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IMPACT OF THE COVID-19 PANDEMIC IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY

REVIEW ARTICLE¹

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ABSTRACT

The COVID-19 pandemic has negatively impacted on many economic sectors globally. The regressed economic environment exacerbated its effects on the construction industry, especially in developing countries such as South Africa. The article presents an evaluation of the impact of COVID-19 on the construction sector, focusing on the construction delivery methods in South Africa. The effect of COVID-19 was evaluated against the South African Council for Project and Construction Management Professions (SACPCMP)'s project life cycle framework. A mixed data-collection method was used for the study. Literature was consulted, and empirical data was collected through focused online panel discussions and structured questionnaires administered through online polls. This article presents the results as effect and frequency of issues arising from COVID-19, industry projections, and recommendations on sustainability. Findings showed a general hold on original investment decisions by clients, in both the public and private sectors; increased professional services' scope of works, and increased health and safety compliance requirements, together resulting in higher costs.

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ABSTRAK

Die COVID-19-pandemie het 'n negatiewe impak op baie ekonomiese sektore wêreldwyd gehad. Die verswakte ekonomiese omgewing het die uitwerking daarvan op die konstruksiebedryf vererger, veral in ontwikkelende lande soos Suid-Afrika. Die artikel gee 'n evaluering van die impak van COVID-19 op die konstruksiesektor, met die fokus op die konstruksieleweringsmetodes in Suid-Afrika. Die effek van COVID-19 is geëvalueer teen die Suid-Afrikaanse Raad vir Projek- en Konstruksiebestuursberoepe (SACPMP) se projeklewensiklusraamwerk. 'n Gemengde data-insamelingsmetode is vir die studie gebruik. Literatuur is geraadpleeg, en empiriese data is ingesamel deur gefokusde aanlyn-paneelbesprekings en gestruktureerde vraelyste wat deur middel van aanlyn-peilings geadministreer is. Hierdie artikel vertoon die resultate as die effek en frekwensie van kwessies wat voortspruit uit COVID-19, bedryfsprojeksies en aanbevelings oor volhoubaarheid. Bevindinge het getoon dat daar 'n algemene houvas op oorspronklike beleggingsbesluite deur kliënte is, in beide die openbare en private sektor; verhoogde professionele dienste op die omvang van werke, en verhoogde vereistes vir voldoening aan gesondheid en veiligheid, wat saam tot hoër koste lei.

Slutelwoorde: COVID-19, ekonomiese impak, infrastruktuur, konstruksie, projeklewensiklus

1. INTRODUCTION

The sudden appearance of the coronavirus disease in 2019 was first reported in Wuhan City, China. The 2019 coronavirus disease, now expressed as COVID-19, is a severe acute respiratory syndrome (Guan *et al.*, 2020: 1711). This highly contagious disease has spread worldwide and was declared a pandemic by the World Health Organization (WHO) in 2020 (Cucinotta & Vanelli, 2020: 157; Gamil & Alhagar, 2020: 122).

COVID-19 has impacted on the world's economies and disrupted life, businesses, industries, financial markets, and supply chains (Protiviti, 2020: online). COVID-19 has caused multiple and different challenges to various economic sectors and countries across the world. Globally, COVID-19 has resulted in a considerable shift in how the construction industry operates. According to McLennan (2020: 25), the pandemic has brought about significant growth in resilience, contract re-structuring, and collaboration with subordinate industries. In addition, COVID-19 has improved supply-chain management, liquidity and cash flow, innovation and diversification, and embracing of new technologies in administration, finances and even implantation of projects in North America, Western Europe, and North-East Asia (Doddy & Sorohan, 2020: 11; McLennan, 2020: 25).

Harari (2020: 14) contends that the COVID-19 pandemic is the biggest crisis of our modern generation, and it may take years to recover from its impact. Many countries face recession and an economic downturn as a result. As the pandemic's effects are beginning to be felt worldwide, governments and corporates focus primarily on the safety of their people. Experts argue that, even if the virus' spread is contained in the short term, economies will continue to feel the pandemic's effect for a long time to come. The full-scale

economic consequence of the pandemic on the construction industry in South Africa is currently not known. Moreover, uncertainty concerning the duration and severity of the crisis makes it difficult to anticipate how a recovery could unfold for the construction industry. However, experts advise that decisive actions must be taken to subsidise and plan new strategies, in order to avoid humankind's travail (Gamil & Alhagar, 2020: 122).

