CONSTRUCTION PROJECT DELAY DUE TO THE COVID-19 PANDEMIC

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ABSTRACT

The COVID-19 pandemic that hit the whole world has harmed several industries including the construction industry. It has caused the operation of the construction industry had to be stopped for a while because the construction industry is reported to be one of the industries with a high risk of COVID-19 virus transmission. Due to that, many construction projects were delayed as a result of series of movement control orders by the government. The purpose of this study is to identify the main contributor factors to project delay due to Covid-19. In addition, this study identifies the mitigation actions to overcome the delays for building construction project in Malaysia. Quantitative method was used and online questionnaire survey were distributed to the target respondents involves clients, consultants, and contractors. The research area covers the conurbation of Klang Valley, Great Penang, and Iskandar city as these areas contain about a third of the overall country's population (Chin et al., 2019). In addition, the number of construction companies as at March 2021 located in Klang Valley, Johor and Penang are 1672, 653 and 323 respectively (CIDB, 2021). Relative Important Index (RII) and correlation analysis were used to analyse the data obtained from the survey. The finding of this study identifies the main factors contribute to delay during COVID-19 pandemic are delay in material delivery; delay in decision making by the consultants; delay in revising and approving document; and unclear of Standard of Procedure (SOP) instructions by the government. As a result, project is suffering with cost overrun and the loss of skilled and unskilled labours. In order to overcome delay, the findings suggest that proper planning and rescheduling; systematic and clear communication; getting help from government aid and completing worker's overdue payment are among the mitigation actions proposed by the respondents. The finding of this study shed light in preventing unnecessary delays in construction project due to the unpredictable pandemic by identifying the factors and impact of delays to improve the awareness of pandemic effect to the construction project. The outcome of the research study can be used as a guidance to help the construction practitioners especially for the clients, consultants, and contractors to monitor and act in the future construction activities to avoid unnecessary project delays when facing unpredictable pandemic in the future.

Keywords: COVID-19, Construction Project Delay, Impact of Delay, Mitigation Actions.

1. INTRODUCTION

The world today has been hit by the COVID-19 attack which has affected many industries including the construction industry. The implementation of the MCO by the Malaysian National Security Council (NSC) is to reduce COVID-19 disease spread has affected many industrial sectors because of the lockdown measures (Nadzir et al. 2020). The first MCO (MCO1) started on 18th March until 31st March 2020. It was then continued for another 2 weeks (MCO2) until 14th April 2020 (Salim et al. 2020). As a result, all construction and maintenance activities must come to a halt. It is reported that most industrial sectors suffered higher losses during the MCO since they were unable to function as usual and had a limited number of clients (Lim 2020). This problem has also faced by the construction workers where limited number of construction workers are allowed at site. This, however, has resulted in project delay (Bond 2020).

The objective of this study is to identify the main contributing factor that cause the delays from Covid 19 pandemic to construction players, and mitigation action to overcome the delay in Malaysia.

2. LITERATURE REVIEW

Construction delays can be defined as any failure to complete a specific construction activity within the time planned (Ness 2010).

2.1 Construction project delays due to COVID-19

The delays caused by the pandemic lead to contractors' impairment in completing construction within the contract period (Alenezi 2020b). Jallow, Renukappa, and Suresh (2020) identified that the lockdown proves hard to oversee projects because employees work from home. However, the construction work is impossible to work from home or even work virtually since most of the construction activities involved physical work (Gamil & Alhagar, 2020; Stiles et al., 2021). Although the construction industry has been allowed by the government to re-operate with strict standard operating procedure (SOP), its operations are certainly not the same as before. It becomes very challenging to implement the SOP in this age of Covid-19 (Pamidimukkala et al., 2021) as there are implications to the employees in the aspect of worker's well-being and health.

2.2 Factors contribute to construction delay

According to (Hasmori et al. 2018), the most remarkable factors contribute to project delay is financial problems. Financing factors involve delay in payment to the contractor from the client (due to less work done on-site) and price variation or escalation due to the COVID-19 pandemic (Alenezi 2020a). Alenezi (2020a) also includes the lack of skilled and unskilled in the manpower are a contributing factor to project delay. The strict lockdown due to the COVID-19 pandemic has caused the migrant workers (skilled and unskilled) been terminated or not getting paid from their employer causing them to leave for their countries (Wahab, 2020).

