



Construction industry post-COVID-19 recovery: Stakeholders perspective on achieving sustainable development goals

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ABSTRACT

Many countries lockdown and safety guidelines enforcement due to Corona Virus Disease of 2019 (COVID-19) affected the construction sector, which is one of the highest labour-intensive industries. Therefore, Nigeria's COVID-19 scenario may hinder sustainable development goals projects connected with the construction sector. Hence, this study investigated the challenges faced during the pandemic and proffer feasible solutions through the stakeholders' perspective to direct the post-COVID-19 recovery phase into a sustainable path for achieving Sustainable Development Goals (SDGs) connected to the construction sector. This was conducted in sequence. First, the face-to-face interviews and results from the qualitative phase were further analysed through a questionnaire survey within Lagos and Abuja, Nigeria. Findings suggest management efficiency improvement, construction companies accelerate rollout and adoption of digitalisation technologies with government support, new skill-building on new tools and technologies, and government should increase the budget on infrastructure facilities as part of the feasible solutions to direct the post-COVID-19 recovery phase to achieve SDGs. In conclusion, the outcome of this paper will shed light on how collaboration with relevant stakeholders and the use of 4IR technologies can stir up attaining the SDGs associated with the sector in the post-COVID-19 recovery era.

KEYWORDS

Construction; COVID-19; mixed-method research design; Nigeria; stakeholders; sustainable development goals

Introduction

There is no doubt that the construction industry has played a significant role in humans' drive towards industrialisation, urbanisation, green revolution, globalisation, digitalisation, and sustainability. Globally, the industry plays a significant role in the economic, societal, and political growth of any country (Zamani et al. 2021). This is one of the sectors that have a significant role to influence the success or failure of the Sustainable Development Goals (SDGs) (Ebekozi et al. 2019a). The United Nations adoption of the SDGs in 2015 marks a critical period for the world development plan. The United Nations (2015) described the SDGs as a "plan of action for people, planet, prosperity, peace, and partnership." This submission correlates with the construction industry regarding achieving the mission of the goals. Independent Research Forum (IRF) (2015) reported that the 2030 agenda for sustainable development includes 17 goals, 100 indicators, and 169 targets. This signifies a fresh course for the world community and development.

International Council for Science (ICSU) and International Social Science Council (ISSC) (2015) argued that the new SDGs and the wider sustainability plan address important worldwide encumbrances to sustainable growth. These aspects were overlooked in the Millennium Development Goals (MDGs) agenda. Examples of the aspect overlooked are lax institutional capacity, environmental degradation, disparity, and unsustainable consumption behaviour. Opoku (2016) affirmed that SDGs are action-oriented, concise, and easy to communicate. In the opinion of Strandenaes (2015), the author described SDGs as worldwide, unified, interwoven, intimate, planet-sensitive, and centred

around humans. Opoku (2016) found that majority of the outcomes of sustainable built environment's projects through the construction industry such as the development of smart cities and sustainable urban locations, sustainable design and construction of infrastructure, and the development of renewable energy technology are some of the role being played by the industry towards the attainment of the SDGs. This has created and contributed to the socio-economic growth and well-being of the people. Majority of the Goals (1-17) have a direct or indirect connection with the construction sector with an emphasis on Goal 1 (put an end to poverty), Goal 3 (safeguard healthy lives and well-being), Goal 6 (environmental sanitation), Goal 7 (reliable and sustainable energy), Goal 9 (build infrastructure), Goal 11 (sustainable cities and communities), Goal 13 (mitigate climate change), Goal 14 (defend the sea/ocean), and Goal 15 (protect the ecosystem) (United Nations 2015). Lekan et al. (2020) found that one of the identified goals (Goal 9) can be achieved through technological innovations in the construction field. This mechanism is a component of the fourth industrial revolution (4IR) technologies (Ebekozi and Aigbavboa 2021).

About a decade to the year 2030, on 30th January 2020, the World Health Organisation declared COVID-19 a worldwide pandemic and threat to human existence (Bong et al. 2020, Loayza 2020). Globally, from December 2019 to early August 2021, about 202,986,864 confirmed cases, 182,353,354 recovered cases and 4,299,735 death. In Nigeria, from December 2019 to early August 2021, about 177,615 confirmed cases, 165,472 recovered cases, and 2,185 death (Nigeria Centre for Disease Control 2021; Worldometer 2021). Responding to this pandemic is a huge challenge to the health sector especially in developing

countries. In October 2020, the World Health Organisation reported that the pandemic has presented an unprecedented challenge to public health, food systems, and jobs. Regarding the job loss, about 50% of the world's 3.3 billion world workforce are at risk of losing their livelihoods. (World Health Organisation 2020). Also, it projected that not less than 132 million people could be added to the current estimated 690 million undernourished people. This is tens of millions of people at the risk of falling into extreme poverty if nothing is done to curb the spread of this virus. A recent survey (April 2021) on the economy by McKinsey & Company shows positive with about 73 percent of the respondents agree that the conditions in the world economy will improve in the next half year (McKinsey & Company 2021). This may come to reality if there are no rising cases of the pandemic across the globe before the last quarter of 2021.

