

The Impact of the COVID-19 on the Construction Industry in Vietnam

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ABSTRACT

The COVID-19 pandemic has generated a wide range of socio-economic disruption, which causes devastating in numerous aspects. Our knowledge of the true health of the construction industry under the ravage of COVID-19 outbreak is largely based on very limited data. This study aims to assess the impact of pandemic on the construction industry through an investigation in Vietnam. Data were collected through 129 respondents whose online questionnaire survey completed according to their recent direct or indirect participation in delivering construction projects during the spread. The implications of COVID-19 on the construction industry were examined based on simple percentage analysis and Relative Importance Index approaches. Three principal facets of the construction industry were considered: firms' business activities, project performance, and workforce demand. The findings highlighted the multilevel, multidimensional nature of the epidemic consequences on the construction sector. Notably, the revenue and profitability, in a general sense, have decreased during the COVID-19 period, while most of the production and business costs had remained unchanged. Further, the pandemic was argued to impair construction practitioners' incomes and mental health and sabotage projects' schedule and cost.

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1 Introduction

It is the beginning of 2021, but the world is more uncertain than ever. At the beginning of the year 2020, many people expected a plump 2020 number to bring more confidence and optimism than 2019, a year full of changes. However, the reality has proved fierce. The Covid-19 pandemic, as of this writing, has caused nearly 40 million infections, more than 1 million 113,000 deaths in 235 countries, areas, or territories (The World Health Organization, 2020). The World Bank asserted that the Covid-19 pandemic had caused the most profound global crisis in decades, and the final consequences are still ambiguous (The

World Bank Group, 2020). Accordingly, a minimum of 5.2% of the global economy will be in decline. The vast majority of emerging markets and developing economies will decline because of the pandemic, and it will also cause lasting damage to labour productivity and potential output. The latest data shows that the global economic recovery has slowed down, although there have been signs of improvement since the middle of this year (The World Bank Group, 2020). As noted by PricewaterhouseCoopers (2020), the Covid-19 outbreak has brought unprecedented challenges, which are expected to have a significant impact on Vietnam's economic development this year. The building sector, as opposed to other sectors, saw 4.5% growth in the first six months of the year, slightly higher than the

4.37% in the first quarter and yet lower than the 7.85% growth during the same period last year, showing that the industry is sluggish and reluctant in its recovery (Can, 2020).

Covid-19 has become a hot topic and has attracted much attention from the academia. In addition to the medical studies of Covid-19, researchers worldwide have proved responsive to academic publications upon the impact of Covid-19 on multiple areas. For example, education (Daniel, 2020), gender equality (T. M. Alon, M. Doepke, J. Olmstead-Rumsey, & M. Tertilt, 2020), small business outcomes (Bartik et al., 2020), strategies for mitigation and suppression (Walker et al., 2020), and refugee camps (Truelove et al., 2020). Multiple studies have been undertaken and published on built environment domain, but not as many as those in other areas. On the other hand, many authors, e.g. (Loayza & Pennings, 2020), (Ataguba & Ataguba, 2020), (Gerard, Imbert, & Orkin, 2020), claimed that the crisis could even be worse in low-income countries. Despite being a developing country with a high poverty rate, Vietnam is coping very well with the pandemic (P. L. Dinh & Ho, 2020; Le et al., 2020). Scholars and systematic assessments are essential as they will help stakeholders grasp the situation and impacts of the Covid-19 outbreak on socio-economic development (H. H. Dinh, 2020). This paper will draw an overall picture of Covid-19 and Vietnamese construction industry's performance, revealing the patterns of the professionals' thinking in the pandemic context. Considering the global spread of the coronavirus and the economic contractions, the empirical evidence in Vietnam is expected to yield valuable insights for other countries and regions to gain a solid recovery.

The goal of this study assessed the impact of the Covid-19 pandemic on construction activities through data collected in an investigation in Vietnam.

Accordingly, research objectives were specified as follow:

- To determine the aspects of the construction industry that have been impacted by the Covid-19 pandemic.

- To evaluate the impact of the Covid-19 pandemic on business activities of construction enterprises.
- To evaluate the impact of the Covid-19 pandemic on the construction workforce.
- To evaluate the impact of the Covid-19 pandemic on the performance of construction projects.
- To recommend measures against the negative effect of the Covid-19 pandemic on the construction industry.

2 Background of the study

COVID-19 and its variants will trigger waves of crisis over the coming months or worse, possibly for several years. The world, having said that, must adjust in order to accept this, as it would necessitate the transformation to the new normal (Välilikangas & Lewin, 2020). We need to increase our ability to update and adapt to a continually changing situation in a way that has never been seen before. The Vietnamese government is in excellent control of the epidemic. However, its intervention has been widely criticised for the lack of systematicity and intensity (H. H. Dinh, 2020; Le et al., 2020). The number of deaths of COVID-19 is worrying, and this positively affects the mental health of the citizens such as anxiety over the unstable job, job loss, income reduction or even death (Gruber et al., 2020; Otu, Charles, & Yaya, 2020). Until the world fights Covid-19, the topic of the epidemic/pandemic's impact on economic sectors has not been particularly appealing to scholars. The world in the past few decades, on account of the development of medical science, has been free from fear and concern for pandemics (Burkle, 2020; Lum & Tambyah, 2020). There have been also many opinions that people, including scholars, show disregard for the impact of diseases on industries (Dixon, McDonald, & Roberts, 2002; Karlsson, Nilsson, & Pichler, 2014). Nevertheless, some epidemics/pandemics were significantly examined in association with industries' performance (see Table 1).

Table 1 Scholarly interests in epidemic/pandemic impact on industries before Covid-19

Epidemic/pandemic	Industry that was impacted	References
Influenza	Mining	(Phimister, 1973),
	Poultry	(Obayelu, 2007)
	Health	(Jim Toole & CERA, 2010)
	Insurance	
	Tourism	(Page, Yeoman, Munro, Connell, & Walker, 2006), (Rassy & Smith, 2013), (Page & Yeoman, 2007)
HIV/AIDS	Finance	(Maldin et al., 2005)
	Construction	(Meintjes, Bowen, & Root, 2007), (Bowen, Dorrington, Distiller, Lake, & Besesar, 2008), (Harinarain & Haupt, 2014)
	Mining	(Matangi, 2006)
Generic	Tourism	(Zengeni & Zengeni, 2012)
	Oil and gas	(Flynn, Kaitano, & Bery, 2012)

Using institutional audit methodology, Meintjes et al. (2007) drew our attention to the burden of HIV/AIDS pandemic on the South African construction industry. The most significant and most visible impact is the cost increase, i.e. increased financial outlays and decreased productivity. The measures, especially

from the CIDB side, had been available, but were not practical and even caused many concerns. In the same vein, Bowen et al. (2008) adopted a quantitative approach pointed out the high prevalence of the virus in the workforce and its correlation with the South African construction industry structure. The findings

from this study suggest that the high HIV/AIDS prevalence rate can have a deleterious effect on not only the construction industry but the South African economy as well. The meagre number of published studies in this theme, to a certain extent, reflects the ambiguous and loose link between the construction industry and the epidemiology.

