Economic challenges: Conceptual framework on factors affecting construction cost during COVID-19 pandemic in Malaysia

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Abstract. Various studies have found that COVID-19 pandemic impacts on a country's economy through several channels, including the construction sector. The construction sector, which has always been a big growth generator for the economy, has also been completely shut down. Construction stakeholders are facing a several of the issues as the construction costs keep increasing as a result of the workplace safety and health compliance, suspension and termination of the project, and productivity loss. Accordingly, this paper attempted to propose a conceptual framework on the factors affecting construction cost during COVID-19 pandemic in Malaysia. Almost all evidence from the literature shows that project completion, supply chain and regulatory compliance are the main factors that need to take heed of by the construction players during COVID-19 pandemic. Significantly, all these three components have the potential as the contributors to the increment of construction costs during COVID-19 pandemic.

1. Introduction

Construction sector contributes significantly to the country's economy, both directly and indirectly [1]. The construction sector contributes to Malaysia’s economic growth which accounted for nearly 3.6% of GDP and employed person increase 2.2% in the fourth quarters of 2019 [2]. The construction sector contributes significantly to society's socioeconomic growth by creating job opportunities, boosting income sources, and reducing unemployment [3].

COVID-19 has imposed a total lockdown, severely limiting economic activity [4]. Due to the COVID-19 pandemic outbreak, the construction sector, without exception, is also facing the impact. The construction sector has plenty to work through during the pandemic and the recovery from ensuring the safety of its workers to capitalising on available relief. The construction timeframe and
costing had to be rescheduled and revised, resulting in increased time and expenditures. However, the construction must be completed, even if it puts a strain on the contractors and workers to do it within the new time and financial constraints [5]. Furthermore, the industry has to operate under new norms which definitely give additional cost to construction and reduce productivity [6]. This study attempted to propose a conceptual framework on the factors affecting construction cost during COVID-19 in Malaysia as a result of these issues.

2. Literature Review

2.1. Pandemic of COVID-19

COVID-19 is an infectious disease that has rapidly spread over the world, causing the World Health Organisation (WHO) to designate it a pandemic [7]. The COVID-19 epidemic is the most significant crisis of current period, and its recovery could take years, affecting a wide range of economic sectors, including construction [8]. Health screening of workers, providing additional personal protective equipment (PPE), upgrading site facilities, implementing social distancing procedures, disinfecting shared tools and equipment, and implementing remote working on site are all procedures that must be followed in the construction sector [9].

2.2. Movement Control Order (MCO)

In compliance with the Prevention and Control of Infectious Diseases Act 1988 and the Police Act 1967, Malaysia enacted the Movement Control Order (MCO) from March 18, 2020 to March 31, 2020, which was later extended to April 14, 2020. All government, private, and commercial facilities were ordered to close, with the exception of those that supplied essential services (the water, electricity, telecommunication, finance, banking, energy, transportation, postal, lubricants, oil, gas, irrigation, fuel, broadcasting, health, pharmacy, safety, defence, prison, fire, cleaning, retail, food supply, port and airport) [10].

The MCO was replaced with a Conditional Movement Control Order (CMCO) as the number of cases decreased. Because of a decline in the number of cases, the CMCO was replaced by the Recovery Movement Control Order (RMCO) on June 9th. The RMCO was in place starting from 10 June 2020 until 31 December 2020. The RMCO was then has been extended to March 2021 [11]. Recognizing the negative consequences of a prolonged closure of the industry, the government has authorised certain construction operations to continue operating even during the MCO's early stages, beginning on April 13, 2020 [6]. The Malaysian government declared on June 5, 2020 that 5,131 of the 6,750 construction sites inspected by the Construction Industry Development Board (CIDB) were still not operational as of June 4, 2020. Construction value added in Quarter 1 2020 fell by 7.9% year on year as a result of the slowdown, which was exacerbated by restrictions imposed by the Movement Control Order (MCO).

2.3. Factor affecting construction cost during Covid-19 pandemic outbreak

In Table 1.0 shows a summary of the factors affecting construction cost during COVID-19 pandemic outbreak. Most of the researches has explain that project completion, supply chain and regulatory compliance are the main factor that affecting construction cost.
### Table 1. Factors affecting construction cost during COVID-19 pandemic outbreak.