Thus, achieving the SDGs in many countries on or before 2030 has become debatable and uncertainty has set in. The pandemic negative impact on the construction sector may be one of the reasons (Ebekozi and Aigbavboa 2021). The sector is one of the industries with the highest labour-intensive workers. Globally, countries adopted strict restrictions on movement to lessen the spread of the pandemic. This affects the economic activity of the construction sector. Examples of the restrictions are physical distancing, self-isolation when necessary, shut-down of workplaces, gatherings and travelling restriction, stay at home order, among others to mitigate the spread of the virus (Loayza 2020, Maxmen 2020). Nigeria's COVID-19 scenario may have hindered sustainable development projects connected with the construction sector. The negative impacts on the sector were unprecedented. Preliminary observations by the researchers reveal that the pandemic poses a threat to the United Nations SDGs of bringing poverty, among others to an end before the year 2030. Sumner et al. (2020) projected that the globe poverty level may increase by 420-580 million persons by the year 2030 if no formidable policies are put in place to alleviate the damages caused by COVID-19. This should be of concern to all. The International Food Policy Research Institute (2020) projected that the pandemic may cause the globe about \$10 trillion.

In Nigeria, according to the report published by the National Bureau of Statistics, the construction and related industries are together responsible for more than 10% of Gross Domestic Product (GDP) in the first quarter of 2020 (Uwaegbulam 2020). This has increased social-economic development because a large number of construction projects are currently been undertaken. These projects are germane to both the national economy and social development. Recently, this sector has suffered site shut down, and many of the open sites faced interrupting supply chains and working restrictions (Ebekozi and Aigbavboa 2021). Due to the more volatile nature of the sector, it will take some time for economic activity to return. Biorck et al. (2020) projected the year 2023 as the earliest construction activities can bounce back to the 2019 level before the pandemic erupted. As the pandemic begins to ease especially in many developing settings such as Nigeria, many firms are planning a fresh combination of remote and on-site working. The new working model will increase productivity, improve employee experiences, and lower operational costs (Alexander et al. 2020). Hence, this study investigated the challenges faced during the pandemic and proffer feasible solutions through the stakeholders' perspective as a guide to direct the post-COVID-19 recovery scenario into a sustainable path for achieving Sustainable

Development Goals (SDGs), with emphasis on the SDGs connected to the sector. The paper's objectives will be achieved through the following:

- i. To investigate challenges faced by the construction sector during COVID-19 pandemic.
- ii. To suggest feasible solutions to direct the post-COVID-19 recovery phase into a sustainable path for achieving SDGs.

Literature review

COVID-19 impact on the construction industry

Records have shown that pandemics are not new to human existence but the complexity of COVID-19 and the high rate of spreading is of great concern to many. It has made prevention in many countries and territories inevitable (BBC 2020). Maybe the late or lax implementation and enforcement of travel restrictions and on-arrival quarantine for most countries contributed. White and White (2020) affirmed that many nations initiated territorial containment mechanisms such as regular hand-washing, social distancing, banning of public gatherings, and self-isolation. Gbadamosi et al. (2020) identified self-isolation at resident, isolation at regular healthcare facilities, isolation at disease control healthcare facilities, isolation at emergency retrofitted temporary healthcare facilities, isolation at temporary mobile/wooden cabin facilities, and isolation at emergency new structure COVID-19 healthcare facilities as the possible six main isolation space creation (ISC) measures for the treatment and to mitigate further spread of the virus. The socioeconomic impacts of COVID-19 pandemic on the construction industry especially in many developing countries such as Nigeria with little no palliative measures tailored to the stakeholders may be severed. Few scholars attempted to highlight COVID-19 impact on the construction sector and the economy by extension in a developing country setting but the uncertainty of the current situation may have contributed to the inadequacy of the review. Examples of scholars are Gamil and Alhagar (2020), King et al. (2020), Ogunnusi et al. (2020). Apart from their findings and recommendations not captured in Nigeria's context, their proposed recommendations to recover the industry were not tailored towards achieving the SDGs. This gap among others will be filled in this paper.

Gamil and Alhagar (2020) found the suspension of construction projects, workforce shortage, construction time and cost overrun, financial crisis, supply of building material shortage because of the shutdown of factories, interruption of planning and scheduling of construction sites, restriction of movement on the work and travel bans, sudden fluctuation of building material prices, interruption of terms and conditions of contract, the uncertainty of key stakeholders/operators survival, negative impact on the existing accomplishment such as the SDGs target, among others as the emerged impacts on Malaysia's construction industry. Ogunnusi et al. (2020) reported that 50% of the respondents suspended their work because of government directives. The authors discovered unforeseen delays in projection completion, extraordinary complexity in cost and time overrun, hardship suffered by construction staff especially the causal/daily workers, disruption to work programme because lockdown was not anticipated, the slowdown in revenue from the real estate sector, adapting to the new health and safety guidelines, challenges in ICT site operations from home like some other services as the impacts on the construction industry. King et al. (2020) found that the industry faces more difficulties regarding financial

Table 1. The 17 Sustainable Development Goals (SDGs).

Goal	Description/Aim
Goal 1	End poverty in all its forms
Goal 2	End hunger, achieve food surplus and improved nutrition, and promote sustainable agriculture
Goal 3	Ensure healthy lives and well-being for all irrespective of the age
Goal 4	Ensure inclusive and equitable quality education and promote life-long learning opportunities for all
Goal 5	Achieve gender equality and empower all women and girls
Goal 6	Ensure availability and sustainable management of water and sanitation for all
Goal 7	Ensure access to affordable, reliable, sustainable, and modern energy for all
Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation
Goal 10	Reduce inequality within and among nations
Goal 11	Make cities and communities safe, resilient, and sustainable
Goal 12	Ensure sustainable consumption and production patterns
Goal 13	Take urgent action to combat climate change and its impacts
Goal 14	Conserve and sustainably use the oceans, seas, and marine resources for sustainable development
Goal 15	Protect the ecosystem
Goal 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 17	Strengthen the means of implementation and revitalise the global partnership for sustainable development

Sources: Modified from United Nations (2015) and Opoku (2016).

and productivity issues because of the COVID-19 crisis and proffered legal, environmental, financial, and productivity supports as mechanisms to solve the issues.