As McGrail, Rickard, and Jones (2006) argue: 'There is often a long period from manuscript commencement to submission, revision, acceptance and, finally, publication.' Not to mention, in construction management research, the methods used in data collection such as interviews, focus groups and questionnaires are considered very time-consuming (Alshenqeeti, 2014; Gill, Stewart, Treasure, & Chadwick, 2008; MacLean, Meyer, & Estable, 2004). It seems that publishing in the construction sector has not been as fast and responsive as some other fields. Drawing on a case study of the ultra-rapid delivery of speciality field hospital, Luo, Liu, Li, Chen, and Zhang (2020) provide an in-depth analysis of the synthesis of product, organisation, and process (POP) approach and building information modelling (BIM). Megahed and Ghoneim (2020), at the same time, highlight the need to envision in what shape post-disaster architecture and antivirus cities might be. From a legal perspective, Hansen (2020) explores the potential of the Covid-19 outbreak as a force majeure in popular suites of a construction contract, i.e. NEC, JCT and FIDIC. Both Megahed and Ghoneim (2020) and Hansen (2020) adopted document review, former one exposing lessons in architecture and urban development, whereas the latter offers legal advice upon pandemic-related force majeure.

Meanwhile, Araya (2020) using agent-based modelling approach looks into the impact of the outbreak on construction project, stimulating the spread of COVID-19 among workers. In a similar vein, Afkhamiaghda and Elwakil (2020) propose a preliminary model and set of indexes of coronavirus spread into the construction site and workforce, implicating the urgency to diffuse cutting-edge technologies (e.g. Internet of Things, robotics). These studies, while both using the context of construction industry in a pandemic situation, delved into very different themes using distinct methods. Several studies have attempted to investigate the impact of COVID-19 on the local and regional construction industry. The reviews are not yet adequate due to the uncertainty of the current situation (Gamil & Alhagar, 2020). Bsisu (2020) investigates the impact of COVID-19 pandemic on Jordanian civil engineers and construction industry. Taken together, these findings would seem to suggest that engineering designers could work from home with reasonable performance. In contrast, site engineers do not believe that after the lockdown is lifted, construction workers will adhere to social distancing and wear essential personal protective equipment. Gamil and Alhagar (2020) claim that the most prominent impacts of Covid 19 are the suspension of projects, labor impact, job loss, time overrun, cost overrun, and financial implications. The findings shed light on the consequences of the sudden pandemics and raise awareness of the most critical impacts that cannot be overlooked. However, Ogunnusi, Hamma-Adama, Salman, and Kouider (2020) explain that some construction sectors of Sub-Saharan Africa (SSA) are exploring the opportunity that emanated with COVID-19 compared with

many other nations of the world. Indigenous manufacturing is one of the promising sectors in the SSA with the interference to supply chain globally, emphasising the significance of fostering the local capacity to encourage industrial construction. Since COVID-19 causes the worldwide recession (T. Alon, M. Doepke, J. Olmstead-Rumsey, & M. Tertilt, 2020; Gallant, Kroft, Lange, & Notowidigdo, 2020; Guerrieri, Lorenzoni, Straub, & Werning, 2020), it is predictable if there will be many studies on the relationship between the construction industry and the economic recession. In the past, however, an inconsiderable amount of literature was published on that umbrella of topics, notably: employment (Hadi, 2011), crisis management (Sfakianaki, Iliadis, & Zafeiris, 2015), profitability (Yoo & Kim, 2015), and government influence (Tansey & Spillane, 2014). A growing body of literature has examined construction performance in developing countries such as Cambodia (Durdyev, Mohamed, Lay, & Ismail, 2017), Ghana (Kissi, Agyekum, Adjei-Kumi, Caleb, & Micheal, 2020), Ethiopia (Ofori, 2018). However, very little is known about the true health of the construction industry under the ravage of Covid outbreak. To the best of our knowledge, the literature has not discussed the multilevel and multidimensionality of epidemic implications. This study hopes to create a foundation for the pandemic's publications and policies' impact on the economy in general and construction industry aspects in particular. This is of utmost importance to prepare stakeholders for similar massive disasters of the future, preventing Covid19-like shocks and rethinking developing industries' resilience to global catastrophic uncertainties.

3 Research Methodology

The present study was conducted based on a questionnaire survey aimed at effectively collecting all the necessary data. The questionnaire was composed of two main parts. The first part contained demographic information of the participants (i.e., qualifications, positions, professional experience, and role in the construction project) whose primary purpose was to describe the participants to ensure reliability and strengthen research findings effectively. The second part included the list of identified aspects among the construction sector that has been impacted by the COVID-19 pandemic (i.e., business activities of construction firms, construction workforce, and construction project performance). Participants were selected to answer an online survey based on their previous direct or indirect participation in the implementation of construction projects in Vietnam during the COVID-19 pandemic.

3.1 Pilot Test

Before distributing the questionnaire, a pilot study was carried out to verify the questionnaire and ensure that the information returned by the construction workforce would be appropriate to the goals of the present study. This stage was carried out by sending the questionnaire project to five experts with many years of experience and comprehensive knowledge on this subject. They assessed the validity of the questionnaire content, evaluated on the readability of the linguistics, and recommended additional factors in the questionnaire. After receiving their comments, the questionnaire was slightly changed.

3.2 Measurement Method

For analysing data, this study used the simple percentage analysis combined with the Relative Importance Index (RII) method to measure the impact of the COVID-19 pandemic on construction activities. The RII method was used by numerous studies (i.e., (Alaghbari, Al-Sakkaf, & Sultan, 2019; Gunduz & Abdi, 2020; Hiyassat, Hiyari, & Sweis, 2016; Jarkas, 2015; Jarkas, Kadri, & Younes, 2012). The RII index was calculated based on Equation (1):

$$RII = \frac{\sum_{i=1}^5 W_i \times X_i}{\sum_{i=1}^5 X_i} \quad (1)$$

Where: W_i is the rating given to each factor by the participant ranging from 1 to 5; X_i represented the percentage of respondents scoring and reflected the order number for the respondents; i is the order score ranging from 1 to 5.

For RII approach, the sample size was determined according to the following formula with a reliability of 95% (Hogg, Tanis, & Zimmerman, 2010):

$$m = \frac{z^2 \times P \times (1-P)}{\mathcal{E}^2} \quad (2)$$

$$n = \frac{m}{1 + \frac{m-1}{N}} \quad (3)$$

Where: n is a sample size of limited population; m is a sample size of unlimited population; P is the degree of variance between the elements of the population (usually $P = 0.5$); \mathcal{E} is tolerance ($\pm 3\%$, $\pm 4\%$, $\pm 5\%$); z is the distribution value corresponding to the reliability of choice (95% confidence, z value is 1.96); N is the total number of responses collected.