Other previous studies, Alsharef et al. (2021) and Abbasi et al. (2020), stated that delays in material delivery, shortages in material availability, and delays in inspections and permitting were all also associated with productivity losses due to MCO during the COVID-19 pandemic. It also reported that the unavailability of materials slower the project execution leads to overall project progress and thus cause significant schedule disruptions. On top of that, equipment breakdown and unskilled operator of equipment are also one of the contributing factors to delay (Alenezi 2020a). According to Wahab (2020), the prolonged MCO has negatively affect the project operations and has caused termination of skilled and unskilled operators to abandon the project site (Wahab, 2020).

2.3 Impacts of construction delay to contractor

During the pandemic, most construction sites are ordered to close operation by the government. As a result, majority of the projects were disrupted, causing delays in the project's completion (Esa, Ibrahim, and Kamal 2020). The extension of time in delivering the project during the COVID-19, the increased project costing and limited resource have hastened the project to achieve the project success (Esa et al. 2020). It is possible that projects will encounter other indirect costs caused by the need to re-sequence portions of the work to account for supply chain disruptions, and the costs of maintaining both idle workers and equipment during a work stoppage (Act 2020). Other than that, the construction industry in Malaysia experienced 11.8% of job loss due to the pandemic which is the highest compared to the other industrial sector. This is also supported by Wahab (2020) studies, the spread of COVID-19 and the implementation of the MCO has impacted construction sector which saw the unemployment rate went up by 0.2 per cent from 3.3 per cent in Q1 2019 to 3.5 per cent in Q1 2020.

2.4 Mitigation action taken to overcome construction delay

During COVID-19 pandemic, construction projects' delays can be minimised with proper planning, including appropriate communication and coordination, and regular payments to contractors (Alenazi 2020). This is supported by Ramlee et al. (2016) indicated that the main factors contribute to project delay is the inability of contractor to follow the planning and schedule. In terms of payment, it is suggested that regular payment must be on time to contractors for any work that is done (Alenazi, 2020; (Funke et al. 2020)). Alsharef et al. (2021) also suggested that construction companies can re-examine their strategic vision, partnerships, execution plans, bidding approach, risk assessment approach, material planning protocol, software resources, and other factors to identify inefficiencies and strategic efforts that can be implemented to improve success. In another study by Chan et al. (2017) indicate that the maturity and experience of company, reputation of company and commitment of the company plays an important role to ensure the completion of the project.

On the other hand, Funke (2020) believes that improve communication among the project team can minimize the delay problems. This statement supported by Gamil and Alhagar (2020) which stated that contractors should be prepared with a complete list of tasks, maintain constant communication with all subcontractors, establish daily video meetings, manage all the orders, constantly reviewing shop drawings, coordinate with all the stakeholders for updates, and maintain proper communication with people onsite. Alenazi (2020) added construction sites must receive deliveries of materials and approve the design documents as soon as possible after a project is awarded and payments must be made on time. This requires a reliable management team that able to minimize construction projects' delays with proper planning, including appropriate communication and coordination, and thus regular payments to contractors (Alenazi, 2020). Funke et al. (2020) added that if payment is done on time, the causes of delays can be reduced.

Another study by Ali (2020) found that government can play a vital role in helping the construction business by reducing the interest rates, providing tax subsidies, reducing utility charges, and creating a crisis fund for the construction sector.

3. METHODOLOGY

A set of questionnaires was developed from extensive literature review according to the objectives of this study. A questionnaires survey was distributed to the target respondents involves project clients, consultants and contractors whom directly involved in project delays due to the COVID-19 pandemic. The questionnaire consists of four (4) sections. The first section (Section A) includes demographic of the respondents. Meanwhile, the second section (Section B) questions relate to the main factor contribute to delays. The third section (Section C) is questions relates to the impacts of delays due to the COVID-19 pandemic. Lastly, the fourth section (Section D) is the questions relates to the mitigation to overcome the delay. The questionnaires were using the 5-point Likert scale ranging from 1 (Strongly Disagree), 2 (Disagree), 3 (Mixed Feeling), 4 (Agree) and 5 (Strongly Agree) to determine the level of agreement among the respondents.

3.1 Pilot test

Prior to the full-scale survey, a pilot study was conducted to selected experts to test the reliability and validity of the questionnaire. The reliability test results are shown in Table 1. The Cronbach's Alpha results in the questionnaire (Section B, C and D) are more than 0.8 and this indicates that the items in the questionnaire has the good internal consistency as shown in Table 2 (Taherdoost 2018). Subsequent to the pilot test, the questionnaire was amended according to the experts' comments includes review of the words and statement, omit the unnecessary questions related to the MCO and the suitability of questions for the target respondents.