Achieving SDGs in the post-COVID-19 recovery for the construction industry

The need for a connection between construction activities and the environment to achieve a sustainable society that can be managed and regulated cannot be over-emphasised. This may proffer solutions to sustainable development problems. Opoku (2016) avowed that the construction industry is a hub of economic activities as well as society's cultural customs. This is one of the increasing determinations and persuasive factors for governments ratifying the 2030 agenda for sustainable development (Sachs 2012). Griggs et al. (2014), Independent Research Forum (IRF) Independent Research Forum (IRF) (2015), Filho (2021), and Santos et al. (2021) opined that the new SDGs for the following decade aims to improve wealth and wellbeing by proffering solutions to the economic, social, and environmental issues that society faces daily. These transformational goals are relevant to develop and developing nations (Zhou and Moinuddin 2021). The outcome is to mitigate or eliminate extreme poverty and safeguard environmental sustainability.

Sustainability is a global concept that controls human's mentality regarding safeguarding the present without bargaining the future (United Nations News, 2020). Table 1 presents the 17 post-2015 United Nations SDGs. In the opinion of Opoku (2016), the mechanisms, strategies, and procedures towards attaining the 17 SDGs should be a multi-stakeholder procedure. One of the possible ways is robust construction activity (Ebekozi et al. 2019a). The authors affirmed that eight of the 17 identified SDGs (2015-2030) have a connection with the construction industry. This includes Goal 1 (no poverty), Goal 3 (good health and well-being), Goal 6 (access to good water and sanitation), Goal 7 (access to affordable and reliable energy), Goal 9 (infrastructure development), Goal 10 (reduced inequalities), Goal 11 (sustainable cities and communities), and Goal 15

(protect the ecosystem). These eight goals interconnect within the construction industry and the outcome would be economic growth with a sustainable livelihood for the environment and the users. To achieve this, attention should be given to the industry. Filho (2021) found that the major SDGs that are affected by the COVID-19 include Goal 1 (no poverty), Goal 2 (no hunger), Goal 3 (good health and well-being), Goal 4 (education), Goal 5 (addressing gender equality), Goal 8 (ensuring employment), Goal 10 (reduced inequality), and 16 (peace and justice). Majority of these goals have a direct or indirect link with the construction sector. Shulla et al. (2021) found that the Covid-19 consequences could affect the SDGs because of the interconnection. They identified Goal 5 (addressing gender equality), Goal 9 (infrastructure development), Goal 10 (reduced inequality), Goal 11 (sustainable cities and communities), and Goal 17 (partnerships for the goals) as the possible goals that will be affected by the Covid-19.

Secher et al. (2018) argued that construction product manufacturers have an important influence and impact on reaching a range of targets within the SDGs. Ebekozi et al. (2021) found that 4IR technologies can play a key role in the recovery of construction sites and revamp related activities to the benefit of the sector. The necessity to conduct this study in tailoring the construction industry towards achieving the SDGs in less than a decade cannot be over-emphasised. The reason is not far-fetched. A vibrant construction sector is likely to accomplish the SDGs but the recent spike of COVID-19 on the sector and other aspects need attention to help build resilient structures and durable sectors through multiple approaches. This led to the emergence of research gaps. It was discovered in the articles reviewed that majority of them focussed on COVID-19 and the construction industry. There was a paucity of literature regarding how the industry will be able to meet up with the SDGs in less than a decade from now. Only a few addressed how some of the individual goals will be achieved but not about the COVID-19 crisis, such as Lekan et al. (2020). The authors research how the 4IR technology will be used to achieve sustainable construction and Goal 9 of the SDGs.

Research method

This study adopted a sequential exploratory research design. The sequential exploratory design involves the first phase of qualitative data collection that is used to inform the second phase of quantitative data collection (Berman 2017). One of the advantages of this design is that the two methods are integrated during the interpretation phase of the study. This type of technique was used in similar research by Ebekozi et al. (2019b). The authors adopted this technique to explore the underlying issues and proffer viable and practicable policies. From the reviewed published papers, a pragmatic approach may be able to proffer possible answers to the issues, especially with less than a decade and with the spike of the COVID-19 on one of the drivers of the SDGs in Nigeria. Evidence from the reviewed literature shows that past similar investigations on either COVID-19 or SDGs related to the construction sector have not used this approach. The participants and respondents engaged for the first and second phases respectively were from Lagos and Abuja. These locations attract high construction activities and they are commercial hubs. Using this method, qualitative data were collated and analysed. Followed was the questionnaire survey concerning the results from the qualitative data. The quantitative results were employed to confirm the qualitative data results. For this approach, the qualitative method phase was dominant in line with Yeasmin and Rahman (2012) that opined that there should be a methodological preference for a mixed-method research design.