Table 2 Demographic of the respondents

Items	Categories	Frequency	Percentage
Education levels	Under bachelor's degree	2	70.7%
	Bachelor's degree	87	1.6%
	Post bachelor's degree	34	27.6%
Work experience (years)	1-5	80	65.0%
	6-10	14	11.4%
	10-15	21	17.1%
	16-20	7	5.7%
	> 20	1	0.8%
Organization involvement	Client	28	22.8%
	Authority	7	5.7%
	Contractor	51	41.5%
	Supervision	7	5.7%
	Consultant	30	24.4%
Role in construction project	Project manager	26	21.1%
	Site manager	15	12.2%
	Site supervisor	13	10.6%
	Designer	7	5.7%
	Architect	1	0.8%
	Company manager	8	6.5%
	Cost estimator	46	37.4%
	Authority	7	5.7%
Organizational size	Micro (< 10 persons employed)	10	8.1%
	Small (< 100 persons employed)	68	55.3%
	Medium (< 200 persons employed)	23	18.7%
	Big (> 200 persons employed)	22	17.9%
Sector	State-owned	35	28.5%
	Private-owned	88	71.5%
Type of project	Building	85	69.1%
	Transportation	6	4.9%
	Infrastructure	20	16.3%
	Industrial	12	9.8%
Type of project fund	Public fund	54	43.9%
	Private fund	57	46.3%
	Offshore fund	4	3.3%
	Mixed fund	8	6.5%
Project capacity	Small scale (≤ 15 VND bil.)	33	26.8%
	Medium to big scale (≥ 15 VND bil.)	89	72.4%
	National important project	1	0.8%

3.3 Sampling and Data collection

To determine the sample size needed through following formula in which $z = 1.96$; $P = 0.5$; pick $\mathcal{E} = 0.04$ (4%). By using formulas (2) and (3) with value $m = 600$ and $N = 129$ the number of samples needed for this study is 107 samples.

Survey data was collected from a sample of respondents who had lately engaged with construction project(s) in Vietnam. The distribution of respondents appears to provide a rather diversified perspective from different positions in projects (i.e., project managers, site supervisors, design engineers, consulting engineers, architects, and authorities). An online questionnaire distributed a total of 150 samples through email. Only 129 answers were received, and 123 qualified responses (average age is 29.33, $SD=5.911$) for research that is more than the required sample size (107 samples), representing an effective rate of 82.0%.

The first part was to collect respondents' demographic information, including their categories of gender, education levels, work experience, organisation involvement in the construction projects, the role of the participant in the construction project, and project characteristics (i.e., type of project, type of project fund, and project capacity). Table 2 presents the demographic of the respondents under the investigation.

4 Results and Discussions

In this study, two software applications were applied to examine the findings, which are MS Excel 365 and SPSS 20. The analysis

results have been calculated and assessed based on their simple percentage, and RII. This section consists of three main items which include the impact of the Covid-19 pandemic on business activities of construction enterprises, construction workforce, and performance of construction projects.

4.1 The impact of the Covid-19 pandemic on business activities of construction firms

In the context of the global and domestic economies facing numerous challenges as a result of the complicated and protracted development of the Covid-19 pandemic, which has had a significant impact on the production and business activities of construction enterprises in various ways. As provided in Figure 1, 78.86% of construction companies have gone worse on their business and operation activities during the Covid-19 existing, while the figures for private-owned and public-owned enterprises at 81.82% and 71.43% respectively. 22.86% of public sector indicated that their activities have remained unchanged compared to private sector, at 18.18%. Only 5.71% of public enterprises have gone better on their business activities, whereas, there is no private enterprise has gone better during the Covid-19 pandemic period.

Figure 2 and Figure 3 show the impact of Covid-19 on revenue and profitability of construction enterprises. Accordingly, the revenue and profitability of most companies have decreased due to the Covid-19 pandemic, while a few companies recorded an increase in revenue and profitability.

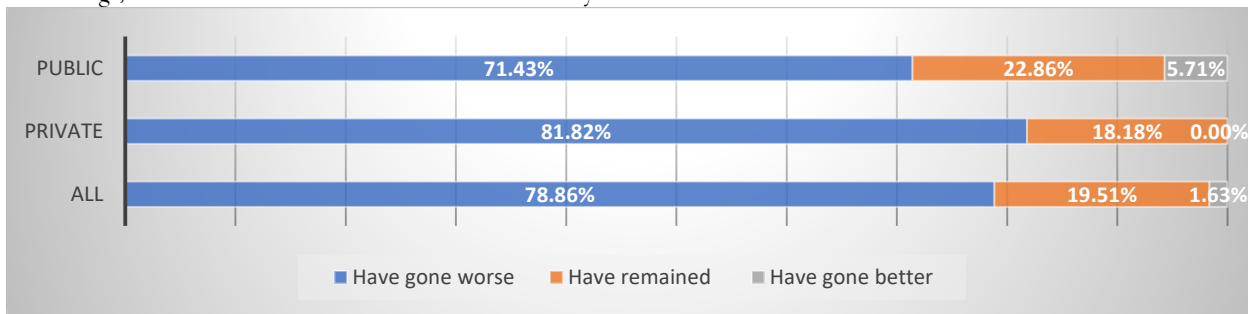


Figure 1. Impact of Covid-19 on business and operation of construction enterprises

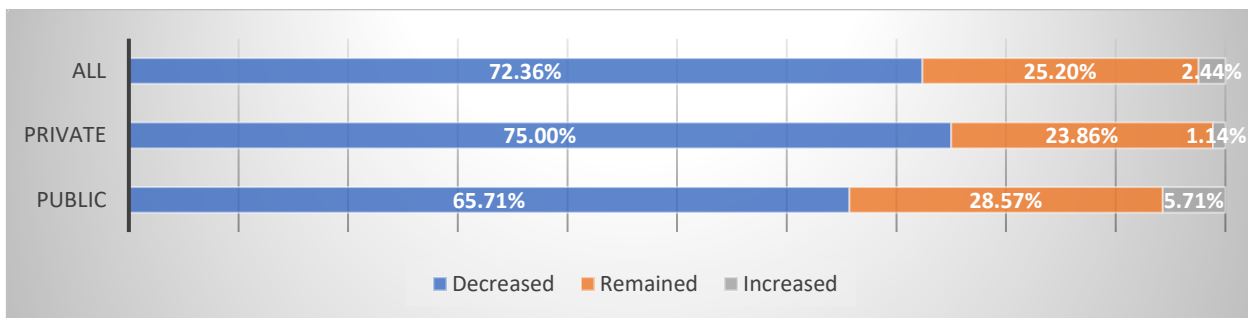


Figure 2. Impact of Covid-19 on revenue of construction enterprises

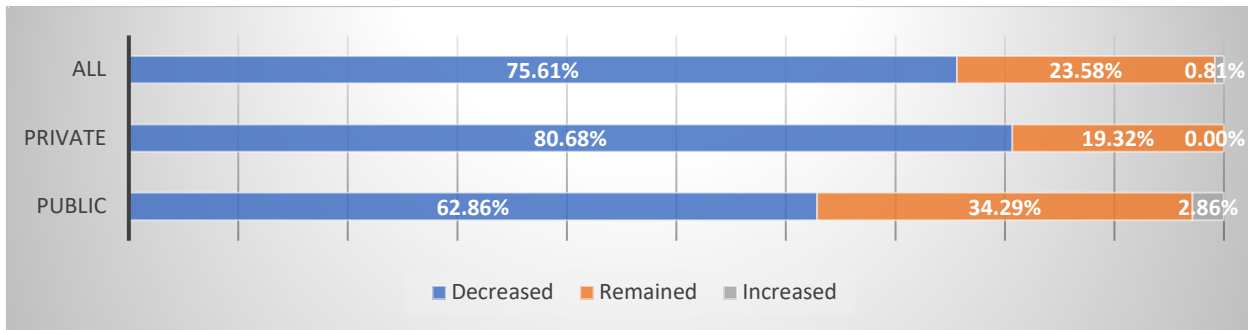


Figure 3. Impact of Covid-19 on profitability of construction enterprises

In terms of enterprises' revenue, 75.00% of private-owned firms have decreased their revenue, while the figure for public-owned firms is lower, at 65.71%. Only 2.44% of construction companies showed that their revenue has grown, whereas, these numbers of private and public sectors are 1.14% and 5.71%, in turn. For profitability of construction enterprises, 80.68% of private enterprises revealed that their profitability has gone down in comparison with 62.86% of public enterprises. Particularly, there is no private company that has increased its profitability during Covid-19, whereas, this figure for public companies is only 0.81%. The rest of construction firms indicated that their revenue and profitability remained unchanged although their activities are impacted by Covid-19.