In South Africa, the pandemic has negatively affected the construction industry. First, the impact has manifested in many diverse ways, including contractual, resource availability, supply-chain disruptions, increased health and safety risks, project delays, and contract cancellations (McKinsey, 2020: 5; Protiviti, 2020: online). More crucially, many organisations have had to lay off key workers and now face the dilemma and uncertainty of skilled worker availability in the future. In addition, because many contracting organisations operate without substantial capital reserves, they risk insolvency.

In order to find both short- and long-term interventions to ease the economic impact of COVID-19 on the South African construction industry, this article determines what the general impact of the pandemic has been on the industry; examines the implications of the pandemic on the execution of the six project stages of the SACPCMP's framework, and explores the decisive measures needed to ease the impact of the pandemic on the construction industry.

2. LITERATURE REVIEW

2.1 Project stages for infrastructure delivery

Infrastructure delivery is made possible through a breakdown of work into packages or stages. Each work stage is assigned resources necessary to execute it. Crucially, each work stage also requires efficient, effective, and sustainable processes and systems to ensure delivery of infrastructure. The project stages for infrastructure delivery are not an easy feat, irrespective of the scale and scope of the project. A great deal can go wrong from planning to handling the ever-changing demands of clients to ensuring the deliverables on time. Consequently, projects are divided into manageable stages, each with its own goals and deliverables, making it easier to control the output. Generally, a typical infrastructure project commences with the initiation stage, with the aim of turning an abstract idea into a meaningful goal. This stage entails the development of a business case and definition of the project on a broad level. The initiation stage is followed by a planning stage, which requires complete diligence as it lays out the project's roadmap (Gallego, Ortiz-Marcos & Romero Ruiz, 2021: 162). The third stage is the execution stage, which involves the project implementation or

the construction stage (Lampel, 2001: 472). This stage ensures efficient workflows and careful monitoring of the project's progress (Gallego *et al.*, 2021: 162). The project closure stage is the fourth and last stage of the project (Loftesnes, 2021: 543).

The four generic project stages described above are further broken down into six stages in the SACPCMP project life cycle framework: Project initiation and briefing; concept and feasibility; design development; tender documentation and procurement; construction documentation and management, and project close-out (SACPCMP, 2008: 5). Specific deliverables and services are expected from the various supply-chain parties at each of the identified six stages. The client is also expected to fulfil its obligations at each specified project stage (SACPCMP, 2008: 5). In addition, key stakeholders have different levels of influence at each one of the project stages. Consequently, given the COVID-19 implications, various parties in the delivery of projects respond differently on the services they provide at each of the six project stages. As a result, projects have been reported to have varied outcomes from those initially planned

2.2 Global impacts of the COVID-19 pandemic on the construction industry

The COVID-19 pandemic had both a negative and a positive impact on the global construction industry. From a questionnaire administered to 71 construction industry professionals from various regions around the world, Ogunnusi, Salman and Kouider (2020: 123) identify common positive and negative experiences with COVID-19 (54.9% of respondents from Africa, 2.5% from Asia, and 18.3% from Europe).

When asked about positive effects, respondents agreed that the pandemic has empowered “the opportunity to improve on virtual alternatives”, where digital platforms have enabled the continuity of meetings previously held only face-to-face (Ogunnusi *et al.*, 2020: 126). Concerning the negative effects perceived by respondents, the pandemic has exacerbated ongoing project issues such as cost and schedule overruns, owing primarily to the daily hardships faced by labour and ineffective work from home for site-based processes (Ogunnusi *et al.*, 2020: 127).

Gamil and Alhagar (2020: 127) gathered information from 129 respondents in a survey and 10 experts in a series of structured interviews to better understand the impact of COVID-19 on construction. The most severe effects of the pandemic, according to respondents, are supply shortages; material price fluctuations; legal issues and interruptions in contractual terms; impact on existing completed activities; uncertainty of survival, and impact on research and technology.

2.3 Impact of COVID-19 on project stages

The impact of COVID-19 has been observed in project performance across all the six stages of the SACPCMP project life cycle framework. Gamil and Alhagar (2020: 122) observe that legal challenges, suspension of works, and material price fluctuations have characterised the pandemic period. McLennan (2021: 25) asserts that the construction industry has been impacted by the pandemic and has recorded its most challenging year in history. The industry projects a global fall of 3.1% in the 2020/2021 year.

Doddy and Soroan (2021: 11) highlight the likely progression of the adverse impacts of COVID-19 on construction projects, funding, administration, mapping, budgets, and timeous output. McKinsey (2020: 4) contends that the crisis is expected to hit long-term supply and demand beyond the short-term impact of an economic downturn on construction demand, resulting in lasting shifts in investment patterns. Table 1 gives a summary of some of the notable effects of the COVID-19 pandemic on the construction industry, including labour, contractual, liquidity, and job site issues.