Table 1: Cronbach's Alpha for pilot study

Section	Cronbach's Alpha, α	N of Items
B: Factors	0.859	12
C: Impacts	0.819	7
D: Mitigation Action	0.850	8

In this study, random sampling technique was opted and 233 number of questionnaires were distributed in March 2021 via online to selected target respondent involves clients, consultants and contractors within the area of research The respondents for this study includes construction practitioners consist of client, contractor and consultant organizations who have experienced in managing construction project during the pandemic.

Table 2: Internal consistency of Cronbach's Alpha, α

Cronbach's Alpha, α	Internal Consistency
$0.9 \leq \alpha$	Excellent
$0.7 \leq \alpha < 0.9$	Good
$0.6 \leq \alpha < 0.7$	Acceptable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

3.2 Ranking Impotant Index (RII)

The RII is used in this study to rank the relative importance of the items based on the objectives (Alenezi, 2020a; Umar, 2018; and Arun, 2013). The five-point scale ranged from 1 (strongly disagree) to 5 (strongly agree) was calculated to determine the relative importance index (RII) for each factors, impact and mitigation actions using Equation (1) as follows:

$$\text{RII} = \frac{\Sigma W}{A \times N} \qquad (1)$$

Where W is weighting given to each factor by the respondents (ranging from 1 to 5), A is the highest weight (in this case is 5) and N is the total number of respondents. The RII value is range from 0 to 1 which the higher the value of RII, the more important was the factor, impact, and mitigation action of delays (Alenezi, 2020a).

3.3 Kruskal-Wallis test

The Kruskal-Wallis test is a nonparametric version of the one-way ANOVA that is used to test if samples come from the same distribution. In this research, the Kruskal-Wallis test will be used to test the level of agreement of those three different groups i.e. clients, consultants, and contractors, on factors contribute to delays during the pandemic. These three groups were selected for this study in order to obtain different perspectives of the main construction players. This statement is supported by Yap et al. (2021) stating that viewpoints of delay causes differ as the clients, consultants and contractors tend to blame each other for unfavourable incidents.

4. FINDING AND ANALYSIS

122 questionnaires were successfully collected with a respond rate of 52.4%. The respond rate is considered sufficient as the minimum number required for random sampling in this research is 119 respondents (Gamil and Alhagar, 2020). Figure 1 and 2 shows the distribution of respondents according to sectors and location respectively.

Figure 1 and Figure 2 show the distribution of respondents according to sectors and location respectively. The distribution of demographic shows is well balanced of respondents for each sector thus, produce reliable findings.

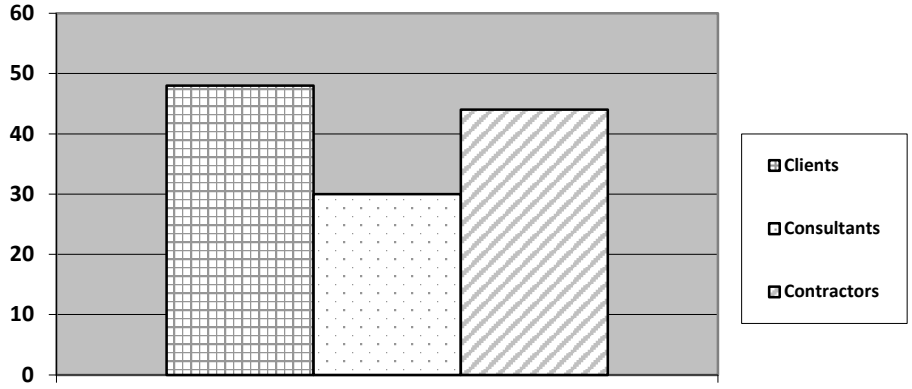

Figure 1: Distribution of respondents according to sectors

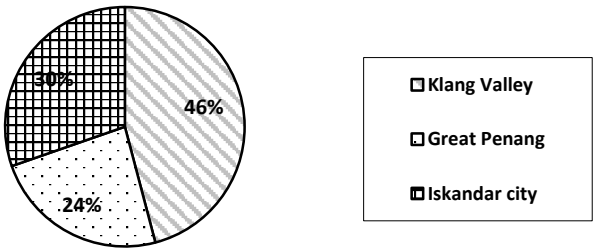

Figure 2: Distribution of respondents according to location

4.1 Main factor contributing to delay in construction project due to COVID-19

The primary data collected was analysed from the perspective of clients, consultants, and contractors. In order to determine the difference of opinion between the groups of respondents, Kruskal-Wallis test was conducted. Table 3 shows Kruskal-Wallis H test results indicates that there is no statistically difference of opinion between groups on all contributing factors of delay (P>0.05). In other words, all the three groups (client, consultant, and contractor) agree that each of the factors contributes to project delay.

