The Delay Issues in The Malaysian Construction Industry And Benefits of Industrial Revolution 4.0 (I.R 4.0) to Mitigate Issues for Project Managers

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ABSTRACT

During this Industrial Revolution 4.0 (I.R 4.0) era, the involvement of government body such as Public Work Department (PWD), Construction Industrial Development Board (CIDB), professional body Contractor Service Centre (PKK) along with independent body such as Board of Engineers(BOE), Board of Architect(BOA) and Board of Quantity Surveyor (BQSM) as well as private consultants and contractors, is predominantly crucial in solving and finding possible solutions on how to mitigate problems that occur in construction projects. The identification of problems in construction projects which is directly related to the major topic of delay will be discussed as a subtopic in this research. Questionnaires were sent to 150 respondents and 36 responded by answering questionnaires via google form and hardcopies. The respondents are from construction background in Klang Valley, Malaysia. The quantitative mono method analysis used in this research adopts SPSS software to validate the analysis. The recommendation on the importance of I.R 4.0 as well as its benefits and contribution to mitigate the problem in the delay in construction projects is discussed.

Keyword: I.R 4.0, construction management, project management, management.

INTRODUCTION

The GDP value in construction industry is small compared to other industries; however, the construction industry has a domino impact on other industries. Hence, it is a vital business and is regarded as a major contributor to the nation's economy (Herman, 2016). Organisation Strategic Plan 2021-2025 (PSO 2021-2025) which was conducted by Malaysian Public Work Ministry (PWM, 2021) is a continuous plan from the previous strategic plan which was enacted for year 2016 until 2020. The government bodies such as CIDB, Public Works Department (PWD), Contractor Service Centre (PKK) and independent bodies such as Board of Engineers (BOE), Board of Architect (BOA) and Board of Surveyor are also related to the growth on the development of Malaysian construction industry (Kamal et al, 2012).

The industry is made up of many players including the contractors, developers, government and private agencies, management teams, engineers, architects, surveying consultants, manufacturers, material suppliers and plant hirers. The government is an important player in the industry through its agencies: The Ministry of Works, Public Work Department (PWD), Construction Industry Development Board (CIDB), Contractor Service Centre (PKK), Board of Engineers of Malaysia (BEM), the Board of Architect (LAM) and Board of Quantity Surveyors Malaysia (BQSM). All these entities have significant roles in the growth and development of Malaysian construction projects (Kamal et al. 2012; Tengan et al. 2017). Nevertheless, more hidden problems arise when the enthusiast of construction team tries to contribute to the environment. Due to the restriction on time as well as other surrounding unsupported matters, they lack awareness and this might cause critical problems (Radujkovic et al. 2017).

Industrial Revolution 4.0 (Ir 4.0) And Its Relation To Construction Industry

The sequence and evolution of revolution industry (IR) helps to highlight its developments throughout the history. The 1st IR revolved around steam machine, metal or glass building (18th Century), followed by the 2nd IR which focused on production in large scale & electricity (19th Century). Subsequently, the 3rd IR was about the invention of Information Technology (IT) as well as invention and technology related to automation (70 years later). Finally, the 4th IR concentrates more on CPS (Cyber Physical System) digitalisation and the internet 30 to 40 years after the third revolution. Therefore, it can be concluded that IR 4.0 is the compilation of technology that will be able to give positive impacts for the construction industry. The following is the brief explanation about Industrial Revolution.

Industrial Revolution 4.0 which was introduced in German by Schwab (2016) received strong support from the German government. It was expected to boost the German industrialism and collaborate with recent technology. I.R 4.0 is the latest industrial advance compared to previous industrials such as industrials I.R 1.0 until I.R 3.0 (Schwab, 2016). This research aimed to recommend the advances made in IR 4.0 and their benefits to the construction industry. IR 4.0 is powered by the advancement and implementation of other technologies that support performance.

The research also clearly shows that the industry encompasses more than utilising these technologies, producing and promoting them. IR 4.0 also has a few effects for the construction project, particularly in technologies. I.R 4.0 have begun to advance gradually all these years and become the standard in the use of high technology tools in design and construction. Some of the tools of I.R 4.0 which contribute to construction projects are Cloud Storage, BIM (building information modelling), AutoCAD, WhatsApp, Telegram, MS Office, MS Project, Smartphone, Drone (UAV - unmanned aerial vehicle), automatic sensor, smart robotic machinery, etc.

I.R 4.0 has already penetrated the construction industry, and it is the perfect time to make it wider (Alaloul et.al, 2018). Embracing and adapting to the new and high-tech technology of I.R 4.0 will benefit the Malaysian construction industry (Tajudin, 2017). Numerous research have proven that I.R 4.0 contributes to the supply chain of the construction industry (Tjahjono, 2017). In essence, I.R 4.0 is very important to the construction project because the advance technology will benefit the construction management in mitigating the problem in delay and preventing from cost and time overrun which have been a problem all this while with the traditional method practised for a decade in the Malaysia's construction industry (Alaloul et al, 2018; Lau et al, 2019).