Table 1: Impact of COVID-19 on the construction industry

<i>Impacts</i>	<i>Author(s)</i>
Shortage of labour	Cosgrove <i>et al.</i> (2020: 10)
Supply chain disruptions	Cosgrove <i>et al.</i> (2020: 10); Chivilo <i>et al.</i> (2020: 10); PWC (2020: 5); McKinsey (2020: 4);
Delays and disruption to contracts	Doddy and Soroan (2020: 12); KPMG (2020: 4); Chivilo <i>et al.</i> (2020: 3)
Suspension and termination of contracts	Doddy and Soroan (2020: 11); McKinsey (2020: 4)
Stress on working capital and liquidity position	Doddy and Soroan (2020: 12)
Increased project cost, due to revised standard working procedures incorporating social distancing	KPMG (2020: 4); McKinsey (2020: 4)
Additional interest cost on working capital loans	KPMG (2020: 4)
Labour impact and job losses	Gamil and Alhagar (2020: 5); PWC (2020: 5)
Time overrun	Gamil and Alhagar (2020: 122)
Difficulties with funding	PWC (2020: 5)
Cost overrun	Gamil and Alhagar (2020: 122)
Remote or smart working	McKinsey (2020: 4)

Source: Researchers' compilation

3. RESEARCH METHODOLOGY

3.1 Research design

COVID-19 has disrupted the construction industry and threatened its sustainability. Therefore, seeking an understanding of the nature of the pandemic's effect on the industry and infrastructure delivery is crucial to ensure its sustainability. The study adopted a mixed methods approach, using quantitative and qualitative data-collection methods on the impact of COVID-19 on the six stages of construction project delivery (Creswell & Plano Clarke, 2017: 11). Specifically, empirical data was collected, using surveys administered through online polls during and after the online panel discussions. In addition, the qualitative data was gleaned from panel discussions and collated around the generated themes. This data has been presented as expert views and contributions from the 136 study participants. The method, adopting live-polling and an online panel discussion, has successfully been used previously for data collection. Studies include that of Powell *et al.* (2015: 3) and that of Sahu (2012: 55) who provide an argument for adopting such progressive web-based research methods.

Webinars were conducted over six days. Each webinar session had expert panellists presenting on a specific topic, followed by another session involving webinar attendees asking questions or commenting on the expert panel presentations. Live polling was administered during the webinars relative to the topic of the day. The live online polling yielded the quantitative data, while the panel presentations and responses to the questions yielded the qualitative data.

3.2 Population and sample

The study participants consisted of built environment professionals who had responded to an open invitation to attend the webinars organised by the Association of Construction Project Managers (ACPM). The invitees, who mainly belong to the ACPM, were built-environment professionals and stakeholders in infrastructure development representing client, consulting, and contracting organisations in South Africa. Table 2 presents the number of participants who attended the webinars on each day, ranging from 117 on 27 August 2020 to 162 on 20 August 2020. The ACPM has a membership of 269 full members and 187 associate members, giving a total membership of 456. The increase in the number of attendees attests to the interest generated by the conversations on the COVID-19 topic. On average, 136 participants attended each session.

Table 2: Type and number of participants

<i>Series</i>	<i>Panel date</i>	<i>Expert panellists</i>	<i>Discussion participants</i>
1 Project initiation and briefing	16/07/2020	4	126
2 Concept and feasibility	24/07/2020	4	140
3 Design and development	30/07/2020	4	136
4 Tender documentation and procurement	13/08/2020	4	136
5 Construction documentation and management	20/08/2020	4	162
6 Project closeout	27/08/2020	4	117
Average number of participants		4	136

3.3 Data collection

Given the anecdotes with regard to the pandemic implications on project delivery and the restrictions on movements and gatherings, online panel discussions were held with experts and construction industry stakeholders. The webinars were hosted by the ACPM in July and August 2020. ACPM is a voluntary association of built-environment professionals in South Africa. Six webinar sessions were held, with each session lasting two and a half hours.

Online polls (quantitative) were conducted during breaks of each panel discussion (qualitative), to which participants responded voluntarily. The discussion participants either agreed or disagreed with the expert panellists' views and provided information on their experience of the COVID-19 pandemic. Recommendations for keeping the industry sustainable post-COVID-19 were also made. Moreover, the questions solicited information on participants' experiences on how the pandemic had affected project delivery, professional services, scope of work, implications through the six stages, and decisive measures to mitigate the impact of COVID-19.

Question one on what the current impact of the COVID-19 has been on the industry, had nine statements. The second question, which focused on establishing what the future impact of COVID-19 might be, had seven statements that characterised the future effect. Question three set six statements on the measures to mitigate the effect of the pandemic on the construction industry. Respondents were asked to rate the level of agreement on the statements in each question based on a five-point Likert scale.