Table 3: Kruskall-Wallis results

No	Factors contribute to delays during MCO due to COVID-19 pandemic	Sig.	Decision
B1	Delay in payment to the contractor during MCO (Alenezi, 2020a)	.221	Retain the null hypothesis
B2	Delay in decision making by the consultants during MCO (Alenezi, 2020a)	.402	Retain the null hypothesis
B3	Delay in materials deliveries due to the MCO restrictions (Alenezi, 2020a; Alsharef et al., 2021)	.258	Retain the null hypothesis
B4	Delay in revising and approving document due to MCO (Alenezi, 2020a)	.474	Retain the null hypothesis
B5	Lack of skilled and unskilled manpower due to MCO (Madurai et al., 2020; Zhang et al.,2020)	.988	Retain the null hypothesis
B6	Unclear COVID-19's SOP instructions during MCO (Alenezi, 2020a)	.535	Retain the null hypothesis
B7	Safety measure taken to reduce the COVID-19 spread during MCO (Alenezi, 2020a)	.115	Retain the null hypothesis
B8	Unable to communicate directly face to face during MCO (Abbasi et al., 2020)	.313	Retain the null hypothesis
B9	Unable to manage and supervise the construction site during MCO (Abbasi et al., 2020)	.054	Retain the null hypothesis
B10	Temporary breaks due to bad weather days and the MCO restriction (Alenezi, 2020a; Alsharef et al., 2021)	.235	Retain the null hypothesis
B11	Escalation of materials costs during the COVID-19 pandemic (Alenezi, 2020a; Alsharef et al., 2021; Ali. 2020)	.220	Retain the null hypothesis
B12	Breakdown of equipment because of the temporary breaks of MCO (Abbasi et al., 2020; Alsharef et. al. (2021)	.646	Retain the null hypothesis

Subsequent to Kruskall-Wallis findings, RII method is used to rank the contributing factors to the construction delay according to each group of respondents i.e., clients' perspectives, consultants' perspective and contractor's perspective.

As illustrated in the Table 4, the first-ranked factor in the view of clients is delay in material delivery due to the MCO restrictions which show the highest RII value of 0.846. This can be proved with the study of COVID-19 pandemic lockdown in Malaysia which had revealed that the delay is not only related to the project progress on site; it also affected the suppliers who deliver the materials due to the restricted movement from one place to another place (Esa et al., 2020).

Table 4: Main factor contributing to construction delays in clients' perspective

No	Main factor contributing to construction delays in clients' perspective	RII	Rank
B3	Delay in material delivery due to the MCO restrictions	0.846	1
B2	Delay in decision making by the consultants	0.792	2
B4	Delay in revising and approving document	0.788	3
B6	Unclear COVID-19's Standard of Procedure (SOP) instructions	0.783	4
B5	Lack of skilled and unskilled manpower	0.779	5
B1	Delay in payment to the contractors	0.779	5
B10	Temporary breaks due to bad weather days and the MCO restriction	0.763	6
B9	Unable to manage and supervise the construction site	0.754	7
B8	Unable to communicate directly face to face	0.750	8
B12	Breakdown of equipment because of the temporary breaks	0.721	9
B7	Safety measure taken to reduce the COVID-19 spread	0.696	10
B11	Escalation of materials costs during the pandemic	0.688	11

Table 5: Main factor contributing to construction delays in consultants' perspective

No	Main factor contributing to construction delays in consultants' perspective	RII	Rank
B9	Unable to manage and supervise the construction site	0.860	1
B3	Delay in material delivery due to the MCO restrictions	0.840	2
B8	Unable to communicate directly face to face	0.820	3
B10	Temporary breaks due to bad weather days and the MCO restriction	0.813	4
B7	Safety measure taken to reduce the COVID-19 spread	0.807	5
B1	Delay in payment to the contractors	0.787	6
B2	Delay in decision making by the consultants	0.780	7
B11	Escalation of materials costs during the pandemic	0.773	8
B5	Lack of skilled and unskilled manpower	0.767	9
B6	Unclear COVID-19's SOP instructions	0.753	10
B4	Delay in revising and approving document	0.740	11
B12	Breakdown of equipment because of the temporary breaks	0.733	12

In the consultants' perspective as shown in Table 5, unable to manage and supervise the construction site is voted as the most critical factor that contribute to the delay during the pandemic. This is supported by Christopher and Ong (2020) in their study that construction is not qualify as 'Essential Service' under the regulations and need to follow the Movement Control Order by working from home.