The qualitative phase adopted a phenomenology type of qualitative research design. Phenomenology focuses on the participants' knowledge and experience during data collection (Creswell and Creswell 2018). Thematic analysis through themes was adopted to analyse the collated data. Twenty semi-structured face-to-face interviews with cognisance to COVID-19 compliance were observed and conducted between January 2021 and early April 2021. Saturation was achieved with 20 participants. The identities of the participants were hidden as showed in Appendix 1. The interviewees were from the contracting firm directors, manufacturing firm (construction materials) top management staff, public and private clients, design team, and NGOs related to SDGs. The face-to-face interviews lasted an average of 60 minutes. Each interview was then transcribed verbatim and clearance of areas not cleared, read again to the hearing of the participant for clarity (Saldana 2015). The rank of those interviewed indicates that they are knowledgeable regarding the construction industry, COVID-19, and SDGs matters. For example, Participants (11, 13, 14, and 16) have been construction consultants for over 27 years. A snowball sampling technique was adopted in line with Creswell and Creswell (2018). The authors avowed that this type of sampling technique permits the researcher to access more participants via the support of the interviewee. The collected face-to-face data were coded (Corbin and Strauss 2015, Jaafar et al. 2021). From the coding, 116 codes emerged. From the emerged 116 codes, ten categories were developed, and finally, two themes emerged (challenges faced during the COVID and feasible solutions into a sustainable path for achieving SDGs).

The quantitative phase adopted a questionnaire survey. Creswell and Creswell (2018) affirmed that a questionnaire survey type of research design describes patterns in a larger group of research. The paper populations were the same as the qualitative phase as presented in Appendix 2. The sampling frame was obtained from the Federation of Building Contractors in Nigeria, selected clients, a list of NGOs from Corporate Affairs Commission, Manufacturers Association of Nigeria bulletin,

professional bodies chapters of Quantity Surveyors, Engineers, and Architects in Lagos and Federal Capital Territory, respectively. For this paper, disproportionate stratification, a type of stratified random probability sampling technique was employed (Davern 2011). This allows the Researchers to give special consideration (larger representation) to the NGOs related to SDGs as presented in Appendix 2. Four hundred and twenty-two was the sample size derived in line with Krejcie and Morgan (1970) Thumb Rule and adopted in this paper. From the 422 questionnaires distributed through the post office and Google form across the two cities, 200 questionnaires (47% response rate) were recovered and suitable for the analysis. Statistical Package for the Social Sciences (Version 27) was adopted for the quantitative phase analysis. Cronbach's alpha coefficient with 5-point Likert scale measurement (strongly disagree = 1, disagree = 2, undecided = 3, agree = 4, and strongly agree = 5) was used to conduct the reliability test, and range from 0.739-0.787 as the internal consistency results among the items on each variable (Pallant 2016).

Results and discussion

Section II and III of Appendix 3 presents the summarised findings of the qualitative phase. The questionnaire survey as shown in Appendix 3 was generated from the oral interview results. The challenges faced during the COVID are in Section II whilst the feasible solutions that emerged from the qualitative findings are presented in Section III of Appendix 3. The respondents graded the challenges faced during the COVID and feasible solutions into a sustainable path for achieving SDGs through a questionnaire survey in the second phase. Information regarding the participants and respondents' backgrounds is presented in Appendices 1 and 2. Ninety-eight percent shows a sound knowledge of SDGs and COVID-19 impact on the construction sector in Nigeria and not less than 74% had 16 years minimum work experience as revealed in Appendix 2.

Challenges faced by construction sector during the COVID-19 pandemic

The challenges faced by the sector during the COVID-19 pandemic are presented in Table 2 as emerged from the oral interview phase and were further tested in the quantitative phase. Human development and management issues, social issues, technical issues, financial issues, safety issues, and productivity issues emerged as the six sub-themes. The emerged six sub-themes are the main challenges faced by construction sector during the COVID-19 pandemic in Nigeria and form part of this paper's implications. From Table 2, the overall mean range is 4.81 to 4.06 with the exemption of Q24 (absence of healthcare safety awareness regarding COVID-19). This shows that majority of the engaged respondents approve of the results from the first phase. Shut down of construction site (Q1) from human development and management issues (Theme A) was rated highest. Regarding Theme B, rising insecurity with a mean score of 4.62 was rated highest, lack of technological capacities from the contractors and design team with a mean score of 4.68 ranked 1st in Theme C, and cash flow issue with a mean score of 4.71 ranked 1st in Theme D. Others are challenges adapting to new COVID-19 is real with a mean score 4.69 ranked 1st in

From Theme F, decrease in productivity with a mean score of 4.65 was rated 1st. This validates results from the first phase. Participant 3 says, "...most construction sites that managed to

Table 2. Identified challenges faced by construction sector during the COVID-19 pandemic.