Other questions were based on a categorical scale and solicited a "yes", "no", or "unsure" regarding the impact of COVID-19, whether construction regulations provided for the pandemic, and how professionals needed to respond to the pandemic.

3.4 Data analysis and interpretation of findings

Comments from the expert panellists were captured as qualitative data and the responses to the polls were captured as quantitative data. Both approaches were designed to determine the impact, future implications, and measures to limit the effect of COVID-19 on construction project delivery. To measure the respondents' agreement levels, 22 statements were rated on a five-point Likert scale. Likert-type or frequency scales use fixed choice response formats and are designed to measure attitudes or opinions (Wegner, 2012: 11). The scale of 1 to 5 was used, where 1 = Strongly disagree (≥ 1.00 and ≤ 1.80); 2 = Disagree (≥ 1.81 and ≤ 2.60); 3 = Neutral (≥ 2.61 and ≤ 3.40); 4 = Agree (≥ 3.41 and ≤ 4.20), and 5 = Strongly agree (≥ 4.21 and ≤ 5.00).

The quantitative data were analysed using an Excel-based statistical analysis application, StatPlus Pro, version 7.3.0. The outputs from the analysis were sets of descriptive statistics such as frequencies, mean and median scores, as well as standard deviations. The outputs are presented in tables and charts for visualisation. The other statistical output from the analysis includes the coefficient of variation (CV) to indicate the extent of variability about the mean.

3.5 Limitation

One of the limitations of this research is that it only assessed the impact of COVID-19 on construction project delivery in South Africa. There is thus a need to use inferential statistics and to extend the study to other African countries for generalisation.

4. FINDINGS

4.1 Current impact of COVID-19 on infrastructure delivery

Table 3 shows a composite mean score of 3.96, which indicates that the vast majority of the participants (80%) agreed that COVID-19 has had an impact on the construction industry.

Table 3: Current impact of COVID-19 on infrastructure delivery

<i>Statements</i> N=140 1 = strongly disagree (≥ 1.00 and ≤ 1.80); 2 = Disagree (≥ 1.81 and ≤ 2.60); 3 = Neutral (≥ 2.61 and ≤ 3.40); 4 = Agree (≥ 3.41 and ≤ 4.20), and 5 = Strongly agree (≥ 4.21 and ≤ 5.00)		Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)	Mean	Median	SD
1	The project's feasibility determination has been affected, due to uncertainty created by COVID-19	35	57	4	0	4	4.20	4.00	0.82
2	The financiers are nervous about committing to their original investment decisions	34	54	8	2	2	4.15	4.00	0.82
3	Project managers need new skills to obtain and convey information to clients	27	54	12	6	1	4.00	4.00	0.84
4	Client priorities and decisions are primarily being driven by the COVID-19 pandemic	26	54	12	6	2	3.99	4.00	0.84
5	Clients are focusing on managing the existing project commitments	24	59	10	2	5	3.95	4.00	0.92
6	Investment in private infrastructure is likely to fall, due to the effects of COVID-19	23	53	14	6	4	3.86	4.00	0.95
7	COVID-19 places more demand on CPMs to allocate more resources to the concept and feasibility stage	19	55	19	5	2	3.83	4.00	0.85
8	Clients are looking towards shifting schedule and cost risks to contractors	22	49	21	6	2	3.84	4.00	0.90
9	The impact of COVID-19 on the clients has led to some construction projects being cancelled	22	50	16	11	1	3.79	4.00	0.96
	Composite mean						3.96	4.00	0.88

Participants agreed that a project's feasibility (MS 4.20), financiers are nervous about committing to their original investment decisions (MS 4.15), and project managers need new skills (MS 4.00) are the top three impacts experienced by the industry.

Participants (92%) reported that it was challenging to determine project feasibility, due to the high uncertainty prevailing. Clients are not committing to their original investment decisions (88%) and are rather focusing on current commitments (83%). Of the participants, 71% agreed that there is a shift in risk allocation, with clients passing on more responsibilities to contractors. Consequently, 70% indicated that construction projects are being cancelled due to COVID-19.

In addition, participants (74%) indicated that project planning has changed as a result of the pandemic. They agreed that there is a greater demand for more resources to be allocated to the concept and feasibility study stages.

A substantial majority of the participants (92%) indicated that the current situation demands more qualified project managers.

Consequently, the vast majority of study participants (76%) agreed that private infrastructure investment is likely to fall due to the pandemic. This finding was perhaps not surprising, given that most of the participants (80%) agreed that COVID-19 may highly influence decisions to develop.