Table 6 shows the perspective of contractors, the first-ranked factor is delay in payment to the contractor (RII=0.836). The delay of payment by the clients made the contractor hard to allocate cost and progress of the construction. This statement is supported by Hasmori et al. (2018) as financial difficulties by the contractor is the highest contributing factor in his study of construction delay in Klang Valley.

Table 6: Main factor contributing to construction delays in contractors' perspective

No	Main factor contributing to construction delays in contractors' perspective	RII	Rank
B1	Delay in payment to the contractors sentence too general, delay payment whether too long, or short ??	0.836	1
B10	Temporary breaks due to bad weather days and the MCO restriction	0.827	2
B3	Delay in material delivery due to the MCO restrictions	0.786	3
B5	Lack of skilled and unskilled manpower	0.773	4
B8	Unable to communicate directly face to face	0.764	5
B9	Unable to manage and supervise the construction site	0.759	6
B6	Unclear COVID-19's SOP instructions	0.750	7
B2	Delay in decision making by the consultants	0.741	8
B11	Escalation of materials costs during the pandemic	0.732	9
B12	Breakdown of equipment because of the temporary breaks	0.723	10
B4	Delay in revising and approving document	0.718	11
B7	Safety measure taken to reduce the COVID-19 spread	0.714	12

In summaries, the perspectives of all three parties are shown in Figure 3 and Table 7. The results of RII in Table 7 indicates that the first-ranked most contributing factor is delay in material deliveries. This is expected as the MCO during the pandemic restricted the business from non-essential work. Thus, it is difficult to find another material supplier for emergency purposes. Most of the respondents agree that they have experiencing the delay in material delivery due to the MCO restriction which made the factor placed in top 3 from each view of respondents. These delays in material delivery were also, in turn, expected to delay overall project progress and cause significant schedule disruptions. The delays were particularly relevant when the supply chain involved material or raw material from overseas. The instruction issued by the Ministry of Transport on 18 March 2020 provides that lorries transporting construction materials will be prohibited, but other types of lorries such as those transporting "essential goods" and food will be allowed to operate during the MCO period (Hishammuddin 2020). Thus, the materials deliveries operation needs to be delayed following the instruction issued due to the pandemic.

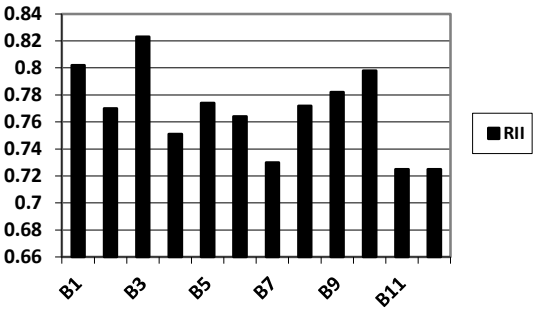

Figure 3: RII ranking for main contributing factors in overall perspectives

Table 7: Main factor contributing to construction delays in overall perspectives

No	Factors	RII	Rank
B3	Delay in material delivery due to the MCO restrictions	0.823	1
B1	Delay in payment to the contractors	0.802	2
B10	Temporary breaks due to bad weather days and the MCO restriction	0.798	3
B9	Unable to manage and supervise the construction site	0.782	4
B5	Lack of skilled and unskilled manpower	0.774	5
B8	Unable to communicate directly face to face	0.772	6
B2	Delay in decision making by the consultants	0.770	7
B6	Unclear COVID-19's SOP instructions	0.764	8
B4	Delay in revising and approving document	0.751	9
B7	Safety measure taken to reduce the COVID-19 spread	0.730	10
B11	Escalation of materials costs during the pandemic	0.725	11
B12	Breakdown of equipment because of the temporary breaks	0.725	11