Code	Issues (Abridged)	Rank	Overall	Contractor	Manufacturer	Client	Design Team	NGOs
A	Human development and management issues:							
Q1	Shut-down of construction site	1st	4.81	4.89	4.70	4.79	4.81	4.86
Q2	On-going construction projects abandoned	2nd	4.43	3.49	4.44	4.74	4.79	4.67
Q3	Under-utilisation of manpower and machines	3rd	4.38	4.50	4.39	4.35	4.34	4.33
Q4	Interruption of terms and conditions of contract	4th	4.20	4.64	4.21	4.06	4.10	4.00
Q5	Workforce staff including some management, not trained to manage pandemic	5th	4.15	4.33	4.00	4.10	4.17	4.15
Q6	Many organisation refused to innovation support							
B	Social issues:							
Q7	Rising insecurity (Investors shunning real estate sector)	1st	4.62	4.76	4.56	4.50	4.65	4.63
Q8	Increased unemployment	2nd	4.27	4.68	4.39	4.25	4.00	4.03
Q9	Increased construction workers redundancy	3rd	4.13	4.34	3.96	4.18	3.98	4.19
Q10	SME in construction related had tough time	4th	4.08	4.10	4.00	4.19	4.01	4.09
Q11	Movement restriction	5th	4.06	4.06	4.07	4.03	4.09	4.04
Q12	Increased casual workers							
C	Technical issues:							
Q13	Lack of technological capacities from the contractors and design team	1st	4.68	4.77	4.55	4.78	4.67	4.65
Q14	Time and cost overrun	2nd	4.59	4.75	4.55	4.67	4.59	4.40
Q15	Uncertainty of key stakeholders/operators survival	3rd	4.44	4.56	4.40	4.39	4.54	4.32
Q16	Planned and scheduled programmes of construction activities interrupted	4th	4.32	4.29	4.32	4.41	4.39	4.21
D	Financial issues:							
Q17	Cash flow issue	1st	4.71	4.77	4.58	4.74	4.66	4.79
Q18	Fluctuation of contract sums	2nd	4.48	4.64	4.31	4.49	4.59	4.35
Q19	High cost of construction materials due to high inflation	3rd	4.32	4.53	4.66	4.23	4.05	4.12
Q20	Slow down in revenue from real estate sector	4th	4.24	4.44	4.20	4.39	4.09	4.09
E	Safety issues:							
Q21	Challenges adopting to new COVID-19 guidelines	1st	4.69	4.75	4.87	4.65	4.60	4.59
Q22	Absence of safety officers on site	2nd	4.49	4.69	4.70	4.45	4.30	4.30
Q23	Majority of the junior workers do not believe COVID-19 is real	3rd	4.35	4.50	4.34	4.36	4.28	4.29
Q24	Absence of healthcare safety awareness regarding COVID-19	4th	3.35	3.50	3.34	3.36	3.28	3.29
F	Productivity issues:							
Q25	Decrease in productivity	1st	4.65	4.79	4.77	4.68	4.60	4.40
Q26	Scarcity of some construction materials due to shut down of factories e.g. Cement	2nd	4.51	4.77	4.76	4.44	4.30	4.30
Q27	Production slow-down is a threat to SDGs associated with construction activities	3rd	4.41	4.50	4.55	4.41	4.30	4.30

Reliability coefficient (Cronbach's alpha) = 0.787 The mean difference is significant at the 0.05 level.

open-faced operational restrictions and disrupted supply chains. One of the outcomes is an economic downturn that hit long-term demand and supply patterns. This is because the sector (construction) is volatile. The manufacturing sub-sector of the industry was not left out. There was a shock to supply because of the movement restriction, leading to reduced productivity and total shut down of many construction sites..." Findings agree with and Filho (2021) and Santos et al. (2021) and it was affirmed that COVID-19 has the potential to harmfully influence the execution of the United Nations SDGs. This is because the construction sector is key to achieving the SDGs. In the opinion of Participants (1, 5, 6, 10, 15, 17, 19, and 20), the Nigerian Government at all levels, supported by the local and international NGOs were involved in the campaign on how to remain healthy during the first and second phases of the pandemic across Nigeria. This justified the reason for the low mean score for Q24 (3.35). Participant 4 says, "...though the pandemic has hit every sector hard, but the construction sector and its associates have suffered in unique ways..." Findings reveal that the pandemic has been brutal towards the construction practitioners because the majority of the activities before now were through the conventional approach (in-situ construction) on construction sites.

Findings show that contractors slightly disagree with Q2 "ongoing construction projects abandoned" with a mean score of 3.49. Participant 3 says, "...hopefully, when the movement restriction is finally relaxed and people are allowed to move about based on the evidence from the appropriate health authorities, we will reopen our construction sites and start activities across the country..." This indicates that construction contractors believe that majority of the construction projects will continue when the green light resurface for activities on site. Findings agree with Shulla et al. (2021) and it was discovered that Goal 9

(infrastructure development) and Goal 11 (sustainable cities and communities), both components of the construction industry were identified among the possible goals that will be affected by the Covid-19. Regarding the social issues, rising unemployment because of site shut-down and movement restriction has compounded the existing social challenges. Table 2 shows that 4.06 is the least mean score from the emerged six possible social issues as a result of the COVID-19 pandemic. Also, four items emerged under the sub-theme (safety issues). The new approach to safety such as physical distancing, regular handwashing, and face-mask wearing were new safety tips and challenging to the operators of the industry, especially the junior workers. Majority of the junior workers' perception is that the elites are the ones vulnerable to the virus (COVID-19). Findings agree with Dahab et al. (2020) and Ebekozen and Aigbavboa (2021). The latter authors found that 85 percent of engaged low-income earners believe that COVID-19 is a 'wealthy person' sickness. But the truth is that the virus does not have respect for financial status, sex, age, colour, and tribe. Dahab et al. (2020) discovered that it may be hard to enforce physical distancing in developing countries because of insufficient surveillance.

Feasible solutions to direct the post-COVID-19 recovery phase to achieve SDGs

Table 3 presents the 26 feasible possible solutions that emerged from the first phase across the six sub-themes. Results show an overall mean range of 4.88 to 4.09. This shows that majority of the respondents agree with the emerged feasible solutions from the first phase across the six sub-themes. This in principle verifies the qualitative findings across the two cities. Also, "promote

Table 3. Feasible solutions to direct the post-COVID-19 recovery phase to achieve SDGs.