Therefore, the effect on construction development has focused on project planning, clients shifting risk allocation, and project cancellations (Table 3) that influenced infrastructure delivery. These findings corroborate the expert panellists' views who contend that the market conditions with a projected reduced economic growth, lack of confidence by project promoters in going ahead with a project, and the fact that investment in the construction industry had already been shrinking, have a definite effect on infrastructure delivery. The impact, according to the panellists, has been noted in the delays in getting statutory approvals and in changes in designs to accommodate the shrinking economic environment.

The panellists (see Table 4) also argued that COVID-19 resulted in restrictions, policy uncertainty, supply chain uncertainty, and constrained financial resources at the macro level. Other outcomes were worker absence and much-deteriorated investor confidence. At the micro-level, the pandemic has caused changes in contract conditions, reconfigured or adjusted scope, additional project appointments such as COVID-19 compliance officers, confusion as to COVID-19 roles and responsibilities, and contractual complications. The latter arose due to halted or suspended projects, reconfiguration, assignment of new duties on the projects, and response to the COVID-19 regulations.

Table 4: Panel views on the COVID-19 impact

<i>Finding</i>	<i>What they said</i>
Changes to contract conditions	Performance on COVID-19 was not initially included in the contract conditions New project roles and responsibilities to manage COVID-19 have emerged
Change to project organisation	There is now a need to appoint or employ a COVID-19 compliance officer. Again, this adds cost to the project
High level of uncertainty	There is uncertainty about the restrictions imposed by the COVID-19 policies and regulations initiated by the government

4.2 Future impact of COVID-19 on construction project delivery

The effect of COVID-19 in the construction industry widely speculated that the pandemic has altered our way of life forever and how the construction industry will operate in the future. However, no one knows for certain what the future impact will be. The study also revealed this. According to the participants, the pandemic will cause the industry to progress in areas such as safer sites, innovative buildings, and digital technologies that have lagged for years.

The vast majority of the respondents (84%) agreed that Innovative Building Technologies (IBT) adoption, with a mean rating of 4.10 (SD = 0.88, CV = 21%), would increase in the construction industry post-COVID-19. Many participants (85%) agreed that technology-enforced safety measures, with a mean rating of 3.98 (SD=0.73, CV=18%), would increase requirements such as for social distancing. Moreover, over 96% of the respondents (Figure 1) showed that COVID-19 would accelerate the construction industry's digital transformation. Although several respondents (28%) were not certain, 61% (SD=0.92, CV= 25%) of the respondents indicated that the construction sites would be safer, due to the requirement to comply with the additional COVID-19 regulations. However, the variability in the response suggests a more conservative response.

Table 5: Future impact of COVID-19

Statements N=140 1 = strongly disagree (≥ 1.00 and ≤ 1.80); 2 = Disagree (≥ 1.81 and ≤ 2.60); 3 = Neutral (≥ 2.61 and ≤ 3.40); 4 = Agree (≥ 3.41 and ≤ 4.20), and 5 = Strongly agree (≥ 4.21 and ≤ 5.00)		Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)	Mean	Median	SD	CV%
1	Innovative Building Technologies (IBT) adoption will increase in the construction industry post-COVID-19	31	53	11	2	3	4.10	4	0.88	21
2	Construction projects will take longer to complete, due to the impact of COVID-19	38	45	9	6	2	4.11	4	0.95	23
3	Technology-enforced safety measures will increase for requirements such as social distancing	18	67	11	2	2	3.98	4	0.73	18
4	Labour disputes will increase in the construction industry, due to COVID-19	25	52	12	8	3	3.89	4	0.95	24
5	Construction sites will be safer, due to the requirement to comply with COVID-19 regulations	16	44	28	9	3	3.64	4	0.92	25

Statements N=140 1 = strongly disagree (≥ 1.00 and ≤ 1.80); 2 = Disagree (≥ 1.81 and ≤ 2.60); 3 = Neutral (≥ 2.61 and ≤ 3.40); 4 = Agree (≥ 3.41 and ≤ 4.20), and 5 = Strongly agree (≥ 4.21 and ≤ 5.00)		Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)	Mean	Median	SD	CV%
6	COVID-19 will force many construction and consulting companies to close or stop practising in the construction industry	10	32	26	25	7	3.11	3	1.12	36
7	Contractual claims and disputes will increase in the construction industry during and post-COVID-19	26	57	10	4	3	4.00	4	0.87	22
	Composite mean						3.83	3.86	0.92	24

The pandemic's future negative impact on the construction industry was also noted on the project delivery period, increased labour disputes, contractual claims, and disputes. The majority of the respondents (83%) indicated that construction projects would take longer to complete, due to the impact of COVID-19 showing a mean rating of 4.11 (SD=0.95, CV=23%). Regarding project aberrations in infrastructure delivery, most of the respondents (77%) indicated that labour disputes would increase in the construction industry, due to COVID-19 (SD=0.95, CV=25%). Equally, the vast majority of the respondents (83%) agreed that contractual claims and disputes would increase in the construction industry during and post the COVID-19 period (SD=0.87, CV=22%).