| Main Factor          | Sub-factor                                      | Gamil & Alhagar (2020) | Simree, F. et al. (2021) | Esa, M. B. et al. (2020) | ENR (2020) | Zhimin et al. (2020) | Qayumani et al. (2020) | Abdullah et al. (2020) | Nicol et al. (2020) | Kofi A et al. (2020) | Hopheore et al. (2020) | Jones (2020) | Raoufi and Fayek (2020) | Aminah, C. et al. (2021) | Helm, D. (2020) | MOH (2020) | Gamble, A. et al. (2021) |
|----------------------|-------------------------------------------------|------------------------|--------------------------|--------------------------|------------|---------------------|------------------------|------------------------|---------------------|-----------------------|----------------------|-----------------|------------------------|------------------------|-----------------|-----------------|------------------------|
| Project Completion   | Lock down                                       | √                      | √                        | √                        | √          |                     |                        |                       |                     |                       |                     |                 |                       | √                      |                 |                 |                       |
|                      | Restriction of Movement                         | √                      | √                        | √                        | √          |                     |                        |                       |                     |                       |                     |                 |                       | √                      |                 |                 |                       |
|                      | Suspension of project                           | √                      | √                        | √                        | √          |                     |                        |                       |                     |                       | √                     |                 | √                      | √                      |                 |                 |                       |
|                      | Stop work order                                 | √                      | √                        | √                        | √          |                     | √                      | √                      |                     |                       | √                     |                 | √                      | √                      |                 |                 |                       |
| Supply Chain         | Shortage of material and machineries            | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 |                      | √                      |                 |                 |                       |
|                      | Overhead cost increase/Cost overrun             | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 |                      | √                      |                 |                 |                       |
|                      | Shortage of labour – adoption of new technology | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 |                      | √                      |                 |                 |                       |
|                      | Materials deterioration                          | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 | √                      | √                      |                 |                 |                       |
| REGULATORY COMPLIANCE| Hygiene kits (Face mask, hand sanitizer, soap)  | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 |                      | √                      |                 |                 |                       |
|                      | COVID-19 detection equipment/testing            | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 | √                      | √                      |                 |                 |                       |
|                      | COVID-19 PPEs                                   | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 | √                      | √                      |                 |                 |                       |
|                      | Screening tools                                 | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 |                      | √                      |                 |                 |                       |
|                      | Limited works at site in one time               | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 | √                      | √                      |                 |                 |                       |
|                      | Cleaning tools and materials                    | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 | √                      | √                      |                 |                 |                       |
|                      | Proper maintenance of toilet facilities         | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 | √                      | √                      |                 |                 |                       |
|                      | With adequate supply of liquid soap and disposable towels | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 | √                      | √                      |                 |                 |                       |
|                      | Training and communication with the employees   | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 | √                      | √                      |                 |                 |                       |
|                      | on the new hazards and controls                 | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 | √                      | √                      |                 |                 |                       |
|                      | Providing transportation for workers            | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 | √                      | √                      |                 |                 |                       |
|                      | Health Supervisor/Officer                       | √                      | √                        | √                        | √          |                     | √                      | √                      | √                   | √                     | √                     |                 |                      | √                      |                 |                 |                       |
3. Methodology
This paper focuses mainly on secondary information as it is concentrates more on review related literature, thus a conceptual framework was created. The focus is more on issues regarding construction costs during the COVID-19 pandemic. Further study is planned to be conducted by comprehensive empirical research using a quantitative research design.

4. Propose Conceptual Framework
Using an analytical tool with numerous variations and situations, a conceptual framework is used to construct a conceptual distinction and organise thoughts. The proposed conceptual framework was constructed based on findings from the literature reviews of previous researchers. According to an analysis of existing studies on the impact of COVID-19 towards construction costs, it was found that project completion, supply chain and regulatory compliance are the three main factors that lead to the increment of the total cost of a project. Accordingly, this study proposes a conceptual framework that incorporates all three variables. Figure 1.0 presents the conceptual framework. It is believed that all these three are the contributors to the increment of the total project cost caused by the COVID-19 pandemic. These three main factors are as discussed below;

4.1. Project Completion
The construction sector has been highly disrupted due to the spread of COVID-19 which has caused construction projects to be delayed or stopped [12]. Because of movement restrictions and supply shortages, the project's suspension is the most affected factor in the onset of a pandemic [13]. The pandemic has not only left projects unfinished, but it has also hampered and delayed project completion [14]. There have been reports of projects that have stopped completely in order to resume construction at a later date [15]. According to the World Bank, epidemics have two effects on the economy. The first is a temporary or permanent reduction in labour supply as a result of direct and indirect consequences of illness and mortality. Second, people's fear of contagion has an effect on their behaviour [16]. Due to the dread of contact with other people and the closure of places of employment, these impacts have resulted in a decrease in labour force participation.

To manage a productive and cost-effective project, construction workforce management should shift away from traditional goals and toward efficient worker utilisation [17]. The authorities' implied limitations have reduced mobility, causing countless industries to close, resulting in job losses as well as the loss of basic supplies such as food and medical supplies, having a huge socioeconomic impact on everyone [18]. The COVID-19 epidemic and the Movement Control Order (MCO) have a variety of consequences for migrant workers, including those who are unable to work as a result of the MCO and those who continue to work in critical services [19]. For the export of infrastructure and construction-related equipment, products, and plants, Indonesia and China remained closed and inaccessible. This will definitely delay the project's completion [20].