For the construction sector, the cost of construction work consists of 60-70% of material costs, labor costs account for 10-20%, and the remaining 10-20% refers to machinery costs (El-Gohary & Aziz, 2014; McTague & Jergeas, 2002). Figure.4 to Figure 7 demonstrate the impact of Covid-19 on production and business costs of construction enterprises, which involve direct materials costs, direct labor costs, machinery ownership and operating costs, and indirect costs (i.e., company management cost, construction site management cost, delivery cost, and bank interest payments). Accordingly, most construction companies explained that although have affected Covid-19 pandemic, their production and business costs have remained unchanged, while the numbers of enterprises showed that their production and business costs have decreased.

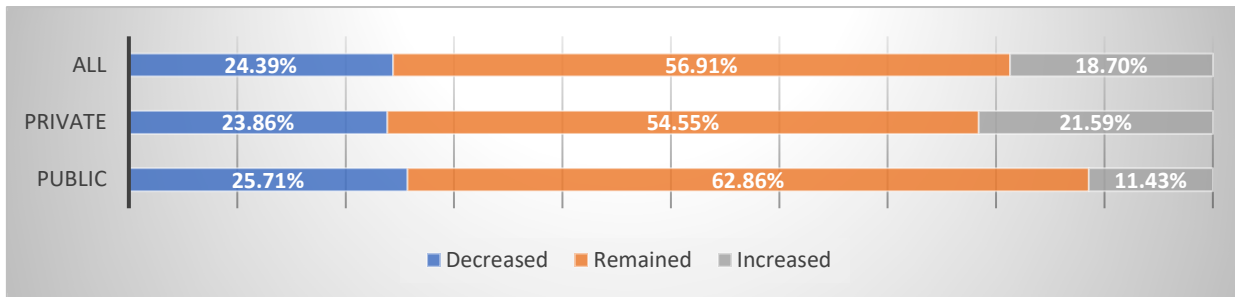


Figure 4. Impact of Covid-19 on direct materials costs

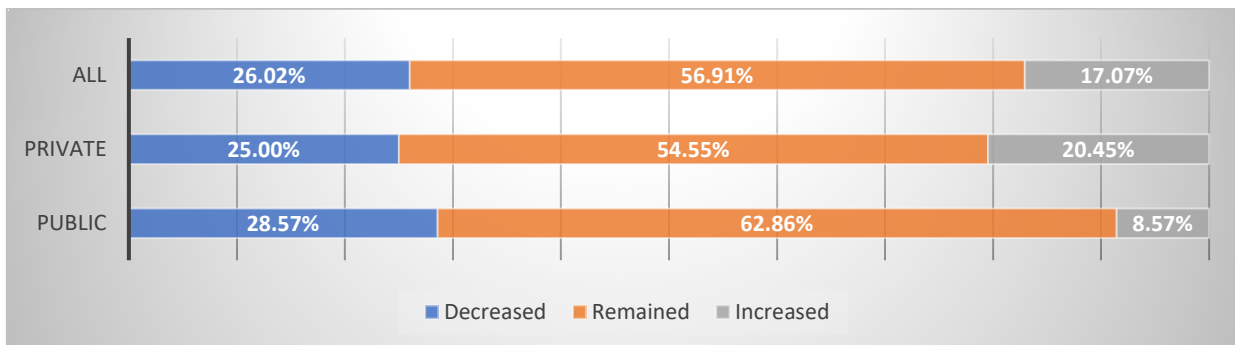


Figure 5 Impact of Covid-19 on direct labor costs

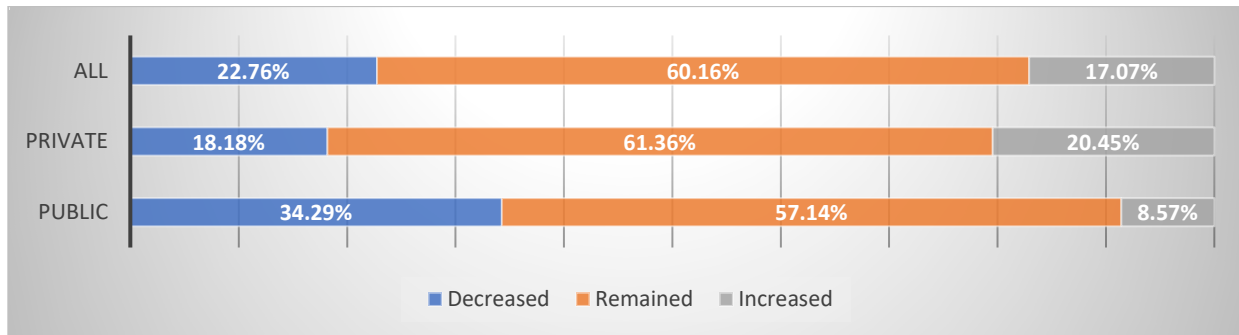


Figure 6. Impact of Covid-19 on machinery ownership and operating costs

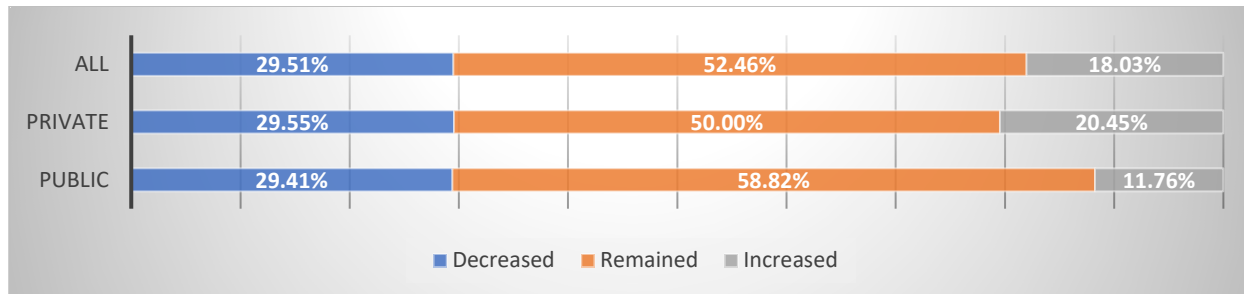


Figure 7 Impact of Covid-19 on indirect costs

In terms of materials costs, 56.91% of construction companies indicated that direct materials costs have remained, whereas, these figures for private and public companies account for 54.55% and 62.86% respectively. 23.86% of private sector revealed that materials costs have decreased compared to 21.59% of this sector showed that materials costs have increased. However, only 11.43% of public sector explained that materials costs have increased, while this number of this sector showed that materials costs have decreased is higher, at 25.71%. In fact, disruptions on the supply chain of construction resources due to difficulties in mobilising especially importing materials like cement, steel, aluminum, and their products which cause materials costs increased (Afkhamiaghda & Elwakil, 2020; Al Amri & Marey-PÃ, 2020; Bsisu, 2020). For labor costs, the majority of enterprises demonstrated that direct labor costs have been unchanged, at 62.86% of public firms and 54.44% of private firms. In contrast, the percentages of companies suggested that labor costs that have increased are 8.57% for public sector and 20.45% for private sector.