A noteworthy finding was the varied response to the pandemic's impact on the contracting and consulting organisations. With a mean rating of 3.11 (SD=1.12, CV=36%), respondents were split on the notion that COVID-19 will force many construction and consulting companies to close or stop practising in the construction industry (41% agreed, 26% neutral, and 33% disagreed).

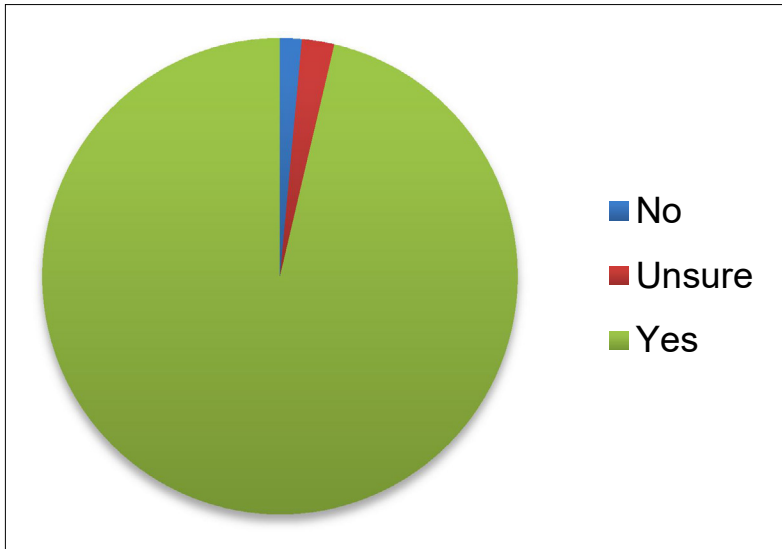


Figure 1: View on digital adoption in the construction industry

4.3 Implications of the effect of COVID-19 on construction work

Table 6 indicates that participants (91%), who are involved and work in the construction industry, have been affected by COVID-19.

Table 6: Effect of COVID-19 on construction work

No of valid cases		127		
<i>Work in the construction industry is affected by the COVID-19 pandemic</i>	<i>Count</i>	<i>Cumulative count</i>	<i>Percentage (%)</i>	<i>Cumulative (%)</i>
Yes	116	116	0.0091	0.0091
Unsure	4	120	0.0003	0.0094
No	6	126	0.0005	0.0099
Total	127	127	0.0100	0.0100

The effect was noted in the way in which projects should be administered throughout the project cycle, from briefing to closure. In stages one to three, namely the briefing and initiation, concept and feasibility, and design development, the need to allocate more resources, involve the project team early, and have skilled project managers were identified (Table 3). The expert panellists observed that the need for an accurate risk assessment and appropriate suitable designs that complied with the COVID-19

regulations were henceforth an essential requirement. Panellist 1 captured the need for accurate risk assessment as follows:

“... things are bad. This is a continuation of pre-existing conditions in the industry. The productivity is low, the supply chains have been disrupted, there are rampant budget cuts, and a high loss of life. In addition, there is an increased risk of fraud and misconduct in the procurement processes and supply chain management with huge implications on project viability and sustainability” Panellist 1 (13 August 2020).

The highlighted conditions place a huge responsibility on the professionals to ensure that an adequate assessment of risks is undertaken at the initiation, concept and feasibility, as well as the design development stages.

On the tender documentation and procurement (fourth stage), study participants identified the need for more collaborative project structures to deliver infrastructure faster.

Table 7: Procurement strategy better suited to dealing with COVID-19

Number of valid cases		136		
<i>What procurement strategy is better suited to dealing with the COVID-19 challenges?</i>	<i>Count</i>	<i>Cumulative count</i>	<i>Percentage (%)</i>	<i>Cumulative (%)</i>
Construction management	39	39	29	28.6765
Design and build	24	63	18	46.3235
EPC	13	76	10	55.8824
Integrated project delivery	37	113	27	83.0882
Management contracting	8	121	6	88.9706
Traditional, design, bid build	15	136	11	100.0000
Total	136	136	100	100.0000

Of the available procurement methods (Table 7), construction management (39/136, 29%) and integrated project delivery (37/136, 27%) were identified as the strategies that were more suitable to deal with the challenges posed by the COVID-19 pandemic. The design and build approach was the third most preferred strategy, with 17% (24/136) indicating that it would be suited to dealing with the pandemic. Overall, the findings revealed that most of the experts looked to procurement methods that allowed for speedier delivery, collaboration, and more owner involvement. These features are characteristic of construction management, integrated project delivery, and the design and build approach. Ahmed and El-Sayegh's (2021: 12) study also identified owner involvement, time, or delivery speed.