Code	Possible solutions (Abridged)	Rank	Overall	Contractor	Manufacturer	Client	Design Team	NGOs
A	Improvement in human development and management efficiency:							
Q28	Skill building	1st	4.64	4.67	4.79	4.50	4.76	4.50
Q29	Collaborate with regulators to facilitate policy changes	2nd	4.56	4.49	4.49	4.54	4.69	4.57
Q30	Transform management models to break the constant slow technological cycles	3rd	4.42	4.59	4.40	4.38	4.44	4.30
Q31	Collaboration	4th	4.40	4.54	4.49	4.46	4.30	4.21
Q32	Rebuilding supply chains towards resilience	5th	4.23	4.30	4.10	4.19	4.27	4.29
Q33	Multichannel mechanism supports such as hybrid virtual model	6th	4.17	4.22	4.32	4.29	4.02	4.01
Q34	Build a control tower across the portfolio	7th	4.09	4.02	4.11	4.05	4.22	4.03
B	Improved social welfare:							
Q35	Govt. should support hardest hit sectors such as the construction industry	1st	4.69	4.66	4.49	4.80	4.77	4.75
Q36	Government should increase budget on infrastructural facilities	2nd	4.53	4.70	4.45	4.49	4.39	4.61
Q37	Contractors should have access to supporting loans to get back to business	3rd	4.35	4.55	4.23	4.38	4.23	4.34
C	Technical and professional skills:							
Q38	Develop new competencies	1st	4.82	4.89	4.85	4.87	4.77	4.70
Q39	Study the operating models	2nd	4.74	4.69	4.79	4.70	4.79	4.71
Q40	Strengthen scientific policy advice	3rd	4.68	4.70	4.70	4.67	4.62	4.70
Q41	Team experience is needed to manage critical driver of hybrid	4th	4.56	4.60	4.52	4.51	4.49	4.69
Q42	Acceleration towards sustainability	5th	4.18	4.55	4.32	4.05	4.01	3.98
D	Financial accountability:							
Q43	Adjust financing mechanisms	1st	4.71	4.77	4.58	4.74	4.66	4.79
Q44	Need to optimise current cost	2nd	4.48	4.64	4.31	4.49	4.59	4.35
Q45	Redeploy capital and resources	3rd	4.32	4.53	4.66	4.23	4.05	4.12
E	Safety and well-being:							
Q46	Government should make mitigation a priority (delay is costly)	1st	4.83	4.85	4.77	4.85	4.87	4.80
Q47	Stakeholders should get closer to customers and clients	2nd	4.42	4.60	4.70	4.30	4.30	4.20
F	Improved productivity through 4IR technologies:							
Q48	Promote policies that will encourage 4IR technologies	1st	4.88	4.90	4.87	4.79	4.91	4.92
Q49	Invest in construction-related 4IR technologies	2nd	4.78	4.86	4.88	4.78	4.70	4.70
Q50	Transform mgt models to break the constant slow technological cycles	3rd	4.67	4.79	4.77	4.49	4.70	4.60
Q51	Increase in off-site construction	4th	4.57	4.77	4.66	4.41	4.70	4.30
Q52	Augmented consideration and vertical integration	5th	4.43	4.50	4.55	4.44	4.33	4.31
Q53	Accelerated rollout and adoption of digitalisation	6th	4.33	4.45	4.40	4.21	4.55	4.02

Reliability coefficient (Cronbach's alpha) = 0.739 The mean difference is significant at the 0.05 level.

policies that will encourage 4IR technologies usage" (Q48) from "Theme F" (Technical) is rated highest. Participant 7 says, "...leaders in the industry should be ready to lead the shift from the conventional construction to automation and e-construction through new skills development..." whilst Participant 16 says, "...we need technology-based construction mechanism, not a construction mechanism supported by technology... Technology has come to stay and everyone needs to be versed in it because it will assist to create superior client experiences and drive the achieving of the SDGs even in the pandemic and post-pandemic... In the opinion of Participant 12, who is an Architect by profession, the benefits of cloud as a construction consultant can better be appreciated if digitalisation is embraced in practice. "...IT has to be part of the construction mechanism for major stakeholders... because your construction mechanism is enabled and delivered through digital technology. Many large construction companies are investing in digital technologies..." said Participant 15. Findings agree with Lekan et al. (2020) and it was discovered that technological innovations in the sector can enhance infrastructural development.

Infrastructural development is one of the SDGs (Goal 9). This can be achieved via 4IR technologies. Some of the 4IR components include digitalisation, augmented consolidation, vertical integration, hybrid virtual models, among others. More pragmatic possible policy solutions that intend to direct the post-COVID-19 recovery phase to achieve SDGs in construction-related goals emerged from this study. Findings agree with the United Nations News (2020) and Zhou and Moinuddin (2021). Zhou and Moinuddin (2021) affirmed that understanding the impacts of Covid-19 and its recovery on achieving the SDGs is pertinent. United Nations News (2020) discovered that pandemic has led to the loss of income and many families falling below the poverty

line. The sector is one of the major employers of labour but has been hit. For example, skill-building to close skill gaps in construction workforce and enhance advanced digital cognitive skills, multichannel mechanism supports, 4th industrial revolution technologies (BIM for construction, digitalisation, and building automation systems), vertical integration, hybrid virtual model, delay is costly, collaboration, optimise construction costs and adjusting financing mechanisms, strengthening of scientific policy advice, among others are needed to revamp the sector. Findings agree with Bogue (2018), Tahmasebinia et al. (2020), and Ebekozi and Aigbavboa (2021) and it was found that usage of 4IR mechanisms can lead to higher satisfaction of infrastructure. This technology will be useful in the post-COVID-19 era to facilitate the recovery of the industry and fast-track the achievement of the SDGs related to the construction industry. Currently, researchers have been exploring this opportunity to conduct studies in this direction. This would bring a new trend of research openings as part of the contribution to the body of knowledge.