For machinery costs, 61.26% of the private enterprises proved that machinery ownership and operating costs have remained unchanged, while this figure for public enterprises is lower, at 57.14%. Only 8.57% of public-owned companies showed that machinery costs have increased compared to 34.29% of the remaining public sector indicated that machinery costs have decreased due to Covid-19 pandemic. The rate of private enterprises demonstrated that machinery costs have increased or decreased are the same, at 20.45% and 18.18% respectively. The Covid-19 makes the idleness of resources like equipment, machinery, and tools, which causes machinery ownership and operating costs increased (Al Amri & Marey-PÃ, 2020; Gamil & Alhagar, 2020). In terms of indirect costs, half of private sector showed that indirect costs have remained, while this number of the public sector is higher, at 58.82%. The proportions of private and public enterprises indicated that indirect costs that have decreased are similar, at 29.55% and 29.51% respectively. These findings reveal that although construction enterprises are impacted by the Covid-19 pandemic, the majority of their production and business costs have remained unchanged.

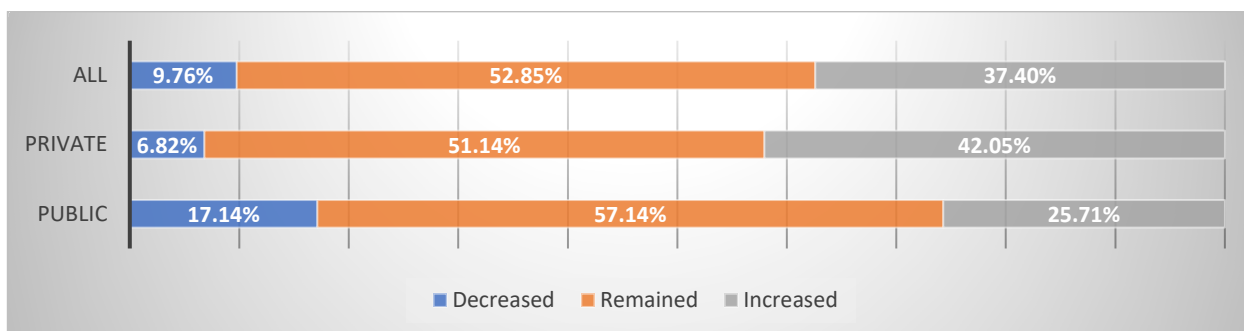


Figure 8 Impact of Covid-19 on permanent labor demand of construction enterprises

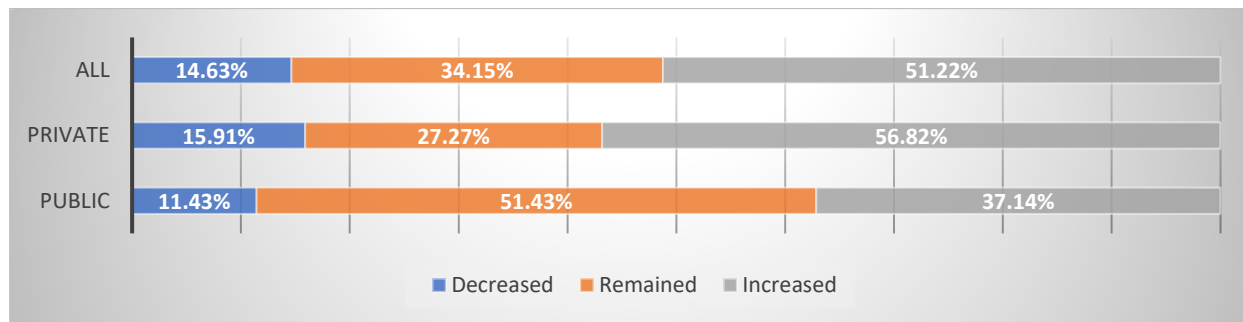


Figure 9 Impact of Covid-19 on contractual labor demand of construction enterprises

The construction industry employs a large number of laborers compared to other industries, hence, labor demand for construction companies is significantly affected by the Covid-19 spread. The findings from the study of (Araya, 2020) indicated that the construction workforce of a construction project may be reduced by between 30% and 90% due to the COVID-19 pandemic. As provided in Figure 8 and Figure 9, the labor demand of enterprises has fluctuated during the Covid-19 existence. The majority of construction firms revealed that their permanent labor demand has remained unchanged, at 57.14% and 51.14% of public and private sectors respectively. However, only 6.82% of private-owned companies showed that their permanent work demand has decreased, whereas, this figure for public-owned companies is higher, at 17.14%. In contrast, the percentage of contractual labor demand of private enterprises has increased, accounting for 56.82%, while this number of public enterprises is only 37.14%. This finding indicates that private construction companies tend to use more of temporary labor during the Covid-19 pandemic than public construction companies.

As demonstrated in Table 3, the Covid-19 has a significant impact on numerous aspects of organisation and management of construction enterprises. The findings indicate that 'planning change' is ranked the 1st position, which proves that the Covid-19 has a high impact on planning change of both public and private enterprises (RII=3.00 and 3.27 respectively). This finding is supported by (Gamil & Alhagar, 2020) who demonstrated that construction planning is likely to be significantly affected during the Covid-19. With RII=2.89, 'policy-making change' is ranked 2nd by the respondents working in the public sector, while this aspect is ranked 3rd by those working in the private sector (RII=3.20). In contrast, participants working public sector ranked 'reward and well-being program' was 3rd position (RII=2.60), whereas, participants working public sector ranked this aspect was 2nd position (RII=3.26). The findings reveal that these two aspects of organisation and management of construction enterprises are noticeably affected by the Covid-19 pandemic. Communication in an enterprise is ranked 4th in both public and private sectors with RII=2.54 and 2.70, in turn, this indicates that this aspect is moderately affected by the Covid-19. Several different aspects such as work culture, competencies, reputation, of construction enterprises are ranked at the end positions (RII=2.53, 2.50, and 2.23 respectively), which proves that the Covid-19 pandemic have a low impact on these aspects of construction enterprises.