During the construction stage, productivity will be the most affected in construction project delivery, and therefore, according to the respondents,

adaptability will be essential. Most of the respondents (126/127, 97%) (Table 8) identified the need to adapt work methods in the construction industry to respond to the demanding requirements of COVID-19.

Table 8: Work methods should respond to COVID-19

Number of valid cases		127		
<i>Work methods in construction should respond to the requirements of COVID-19</i>	<i>Count</i>	<i>Cumulative count</i>	<i>Percentage (%)</i>	<i>Cumulative (%)</i>
No	1	1	1	1
Unsure	2	3	2	2
Yes	123	126	97	99
Total	127	127	100	100

Closing a project is another critical stage in the project cycle. Most of the performed activities at the closing stage mainly have to do with documentation (Kamal *et al.*, 2013: 169). Findings show that obtaining sign-offs on the projects post-COVID-19 and getting the project documentation such as occupation certificates will be more complex and affect the handing over of the built infrastructure.

Notably, participants agreed that items closely related to COVID-19 (Table 9), namely obtain all statutory compliance certificates (74%) and complete health and safety files for handover (71%), were perceived to be difficult to achieve during or after the pandemic. The other relatively complex items that might affect project closeout were noted as producing and coordinating design documentation (54%), release completion certificates (54%), technical items such as the supply of operating manuals, and coordination of design. The findings reveal that the restrictions in place and how work will be conducted in the future have implications on the level of collaboration, exchange of information, and compliance with all the regulations.

Table 9: Effect on project closure

	<i>Aspect affected</i>	<i>Very easy (%)</i>	<i>Easy (%)</i>	<i>No change</i>	<i>Difficult (%)</i>	<i>Very difficult (%)</i>	<i>Mean (%)</i>	<i>Mean LCL 95%</i>	<i>SD (%)</i>	<i>CV (%)</i>
1	Supply operating and maintenance manuals	2.25	10.11	37.08	44.94	5.62	3.41	3.24	0.70	0.24
2	Supply of warranties and guarantees	1.12	8.99	44.94	38.20	6.74	3.40	3.24	0.63	0.23
3	Produce and coordinate design documentation	4.49	11.24	30.34	49.44	4.49	3.38	3.19	0.83	0.27

	<i>Aspect affected</i>	<i>Very easy (%)</i>	<i>Easy (%)</i>	<i>No change</i>	<i>Difficult (%)</i>	<i>Very difficult (%)</i>	<i>Mean (%)</i>	<i>Mean LCL 95%</i>	<i>SD (%)</i>	<i>CV (%)</i>
4	Obtain all statutory compliance certificates	1.12	4.49	20,22	60.67	13.48	3.81	3,65	0.59	0.20
5	Complete health and safety file	2.25	7.86	19,10	51.68	19.10	3.78	3,58	0.86	0.24
6	Certify completion certificates	6.74	5.61	33,71	50.56	3.37	3.38	3,19	0.83	0.27
7	Produce and coordinate as-built drawings	4.49	13.48	46,07	34.83	1.12	3.15	2,97	0.69	0.26

4.4 Decisive measures to mitigate the impact of COVID-19

The expert panellists suggested several decisive measures that could help lessen the impact of COVID-19 on construction project delivery. The areas proposed include addressing how procurement should be done; reviewing regulations; adopting digital workflows, and setting up an industry oversight body for infrastructure development.

The expert panellists proposed the need to implement e-procurement methods, in order to ameliorate the impact of COVID-19, because the e-procurement systems give more flexibility and control over the entire purchasing process. The panel argued that e-procurement would help overcome problems associated with procurement in the COVID-19 era. Furthermore, a well-defined procurement process will provide a competitive advantage to an organisation by lowering costs across the value chain; increasing efficiency in the delivery of impeccable service; assisting with product innovation; mitigating supplier risk, and increasing supply chain resiliency.