Regarding optimise construction costs and adjusting financing mechanisms, Participant 12 identified two approaches (cutting costs and rethinking traditional financing mechanisms). The outcome will significantly improve cost efficiency and enhance construction project delivery for effective SDGs attainment in the post-COVID-19 era. This is because 4IR is capital intensive and many construction practitioners lack the financial capacity. Findings agree with Lotz (2019) and it was found that stakeholders need to develop and optimise current costs and adjust financing techniques. The hybrid virtual model is one of the hybrid approaches that allow some employees to be on construction sites while others work from home. "... hybrid increases productivity for individuals, promises greater access to talent, and lower cost..." said Participant 6. The latter possible policy solution

(strengthen scientific policy advice) is to mitigate misinformation and conspiracy theories and eliminate contradictory policy advice in the face of uncertainty surrounding preliminary scientific evidence. Achieving this requires collaboration.

Participant 20 says, “...local and international collaborations are necessary to achieve SDGs in post-COVID-19. This can be in form of knowledge sharing regarding operational techniques and supply health and economic benefits to stakeholders...” Findings agree with Klenert et al. (2020) and it was found that collaboration and mitigation are among the lessons learned from COVID-19 for mitigating the negative impact of climate change. Findings reveal that the construction industry matters more than ever during the pandemic by constructing hospitals to respond to critical crises and in the recovery through creating the platform for the provision of lifesaving equipment. Thus, to achieve SDGs, especially construction-related SDGs, all hands must be on deck as highlighted in Table 3. Table 3 summarised the feasible solutions to direct the post-COVID-19 recovery phase to achieve SDGs in less than a decade. Strengthening scientific policy advice (Q40), one of the emerged feasible solutions cannot be over-emphasised as earlier mentioned. Also, collaboration (Q31) is necessary to achieve SDGs in post-COVID-19. It will create the platform for knowledge sharing regarding operational techniques and supporting health and economic benefits.

Implication and contributions of this study

As part of the paper’s implication, the suggested feasible solutions to direct the post-COVID-19 recovery phase to achieve SDGs can be used by the policymakers and key construction practitioners as a guide to mitigating negative impacts of COVID-19 on the construction sector. Also, this paper intends to positively stir up stakeholders and bring to the front burners the significance of working towards achieving construction-related SDGs in the post-COVID-19 era. This is because the output of this paper will increase awareness regarding the SDGs related to the construction sector and the need for the key stakeholders to close rank in the post-COVID-19 era towards achieving these goals. This may lead to boost economic activities. This is because the construction sector is well known as a good catalyst for developmental growth.

Achieving SDGs associated with the construction sector in the post-COVID-19 recovery has implications for policy integration and social work. This is one of the contributions of the study. For example, the construction of health and educational facilities does not only create platforms for conducive learning and health service delivery but creates economic growth. Regarding this paper’s contributions, the paper made contributions in a variety of ways. First, by situating the study in the context of a developing nation using one of the largest African countries as a case study with attention on two of the commercial hubs cities. Second, by identifying the challenges encountered by those that were and still on-going actively involved in construction activities during the spread of the pandemic to seek possible solutions to mitigate the spread and grow the industry. Third, hinging the research on a very important topic that has been the bane of the construction industry in the developing nations with emphasis on achieving the 17 SDGs before 2030 cannot be over-emphasised. Finally, adopting a methodological approach that enables the authors to examine what can work (pragmatic) for the country by contextualizing their findings from the field of experts can be regarded as one of the contributions to the body of knowledge.

Conclusion and recommendations

The significance of achieving SDGs connected with the construction sector cannot be over-emphasised. This paper recommends some feasible ways to direct the post-COVID-19 recovery phase to achieve SDGs connected with the construction sector. The government at various levels should take the lead with policies that are “pro-achieving SDGs.” For example, the government should redeploy its capital and resources towards more infrastructural and construction projects and promote policies that will encourage 4IR technologies usage in the industry. One of the ways this can be achieved is by making access to funding 4IR easy for the operators of the industry. The study suggests that the rollout and adoption of digitalisation, new skill-building on new tools and technologies, such as BIM and upskill the workforce should be all-inclusive.

The emerged recommendations from this study are enlightening to the policymakers, construction related-manufacturing sector, and construction companies’ management team. Though this is tasking, can be achieved if there is a collective effort by the key stakeholders. In all these, These recommendations form part of the components that intend to stir up policymakers and other stakeholders on the possibility of achieving SDGs associated with the construction section despite the COVID-19 pandemic. It is expected that key stakeholders should collaborate to ensure that this mission is accomplished. Thus, this research concludes that the government at various levels should lead in the path to direct the post-COVID-19 recovery phase to achieve SDGs connected with the construction sector in Nigeria. This has become pertinent because some of the feasible solutions that emerged from this study demand policies and programmes for implementation and enforcement. For future studies, more cities can be covered.

Acknowledgements

Special thanks to the participants and respondents for providing knowledgeable contributions to enhance the findings of this paper. Also, the authors appreciate the comments, suggestions, and recommendations provided by the anonymous reviewers, which collectively helped hone and strengthen the quality of this manuscript during the blind peer-review process.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

Faculty of Engineering and the Built Environment and CIDB Centre of Excellence (05-35-061890), University of Johannesburg, Johannesburg, South Africa.