Table 3 Impact of Covid-19 on organisation and management of construction enterprises

Aspects	All (N=123)		Public sector (N=35)		Private sector (N=88)	
	RII	Rank	RII	Rank	RII	Rank
Planning change	3.20	1	3.00	1	3.27	1
Policy-making change	3.11	2	2.89	2	3.20	3
Reward and well-being program	3.08	3	2.60	3	3.26	2
Competencies	2.50	6	2.11	6	2.65	5
Reputation	2.23	7	1.97	7	2.33	7
Work culture	2.53	5	2.31	5	2.61	6
Interaction	2.66	4	2.54	4	2.70	4

4.2 The impact of the Covid-19 pandemic on construction workforce

The labor market is being significantly affected by the Covid-19 pandemic, in which, its impact indicates the effect on the income of millions of construction laborers worldwide. Figure 10 illustrates the impact of Covid-19 on income of construction workforce. Accordingly, most respondents showed that their incomes have remained unchanged even though affected by the Covid-19, at 52.85%. 44.32% of respondents working in private sector explained that their incomes have decreased, while this figure for public sector is higher, at 48.57%. Only 2.27% of laborers working in private enterprises demonstrated that their incomes have increased during the Covid-19 spread, whereas, no laborer is working in public enterprises showed that their incomes have increased. This finding is supported by the RII result, which ranks income as the most affected in the first position with RII=3.33 (Table 4). The result proves that Covid-19 has a very high impact on construction workforce's incomes. Although their incomes are affected by the Covid-19, very few respondents have received support from their companies. As provided in Figure 11, only 7.95% of private-owned enterprises

introduce on reward and well-being programs to support their employees, while this number of public-owned enterprises is higher, at 17.14%. In contrast, 51.14% of respondents working in private sector showed that their companies more difficult carried out to support programs in their workforce, whereas, this figure for public sector is 42.86%.

As provided in Table 4, with RII = 3.49, factor of 'mental health' is ranked the first position by the respondents working in the public sector, while respondents working in public sector assessed this factor is the second position (RII=3.25). This finding indicates that the Covid-19 pandemic has a significant impact on psychology of construction workforce. In fact, during the Covid-19 spread worldwide, many countries have experienced lockdown and quarantine time in a long time, which is the main cause negatively affected by human mental health (Torales, O'Higgins, Castaldelli-Maia, & Ventriglio, 2020; Xiong et al., 2020). The surveyed respondents ranked 'motivation' as the third

position in both private and public sectors (RII=3.11 and 3.31 respectively), which proves that the Covid-19 has a moderately affected work motivation of construction workforce. Factors of 'productivity' and 'physical' of labors are ranked at the end with RII=3.02 and 2.90 respectively, which reveals that the Covid-19 has a low effect on productivity and physical of construction workforce. Recently, although Vietnamese construction labor productivity has been enhanced (Hai & Van Tam, 2019; Nguyen, Van Tam, Dinh, & Quy, 2020; Van Tam, Huong, & Ngoc, 2018; Van Tam, Quoc Toan, Tuan Hai, & Le Dinh Quy, 2021), the existence of Covid-19 can make a negative impact on construction productivity improvement. The finding is supported by (Alenezi, 2020) who demonstrated that the Covid-19 is a cause make low productivity of construction workers. In Oman, construction companies are also reducing their staff, and the workforce is mostly unemployed (Al Amri & Marey-PÄ, 2020).

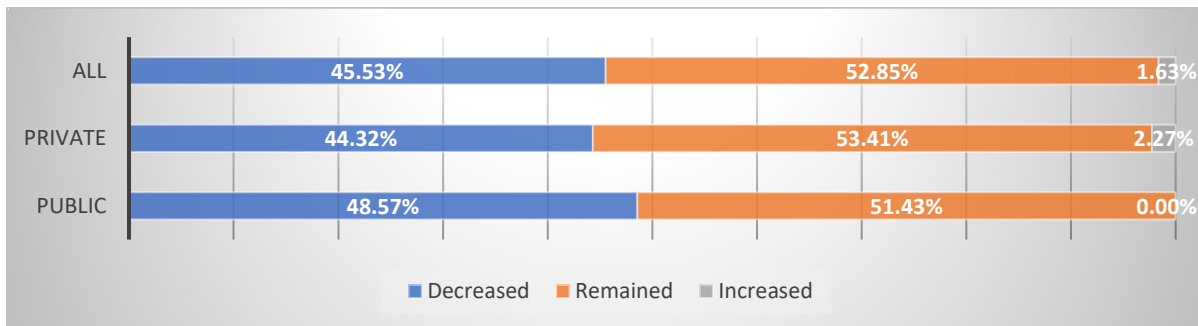


Figure 10 Impact of Covid-19 on income of construction workforce

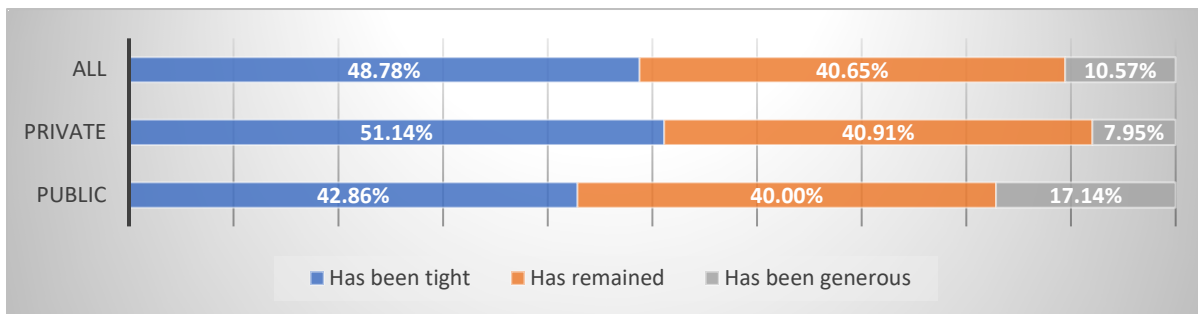


Figure 11 Support of enterprises for their employees

Table 4 Impact of Covid-19 on construction workforce

Factors	All (N=123)		Public sector (N=35)		Private sector (N=88)	
	RII	Rank	RII	Rank	RII	Rank
Income	3.33	1	3.34	2	3.32	1
Mental health	3.32	2	3.49	1	3.25	2
Motivation	3.17	3	3.31	3	3.11	3
Productivity	3.02	4	3.14	5	2.98	4
Physical	2.90	5	3.17	4	2.80	5

4.3 The impact of the Covid-19 pandemic on construction project performance

Numerous construction projects globally are being impacted by the Covid-19 in various aspects. Figure12 to Figure 15 show the impact of Covid-19 on performance of construction project in terms of schedule, quality, cost, and safety. The surveyed respondents indicated that most construction projects have fallen behind schedule due to the effect of the Covid-19 pandemic, accounting for 61.79% of the total, while only 3.25% of respondents explained that construction projects have run ahead of schedule. This finding is supported by the results of the RII method (Table 5), with RII=3.33, 'schedule' is ranked the 1st position, which indicates that the Covid-19 has a very high impact on construction project schedule. This result is in the line with

the study of (Afkhamiaghda & Elwakil, 2020; Al Amri & Marey-PÄ, 2020; Alenezi, 2020) which revealed the Covid-19 is a major cause of delays in construction projects in Kuwait, Oman, and South Africa. Similarly, 'project cost' is evaluated the 2nd by respondents working in both public and private sectors (RII=2.74 and 3.19, in turn), which reveals that the Covid-19 have a significant influence on construction project cost. Besides, 51.22% of respondents indicated that project cost has been increased, whereas, only 8.13% of respondents showed that project cost has decreased during the Covid-19 existing.