Table 10: Measures to mitigate the effects of COVID-19

Statements N=140 1 = Strongly disagree (≥ 1.00 and ≤ 1.80); 2 = Disagree (≥ 1.81 and ≤ 2.60); 3 = Neutral (≥ 2.61 and ≤ 3.40); 4 = Agree (≥ 3.41 and ≤ 4.20), and 5 = Strongly agree (≥ 4.21 and ≤ 5.00)		Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)	Mean	Median	SD	CV (%)	Valid cases
1	Testing and verification standards during commissioning on public infrastructure should be improved	36	53	7	1	2	4.20	4.00	0.65	19	88
2	E-procurement would help overcome problems associated with procurement in the COVID-19 era	29	54	12	3	2	4.04	4.00	0.73	21	135
3	Digitalising as-built-drawings and installed asset information should be mandatory for medium and large public infrastructure developments	23	56	11	2	1	3.83	4.00	1.13	28	88
4	Building standards should be revised, given the COVID-19 implications	32	39	16	8	6	3.83	4.00	1.29	30	88
5	Designers and project managers should be more accountable for the post-occupancy performance of infrastructure	20	51	20	4	3	3.81	4.00	0.87	24	88
6	COVID-19 infrastructure command centre comprising industry professionals to support government decisions will mitigate risks of undue practices, and achieve infrastructure objectives	18	59	14	10	0	3.50	4.00	0.68	21	135
Composite mean							3.86				

Table 10 shows that the study participants agreed with this view and rated the panel's contention a mean score of 4.04 (SD=0.73, CV=21%). Another proposal was that the forms of agreements should be revised to accommodate risks posed by pandemics such as COVID-19. This proposal was also affirmed by most of the respondents (78%) and received a mean rating of 3.83 (SD=1.29, CV=30%). With a mean score rating of 4.20, participants strongly agreed that testing and verification standards during commissioning on public infrastructure should be improved.

Generally, both the panellists and the study participants noted that the current construction regulations were inadequate to respond to the challenges posed by the COVID-19 pandemic.

The expert panels strongly advocated the need for skilled and knowledgeable professionals. They argued that, given the challenges posed by COVID-19

in the procurement, design, construction, and handover stages, it was time the industry promoted a high level of professionalism. Participants in the study acknowledged that there is a need for professionals to craft new ways to respond to the pandemic.

The industry's call to uphold professionalism was also met with the professionals' demand to ensure effective and efficient delivery of infrastructure. The study respondents indicated a need to establish an infrastructure oversight body, a central infrastructure command centre, comprising built-environment professionals to ensure effective and efficient infrastructure delivery. The majority of the respondents (76%) supported the idea of a command centre, rated at 3.50 (SD=0.68, CV=21%).

5. DISCUSSION AND CONCLUSION

COVID-19 has affected all the stakeholders in the construction industry and, therefore, impacted on the infrastructure delivery process. Similar findings by Jallow, Renukappa and Suresh (2020: 10) in the United Kingdom found that the lockdown, a consequence of the pandemic, made it very difficult to manage projects. Studies conducted in Nigeria by Ogunnusi, Salman and Kouider (2020) also found that the pandemic significantly affected the construction industry. It was noted that COVID-19 had imposed new demands throughout all the project stages. Findings show that the impact of the pandemic means that careful and detailed assessment of risks is now more critical than before. All the key players, including clients, financiers, professionals, contractors, and suppliers, have been affected.

Although some of the consequences were unavoidable, the study highlighted the need to revisit the way in which business is conducted, underscoring the importance of technology in improving efficiency and resilience. Digitalisation of operations has particularly been adopted in many organisations to enable automation and/or for remote control systems (Strusani & Hounghonon, 2020: 9).

Administration of project contracts was also identified as a key issue that the pandemic tested. Findings show that several forms of agreements were not adequate for the COVID-19 pandemic. The study established that standard forms of contract should be revised to deal with current and future pandemics. Consequently, Ogunnusi *et al.* (2020: 127) recommended that modification of rules especially on health and safety, contingency plans, definition of force majeure, and standard forms of agreements should be considered.

In conclusion, the following are recommended:

1. The creation of a COVID-19 infrastructure command centre comprising industry professionals to support government decisions,

mitigate the risk of undue practices, and achieve infrastructure objectives. This is important, especially since the government has identified infrastructure development investment critical to economic recovery post-pandemic.

2. There is a need to revise the contracting terms, especially on risk allocation and fees, to correspond with an increased scope of work dealing with the pandemic.
3. Prioritise health and safety requirements in the first four stages of the SACPCMP's project life cycle framework.
4. Shared risk between parties can be achieved by adjusting the standard forms of contracts.
5. Collaboration and adoption of technology, use of virtual platforms for procurement and management.
6. Allow for COVID-19 or pandemic pricing in the documentation.

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