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Appendix 1. Summary of background information on participants

Participant/Rank	Position	City/Participant Code		
		Lagos	Abuja	Total
Contracting firm	Management Staff/Director	1, 2	3, 4	4
Construction manufacturing firm	Operational Manager/Sales Manager	5	6	2
Client (public and private)	Director/Project owner	7, 8	9, 10	4
Design Team/Consultant (Architects, Engineers, and Quantity Surveyors)	Principal Manager/Senior Partner	11, 12, 13	14, 15, 16	6
NGOs related to SDGs	Field Coordinator	17, 18	19, 20	4
Total Number of Participants				20

P = Participant

Appendix 2. Summary of background information on respondents

Category	Classification	Frequency	%
Organisation	Building/Construction company	55	27.5
	Manufacturing company (Construction materials)	25	12.5
	Client (Public and private)	40	20.0
	Design team (Architect, Engineer, and QS)	68	34.0
	NGOs related to SDGs	12	6.0
	Total	200	100
State/Territory	Abuja	85	42.5
	Lagos	115	57.5
	Total	200	100
Work Experience	0 – 5 years	2	1.0
	6 – 10 years	10	5.0
	11 – 15 years	40	20.0
	16 – 20 years	100	50.0
	Above 20 years	48	24.0
	Total	200	100.0
Knowledge of SDGs and Covid-19 impact on construction sector	Yes	196	98.0
	No	4	2.0
	Total	200	100.0

Appendix 3. Questionnaire survey

Section 1: Demographic characteristics

Please choose the appropriate option by ticking or fill where necessary. Do not tick more than one option.

- Type of organisation: A. Building/Construction company B. Manufacturing company (Construction materials) C. Client (Public and private) D. Design team (Architect, Engineer, and QS) E. NGOs related to SDGs
- State/City you are based. A. Abuja B. Lagos
- Years of work experience. A. 0-5 B. 6-10 C. 11-15 D. 16-20 E. Above 20
- Do you have sound Knowledge of SDGs and Covid-19 impact on construction sector? A. Yes B. No C. No response

Section 11: Information

- i. **This section presents the challenges faced during the COVID-19 as emerged from the qualitative phase**
- ii. **Note**, for the purpose of this questionnaire, the Likert Scale: (1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, 5 = strongly agree) are applicable. Please ensure you tick only one in a row.

Code	Post-COVID-19 for the Construction Industry to Achieve SDGs	Scales				
A	Human development and management issues: Construction sites shut-down On-going construction projects abandoned Under-utilisation of manpower and machines Interruption of terms and conditions of contract Workforce staff not trained to manage pandemic Many organisation refused to innovation support	1	2	3	4	5
B	Social issues: Rising insecurity (Investors shunning real estate sector) Increased unemployment Increased construction workers redundancy Increased casual workers SME in construction related had tough time Movement restriction					
C	Technical issues: Lack of technological capacities from the contractors and design team Time and cost overrun Uncertainty of key stakeholders/operators survival Planned and scheduled programmes of construction activities interrupted	1	2	3	4	5
D	Financial issues: Cash flow issue Fluctuation of contract sums High cost of construction materials due to high inflation Slow down in revenue from real estate sector					
E	Safety issues: Challenges adopting to new COVID-19 guidelines Absence of safety officers on site Majority of the junior workers do not believe COVID-19 is real Absence of healthcare safety awareness regarding COVID-19					
F	Productivity issues: Decrease in productivity Scarcity of some construction materials due to shut down of factories Production slow-down is a threat to SDGs associated with construction tasks					

Section III: Information

- i. This section presents the feasible solutions that emerged from the qualitative phase and will enhance the sector into a sustainable path for achieving SDGs in the post-COVID-19 era.
- ii. Note, for the purpose of this questionnaire, the Likert Scale: (1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, 5 = strongly agree) are applicable. Please ensure you tick only one in a row.
Kindly fill in the following information if you want the summary of the results to be forwarded to you.

Post-COVID-19 for the Construction Industry to Achieve SDGs						
Code	Post-COVID-19 for the Construction Industry to Achieve SDGs	Scales				
A	Improvement in human development and management: Skill building Collaborate with regulators to facilitate policy changes Transform management models to break the constant slow technological cycles Collaboration Rebuilding supply chains towards resilience Multichannel mechanism supports such as hybrid virtual model Build a control tower across the portfolio	1	2	3	4	5
B	Improved social welfare: Government should support hardest hit sectors such as the construction industry Government should increase budget on infrastructural facilities Contractors should have access to supporting grants/loans to get back to business					
C	Technical and professional skills: Develop new competencies Study the operating models Strengthen scientific policy advice Team experience is needed to manage critical driver of hybrid Acceleration towards sustainability	1	2	3	4	5
D	Financial accountability: Adjust financing mechanisms Need to optimise current cost Redeploy capital and resources					
E	Safety and well-being: Government should make mitigation a priority (delay is costly) Stakeholders should get closer to customers and clients.					
F	Improved productivity through 4IR technologies: Promote policies that will encourage 4IR technologies usage Invest in construction-related 4IR technologies Transform management models to break the constant slow technological cycles Increase in off-site construction Augmented consideration Accelerate rollout and adoption of digitalisation Vertical integration					

State/City

Organisation/Position

Phone/E-Mail Contact:

Thanks for your participation.