In contrast, the majority of respondents indicated that project quality has been remained and safety has been ensured within construction process. In particular, 82.93% of respondents explained that the quality of construction project is remained unchanged, while only 13.82% of respondents showed that project quality has been decreased. Besides, 73.17% of

respondents demonstrated that safety of construction process has been ensured compared to only 14.63% of respondents suggested that safety of construction process has been decreased. These findings are supported by RII' results which ranked safety and quality of construction project at the end positions with RII=2.24 and 2.09 respectively, which proves that the Covid-19 have a low impact on safety and quality of construction project during the Covid-19 spread. The surveyed respondents ranked 'stakeholders communication' and 'environmental issue' are 3rd and 4th position (RII=2.80 and 2.27, in turn), which reveals that the Covid-19 pandemic has a moderate impact on stakeholder communication and environmental issue within construction process. These findings are further supported by (Alenezi, 2020) who explained that the Covid-19 is a primary cause that makes poor safety conditions, poor scheduling and planning of project, and poor communication with other parties.

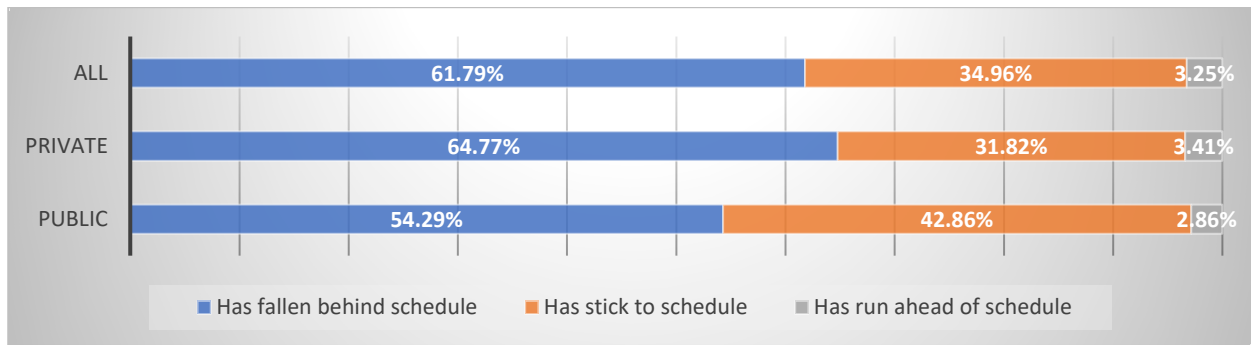


Figure 12 Impact of Covid-19 on schedule of construction project

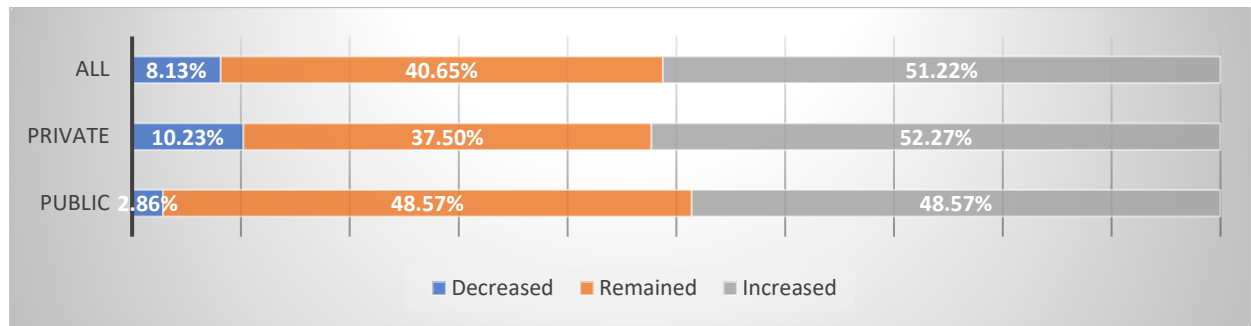


Figure 13. Impact of Covid-19 on cost of construction project

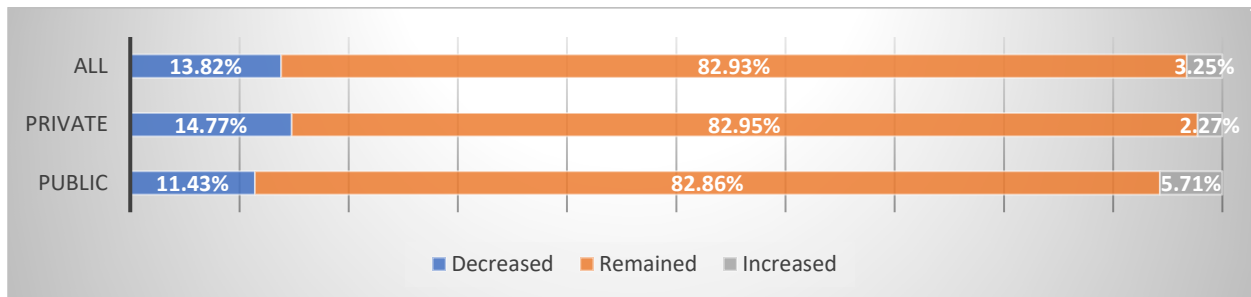


Figure 14 Impact of Covid-19 on quality of construction project

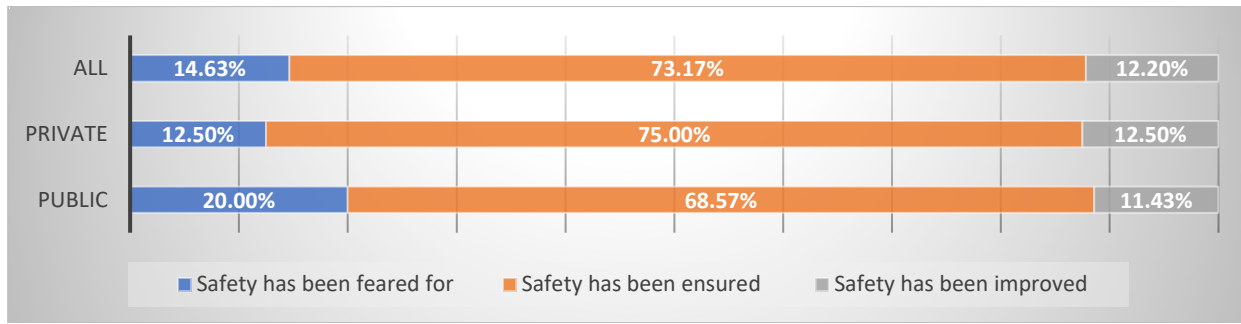


Figure 15 Impact of Covid-19 on safety of construction process

Table 5. Impact of Covid-19 on performance of construction project

Aspects	All (N=123)		Public sector (N=35)		Private sector (N=88)	
	RII	Rank	RII	Rank	RII	Rank
Schedule	3.33	1	3.26	1	3.36	1
Cost	3.07	2	2.74	2	3.19	2
Stakeholder communication	2.80	3	2.54	3	2.90	3
Environmental issue	2.27	4	2.20	4	2.30	4
Safety	2.24	5	2.17	5	2.27	5
Quality	2.09	6	2.00	6	2.13	6