4.2 Impacts of delay in construction project due to the COVID-19 pandemic

Based on Table 8, the most preferred impacts of delay perceived by all the respondents were cost overrun (RII=0.805), and loss of skilled and unskilled manpower (RII=0.803). During the pandemic of COVID-19, the factors that related to cost overrun is the delay in payment to the contractors, delay in decision making by the consultants, delay in material delivery due to the MCO restrictions, delay in revising and approving document, unable to communicate directly face to face, unable to manage and supervise the construction site, temporary breaks due to bad weather days and the MCO restriction, escalation of materials costs during the pandemic, and breakdown of equipment because of the temporary breaks. If there are discrepancies happen, then cost overrun will occur. Time overrun leads to cost overrun. COVID-19 costs should be tracked separately by assessing the damages and performance barriers. The cost analysis should be evaluated based on impacted scope of work, idle equipment, general conditions, and extra preventive measures such as thermal readings, employee screening and facilities management (Critelli et al, 2020). The loss of manpower is highly impacting the construction companies. This statement is supported by the Department on Statistic Malaysia (2020) that stated construction industry experienced 11.8% of job loss due to the pandemic which is the highest compared to the other industrial sector. Construction industry also has the highest unpaid leave percentage by 15.6%. In addition, during the MCO, foreign workers are forbidden to cross the border to Malaysia and hence make it difficult for the construction companies to hire skilled and unskilled worker during the pandemic.

4.3 Mitigation action taken to overcome the delay in construction project due to the pandemic.

By using the Relative Important Index (RII), the most effective method in mitigating delays were obtained according to the answer in the questionnaire that was distributed to the respondents. Based on Table 9, the most preferred mitigation action is proper planning and scheduling (RII=0.857). Proper planning and scheduling in the construction project is the most effective method to avoid/minimize delays from the viewpoint of the clients, consultants, and contractors. In construction, it is necessary to ensure the good coordination among all of industry players including client, consultant, and contractors. This statement can prove by a study that stated proper project planning and scheduling will create a good path and great measurement tools that is needed to be competitive during the construction project. The project cost can be managed efficiently, and a company is better prepared with unexpected events with outlining a plan of time. By sequencing the work properly, the quality control measure can also be maximized, and material or other elements can be bought with enough lead time (Hasmori et al., 2018b).

Second-ranked most preferred mitigation action is systematic and clear communication or instruction. As the MCO forbid a whole construction worker to go to construction sites, a systematic and clear communication between the team project is one of the most preferred ways to mitigate the delay problems. Even though working from home is considered difficult for a construction team, works like rescheduling the plan and project progress can be done effectively if systematic and clear communication is applied.

Table 8: Impacts of construction delay due to the pandemic on overall views.

No	Impacts of construction delay due to the pandemic on overall views.	RII	Rank
C1	Cost overrun	0.805	1
C3	Loss of skilled and unskilled manpower	0.803	2
C5	Additional cost on safety requirement	0.797	3
C2	Time overrun	0.775	4
C6	Construction workers exposed to the COVID-19	0.761	5
C4	Project abandonment	0.731	6
C7	A lot of equipment faced breakdown and materials destroyed	0.730	7

Table 9 also shows that the third ranked most preferred mitigation action is getting help from government aid (RII=0.828). This mitigation action is similar to a study about the COVID-19 and construction companies in Kabul, Afghanistan which considered that government can play a vital role in helping the

construction business by reducing the interest rates, providing tax subsidies, reduction in the utility charges and creation of crisis fund for the construction sector (Ali, 2020).

Other than that, completing worker's overdue payment is also considered as most preferred mitigation action with RII of 0.820. The construction players agreed that completing the workers' payment or contractor's payment can increase their motivation to get the work done rapidly. Since the MCO restriction is started, a lot of non-government companies is financially affected. Hence, a continuous financial flow is important to keep the workers' motivation strong.

Table 9: Mitigation action taken to overcome the construction delays based on client, contractor and consultant perspectives

No	Mitigation actions to overcome the construction delays	RII	Rank
D1	Proper planning and rescheduling	0.857	1
D3	Systematic and clear communication or instruction	0.836	2
D5	Getting help from government aid	0.828	3
D2	Completing worker's overdue payment	0.820	4
D4	Early understanding of rights and obligation	0.815	5
D7	Reconstructing the SOP guidelines	0.793	6
D8	Increasing number of site workers	0.766	7
D6	Following the SOP guidelines	0.761	8

5. CONCLUSION

In conclusion, all three group of respondents i.e. client, consultant and contractor agree that the delay in material delivery is the main factor contributes to construction project delay during the COVID-19 pandemic due to the MCO restrictions. As a results, the project suffers with cost overrun which is the most impactful effect to the project. The finding of this study also highlighted that proper planning and rescheduling; systematic and clear communication or instruction; and getting assistance from government are amongst the mitigation actions in overcome delay. However, in order to make this a success, all parties should work hand-in-hand in dealing with delay due to the unprecedented event of pandemic.

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