they were healthy and infection-free before performing their duties and operating equipment.

From the qualitative study, temperature checks using thermal scanners were effective to a 94% advantage over testing at 5.6%. However, workers who recorded high temperatures were not documented, and follow-up procedures needed to be carried out to ascertain their health condition. Lack of monitoring workers with early signs could contribute significantly to the spread of COVID-19 if there are no records to identify the carrier. A total closure of site activities is imminent to a high degree, eroding all other measures and leading to project delay and cost increment.

Hygiene and Sanitation

Hand washing recorded a high compliance rate of 67% as seen in the study, followed by a cumulative of 28% for the use of hand sanitisers and cleaning of touched surfaces while the use of spray disinfectant was noticeably low. Considering the financial state of most construction companies to reduce spending on other means of hygiene and sanitation, hand washing with soap is preferred to using hand sanitisers.

Education and Awareness Creation

The response awareness through meetings, which stood at 61%, is supposed to be an ineffective tool at such a time. The use of digital platforms to create awareness should be the way forward to avoid close contact with colleagues during the pandemic. Promoting this particular variable will aid in the study of other variables discussed above.

Project managers should support social initiatives to inform staff about the COVID-19 virus by using alternative channels such as text messaging, billboards, leaflets, and loudhailers. Face-to-face interactions should be kept to a minimum and adhering to social distancing principles, while online seminars and briefings should be encouraged, and absentees should be penalized. This will reduce the frequency of interactions with employees.

The measures mentioned above are essential in enabling employees to assess their health before reporting to work, and if symptoms continue, they can self-quarantine and contact medical authorities. As a result, it is necessary to practice social distancing at work or on construction sites, and Personal Protective Equipment (PPE) such as masks, shields, safety boots, and safety helmets can be used in any unsafe or hazardous situation. Businesses must educate employees and construction workers about the importance of sanitary practices, healthy and safer work procedures, and other preventative measures that must be implemented to meet Standard Operating Procedures (SOPs) at construction sites and living areas to reduce the spread of COVID-19. The instructions and directives issued by various departmental authorities to examine the condition of foreign employees in Lagos and Abuja are preventative measures to guarantee workers' well-being and are most suitable for their workplace (Shah et al., 2020).

How Digital Technologies be Substantially Explored for Improved Project Performance In The Nigerian Construction Industry To Manage Possible Future Occurrences

As was already noted, limiting the spread of COVID-19 requires adhering to the new, universal criteria of maintaining social distance. Technology was used at the beginning of COVID-19, focusing on healthcare systems. For instance, Makcik Kiah19 (MCK19) is the first delivery robot made in Malaysia for hospitals. It was created to help healthcare frontline workers deliver food and medication to COVID-19 patients, limiting contact and reducing the risk of transmission (Al-Ogaili et al., 2020).

Due to shortages of resources, the Nigerian construction sector generally continues to rely on manual labour rather than the deployment of technology in building operations. However, due to the COVID-19 pandemic, utilizing and putting digital technologies into practice is urgently required to manage and get past the problems brought on by the COVID-19 pandemic. Construction technologies include cutting-edge inventive instruments that are extensively used across the world, particularly in industrialized nations. As a result, it is critical to investigate the use of digital technologies (Wang, 2007). Although COVID-19 may be seen as a barrier to the industry, it allows cutting-edge technologies like Building Information Modelling, drones, Virtual Reality, Robotics, Augmented Reality, and others to be adopted and used as new standards in Nigeria. These devices can help increase workers' productivity while protecting construction workers' health, well-being, and safety by requiring fewer conversations between individuals. These technologies are anticipated to remain and develop despite the COVID-19 pandemic. Technology intervention could help the industry better if the necessary steps are taken in the right direction, not just to battle the COVID-19 pandemic but in the event of a possible future outbreak.