4.2. Supply Chain
Construction materials were also affected by the COVID-19 preventive procedures. Many project managers expressed their dissatisfaction with the lack of construction and illness prevention materials. Due to disruptions in manufacturing by machine suppliers and transportation, construction projects have experienced late equipment supply and delivery, similar to material shortages [21]. In addition, there is a scarcity of materials to support ongoing projects, as well as material price fluctuations [13]. Delays in material supply were projected to stymie overall project development and cause major schedule problems. When the supply chain contained components or raw materials from other nations, delays were more noticeable [22]. The construction supplies
subsector, which includes raw material suppliers, building material suppliers, and equipment makers, could be impacted [23].

As a result of the pandemic outbreak, subcontractors’ ability to pay machine tariffs and materials on-site may be hampered, leading in additional costs [13]. Supply and equipment shortages, late deliveries, bad weather, and poor supplier performance all add to project schedule and cost overrun risks [21]. Apart from that, contractors are also required to pay salary even if the work is not progressing [13]. The spread of COVID-19 has severely harmed the construction sector, disrupting supply chains and causing a labour scarcity due to quarantines [24]. Furthermore, practically every company stated that the lockdown strategy made it difficult for workers to return, which hampered their ability to resume construction work [21]. For a number of reasons, workers chose not to report to work, which had an influence on productivity and efficiency. Quarantine regulations, caring for children due to school closures, and the fear of being ill at work and infecting family members were among the reasons mentioned [22].

Deployment of various virtual working strategies (using technological tools) when appropriate, as well as workspace management and other design considerations [15]. Artificial intelligence and robotics, for example, are being deployed to job sites to track task completion using actionable and real-time data in order to improve site efficiency. Construction companies who adopt and utilise technology benefit from enhanced teamwork, increased efficiency, and on-budget and on-time project completion, resulting in larger profit margins, particularly in this COVID-19 [25]. The construction site has become safer as a result of technological advancements, as well as a more efficient workforce. It has also aided teamwork, increased productivity, and taken on other difficult initiatives [26]. As a result of the technical instruments' adaptation, the virtual environment will become progressively integrated into our construction activities as a "new normal," and working flexibility will improve [27].

4.3. Regulatory compliance

Construction companies are implementing a variety of procedures to mitigate the effects of the pandemic on their operations and workforce, including providing additional personal protective equipment (PPE) to workers, disinfecting shared tools and equipment, health screening of workers, upgrading site facilities, and implementing or social distancing procedures [9]. Contractors must adhere to the regulations given by the Malaysian Ministry of Health (MOH), which include following the Standard Operation Procedures (SOPs) prescribed by the government [28]. Regulatory compliance associated with health and safety rules on construction sites has significantly impacted construction projects [29][30]. Regulatory compliance has been introduced by the government aimed at controlling the virus outbreak on construction sites. On the negative side of this regulation, the contractor has to bear this additional cost. The cost comprises purchasing Covid-19 PPEs hygiene kits wash station, cleaning tools and materials, Covid-19 testing, masks and screening tools. Apart from that, they also need to provide health officers and invest in training and communication with the workers on new hazards and controls [28][31][32]. The training basically ensures that all the workers follow all the regulatory compliance so that the project can be operated. Otherwise, the authority has the right to terminate the site. In addition, the other factor that incurred additional cost to a project was related to the Covid-19 swab test. The workers have to test every two weeks before resume their work on-site [5]. Furthermore, the limitation of worker on-site regulation to promote social distancing gives a direct impact on the project time frame due to low productivity that eventually leads to increment cost of the total project [5][33].
Figure 1. Conceptual framework on factors affecting construction cost during Covid-19 pandemic in Malaysia
5. Conclusion
This article proposes a conceptual framework on factors affecting construction cost during COVID-19 pandemic outbreak from secondary data i.e. literature review. This framework consists of three (3) main factor which are project completion, supply chain and regulatory compliance. Under project completion, there are five (5) sub-factor which are lockdown, restriction of movement, suspension of project, stop work order and shortage of labour. For the second factor, supply chain consists of shortage of materials or machines, overhead cost increase or cost overrun, shortage of labour due to adoption of new technology, shortage of labour and materials deterioration. The last factor, regulatory compliance consist of hygiene kits, cleaning tools and materials, health supervisor or officer, proper maintenance of toilet facilities or wash stations with adequate supply of liquid soap and disposable towels, COVID-19 PPEs, COVID-19 detection equipment/testing, masks, training and communication with the employees on the new hazards and controls, providing transportation for workers, screening tools and Limited works at site in one time (implement social distancing). However, these factors need further investigation in term of survey to the construction stakeholders in order to determine the final framework. All in all, literature reviews revealed that the project completion, supply chain and regulatory compliance have been found as the factors that impact construction costs due to the COVID-19 pandemic situation. Nevertheless, to date, there have not been many studies conducted on the impact of the pandemic on construction costs. Besides the three factors that have been mentioned, what are the other factors that could contribute to the construction costs during the pandemic? To answer this, further research needs to be done on the ground.

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