5 Conclusions and Recommendations

Construction activities, without exception, have also been affected by the pandemic. In general, the effects are negative and multilevel (Figure 16). In terms of organisational level operations, there has been a clear decline in overall revenue. Although some types of costs have been remain or reduced, they are caused by freezing in operation or shortage of contracts. Demand for labor has shown signs of increasing during the epidemic. This is quite surprising because it is the opposite of some other areas such as: gastronomy, tourism, service, or non-food retail (Spurk & Straub, 2020), leisure & hospitality and retail

trade (Kurmann, Lale, & Ta, 2020). Having said that, construction businesses suffer in many ways. There is not much difference between the public and private sectors when the three most affected dimensions are composed of Planning change; Policy-making change and Reward and well-being program. Meanwhile, the reputation was considered almost not very affected. This is quite surprising compared to other studies where the authors believe that reputation could suffer a lot during times of crisis (Abimbola et al., 2010; Patterson, 1993; Šontaitė-Petkevičienė, 2014). According to the majority of the respondents, employee income and welfare were said to have decreased. This is understandable because the company's revenue has been hit hard in the context of the bleak market and the local shutdown in many places. This situation is likely to last, and even worsen, when the economic shock is on, not much different from the Spanish flu pandemic of 1918 (Brainerd & Siegler, 2003). In addition to income, both public and private practitioners believe that their psychology and motivation are seriously affected by the outbreak. This finding suggests a real need for models and policies related to mental health care at workplace. At project level, schedule, cost and communication were considered to be under the most pressure. We need to pay attention to this finding because the trio has long been seen as influential greatly to the success of the project (Andersen, Birchall, Jessen, & Money, 2006; Belout & Gauvreau, 2004).

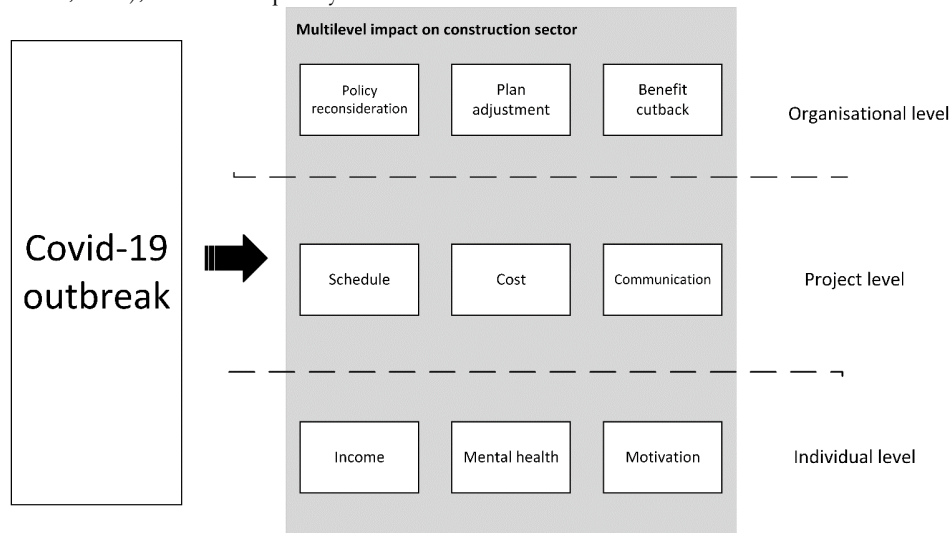


Figure 16 Overview of Covid-19's major impacts on Vietnamese construction sector

Taken together, these results provide a rather panoramic picture of the construction industry in the Covid-19 era. A pandemic like an atomic bomb has already exploded, but has left many serious and persistent consequences. Research such as this paper, although still sketchy, will serve as the foundation for policy-makers and management to envision those consequences, towards building countermeasures to help revive the economy and the construction industry in particular.

Although the Vietnamese government introduced several supportive policies, construction businesses have also actively implemented solutions to maintain their business and operation activities and constrain the COVID-19 pandemic's negative impacts. Accordingly, many solutions have been implemented by construction enterprises such as cutting staffs; reducing workers' wages; reducing bonus and welfare regimes; reducing other costs (e.g. advertising, training); delaying in payment of wages and allowances to employees; negotiating on late payment of bank interest negotiating for advance payment; applying for a specific mechanism for businesses from the state. However, these solutions are still temporary, challenging to bring into play long-term effectiveness in the face of complicated developments of the COVID-19 epidemic. Therefore, in order to help construction businesses to ensure construction activities and towards long-term sustainable values in the case of the COVID-19 pandemic existing, the authors proposed several recommendations as follows:

(1) Restructuring the management system; rearranging human resources; providing a flexible working framework; developing a job management program in case employees work at home, helping keep tasks being interrupted, ensuring quality and productivity, and preventing risks caused by COVID-19.

(2) Developing immediate and long-term scenarios and measures to ensure regular, continuous, and less interrupted construction work during the COVID-19 outbreak. Both ensure labour safety, safety against epidemics, and ensure project implementation efficiency.

(3) Promoting the application of information technology to production and business activities to accelerate digital transformation in enterprises. From the work of planning, finance, management, human resources, salary, and site management. Stakeholders should integrate all work systems to build a system throughout the business. It is advised that the management integrate most business processes in business operations from the enterprise level to the management and implementation of construction site level.

(4) Ensuring a sustainable supply chain: enterprises should control and assess the degree of cooperation of suppliers, essential partners of the business, assess the availability of resources, the ability to cooperate, and the readiness of these partners to respond to diseases. Identifying vendors, backup, or alternative partners in an existing partner cannot support the business. Evaluating contract terms and insurance policies to ensure coverage within the contract's scope related to the delayed transfer of resources.

(5) Ensuring financial safety: Enterprises should control the actual cash flow that is regularly circulating to minimise the possibility of a shortage of cash flow due to the decline in revenue; ensuring the financial supply for activities at enterprises and construction

sites to be carried out continuously. The impact on working capital in the supply chain should be appraised. Carefully review debt obligations to identify a possible breach of contract (penalty due to late progress, late payment of interest) and evaluating potential consequences. Actively connect with lenders and other stakeholders in the project to ensure payments are received on time and proactively rearrange debts and alternative financing sources. Assessing the consequences that occur when work is interrupted, delaying, and reviewing insurance policies to assess the likelihood of compensation for production disruptions and clarify coverage of coverage in an outbreak continue to have complicated developments.

This study has some limitations which have to be pointed out. This study was a local, not global, study conducted using web-based questionnaire survey data. The article does not include quantitative parameters to help the readers understand the extent of the damage. The depth of the study is also limited when there are no statistical analyses of correlation, causality or regression. In conclusion, the results of this study highlight the multilevel, multidimensional nature of epidemic impact on the construction sector. It would be beneficial to determine the key impacted areas in order to develop industry-wide policies on dealing with catastrophic events and developing in a new normal. Our study, being of an exploratory and interpretive nature, raises a number of opportunities for future research, for instance: status of construction workers' suffering and their solicitation; safe working solution in the context of an epidemic; or even rethinking construction industry reform strategies.

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