Drones are currently being used in surveying in some construction firms. This technology can be extended to spraying disinfectant in high-risk areas and monitoring compliance rates and the safety of workers. Using drones to monitor and take images and videos of the various stages of projects and make reports should be explored. However, its use can be expanded to encourage safe construction where less human contact is sought to be minimized. During high-rise construction, where safety is paramount, problems encountered in dangerous areas can be seen and addressed. Project managers and project team members can make decisions by collectively sharing drone images.

Hospitals were overrun by the COVID-19 pandemic, raising the need for PPEs. To provide their workers with urgently required protective gear, many healthcare facilities opted for 3d printing (Daley, 2022). However, the technology has been widely used in manufacturing to replace parts of machines (Adegoke, 2023). The emergence of 3d printing and cloud computing could cause a significant improvement in how construction is done in developing nations.

The incorporation of all information into a building project assists the designer and other construction experts in constructing a design more successfully than other tools already available on the market with the use of building information technology. The 3D model-based technique will reduce reliance on 2D drawings, which can sometimes be challenging to grasp. The top three drivers boosting BIM adoption in Nigeria are professional training, preference, and customer satisfaction with BIM-executed projects (Olatunji, 2022).

It permits the production of virtual 3D models that can be explored and altered, linking materials, spaces, and systems more easily understood. A database generates 3D images and plans, as well as the capacity to design and test structures in 3D.

Construction frequently involves multiple repetitive tasks that are labour-expensive and time-consuming, making it uneconomical in the long term. Using robotics and automation in tasks such as welding, bricklaying, and moving roofing tiles and materials to floors in high-rise buildings might save a significant amount of workforce, project time and money. In developing countries such as Nigeria, moving roofing sheets is still manually, and assembly is still primarily done with a hammer and nails rather than nail guns. In this uncertain period, reliance on labour should not be the norm, but instead, exploring new ways to improve productivity and efficiency by employing robots and automated processes in activities such as bricklaying, welding, and rebar work.

Sustainable construction through waste reduction often referred to as lean construction is achievable with the help of robotics. A large amount of generated waste on site is detrimental to profitability and the environment at large. Furthermore, Robots can significantly reduce project expenditures by lowering the quantity of labour necessary (Multani, 2021).

Engineers and designers are more collaborative with the in-cooperation of BIM. They use 4D and 5D design simulations to combat and minimize 2D drawings. With this growing trend, projects are planned better, optimizing work schedules. Workers are properly documented and monitored through online channels, Management of scarce resources more effectively, and alternative supply channels. There is no need to wait and experiment on too many models.
It is visible from the study that managerial problems negatively impacted project time overrun by 17% during COVID -19. A complete management system considers unforeseen events that could hinder the successful delivery of construction projects. In addition, BIM should be incorporated into civil engineering courses. Learning centres should be established where new trends in technology are taught.

Conclusion

This study aims to examine the consequences of the COVID-19 pandemic on civil engineering operations and the effectiveness of the response mechanisms that were used to curb the spread in the Nigerian construction sector. This research identified the challenges and analyzed the most prevailing factors that contributed significantly to cost increment and longer completion time of projects. The major factors responsible for project cost overrun were the hike in prices of building materials, increased labour cost, and rise in heavy equipment procurement. In contrast, the significant factors responsible for project overrun were the labour supply shortage, lack of funding by stakeholders, and management difficulties.

The effectiveness of the response mechanism through social distancing, testing of workers, hygiene and sanitation, and Education/Awareness creation could have been more satisfactory, though lacking in digital technologies.
Despite technical intervention through innovations brought upon by the fourth industrial revolution through digitalization, adopting diverse technologies still needs to be a standard and routine practice in the Nigerian construction sector due to numerous obstacles like cost, price, culture, and technological know-how. However, establishing digital technologies with practical applications is advantageous to combat the COVID-19 outbreak.
The Nigerian construction sector will remain competitive in this environment by adopting innovative strategies and operations. Because the COVID-19 outbreak has had a widespread influence on the construction industry, consider using technology to implement construction projects to improve project and work performance, improve coordination, and execute projects on schedule and within budgetary restrictions, resulting in larger profit margins.

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