Delay Factors in Construction Industry

Delay is more about time, cost, scope of work, material delivery, benefits, workflow, resources, stakeholder or organisation which create problems during construction and are often difficult to resolve (Mossalam, 2018). In addition, the delay can also arise from unskilled foreign and local workers, improper implementation of the technology and low quality enforcement on practical works (Kamal et al, 2012). Before commencing on any work at a construction site, respective project teams should study the problem that might occur during the work progress (Szymański, 2017). Both construction team and the stakeholder should be aware and compromise for the success of the project (Sakal, 2005; Riemann et al, 2014). Besides, big construction projects have their problem to take care of (Sambasivan et al, 2007).

Delay is one of the major issues in construction project which causes unpredicted impacts. It is a common situation when a project gets stranded due to some issues that occur during construction period. Delay, in general, is divided into two categories which are non-excusable delays and excusable delays (Hamzah et al, 2011), as quoted in Omran et al, (2015).

Complicated designs in project also contribute to the cause of delay. This, as a result, drags the contractor on negotiation and discussion with the stakeholder and consultants to meet the designs as per the specifications prepared by consultants at the earlier stage. According to Hamzah et al. (2011), Sweis (2013) and Omran et al. (2015), this process will take a longer time as the designs need to be changed during the construction period due to lack of material supply or machinery that do not meet the design requirement as well as shortage of skilled labours to work on the special design according to the specialist's requirement.

In this research, the researchers have identified the importance of fully utilising the technology of I.R 4.0 which could mitigate the delay issue in construction projects in advance. Furthermore, it can also complete the project construction beyond the stipulated time and save overrun cost.

NO	AUTHOR	DELAY		
		NON-EXCUSEABLE	EXCUSEABLE	CON CURRENT
1	Hussein, 2014	√	√	√
2	Ahmed et al., 2003		√	
3	Alaghbari et al., 2007	√	√	√
4	Assaf et al., 2006	√	√	√
5	Benz, 2018	√	√	√
6	Gebrehiwet et al., 2017	√	√	√
7	Mossalam, 2017	√	√	√
8	Mustafa et al., 2012	√	√	√
9	Hamzah et al., 2011	√	√	√
10	Rejment et al., 2015	√		
11	Riemanna et al., 2014	√	√	√
12	Sambasivan et al., 2006	√	√	√
13	Sakal, 2005	√	√	√
14	Serpella, 2015	√	√	√
15	Szymanski, 2017	√	√	√
16	Tumi et al., 2015	√	√	√

Table 1: Criteria of delay according to authors

As per table 1, according to a selective of authors, delay factors can come in 3 different criteria such as non-excusable delay, excusable delay and concurrent delay which are related to the objective of this research. The data of this research are also taken from the analyses of their journal articles.

a) Non-excusable delays.
Non-excusable delays are delays due to the complications or issues related to the factory, subcontractor or contractor and have nothing to do with the stakeholder's management. Subsequently, Extension of Time (E.O.T) will be given and Variation of Order (V.O) cannot be claimed. Other factors include poor financial management, lack of site management, no cooperation between contractors or sub-contractors, regular changes of construction team due to lack of performance, lack of supervision, under-estimate material stock on site, improper inspection during work in progress due to quality or double check on wrong specification as well as delay in ordering material to site (Alaghbari et al., 2007, Assaf et al., 2006, Assaf et al., 2006, Assaf et al., 2006, Benz, 2018, Gebrehiwet et al., 2017, Mossalam, 2017, Mustafa et al., 2012, Hamzah et al., 2011, Rejment et al., 2015, Riemanna et al., 2014, Sambasivan et al., 2006, Sakal, 2005, Serpella, 2015, Szymanski, 2017, Tumi et al., 2015).

b) Excusable delays
Excusable delays, also known as 'force majeure' are classified into two categories namely compensable and non-compensable delays (Alaghbari et al, 2007). Compensable delays are usually caused by stakeholders and consultants either due to decision making issues or changes of design problems which are not related to contractors (Hussein, 2014; Ahmed et al., 2003; Alaghbari et al., 2007; Assaf et al., 2006, Benz; 2018; Gebrehiwet et al., 2017; Mossalam, 2017; Mustafa et al., 2012; Hamzah et al., 2011; Riemanna et al., 2014; Sambasivan et al.; 2006, Sakal, 2005; Serpella, 2015; Szymanski, 2017; and Tumi et al., 2015).

According to Alaghbari et al. (2007), the second category of delay is also known as Noncompensable delay. 'Acts of God', is mostly due to natural disasters such as flood, volcano eruption or disasters caused by humans, for example, riots. In this case, the contractors cannot be blamed for the delay. However, the contractors will resume their work without extra charges or claim unless the latter is covered in the insurance.

i) Compensable
The delay caused by stakeholders can interrupt the contractors' works (Alaghbari, 2005), for example, the inefficiency in providing proper decisions by stakeholders or end users, when it is urgently needed by the consultants or contractors during construction period at the construction site. Another cause is financial crisis which depends on back up funding programme on project financing by banking institutions. Additionally, another delay crisis emerges when some stakeholders have no clear directions or specific conditions for the project requirement (Alaghbari et al, 2007; Hamzah et al, 2011).

ii) Non-Compensable
This delay is caused from situations not related to the stakeholders or contractors themselves but by other factors such as natural disasters that include earthquake, fire disaster, flood or changing of monsoon season, as well as issues created by humans such as strike, political issues or anything that contributes to it (Hamzah et al., 2011 ; Alaghbari et al., 2007 ; Omran et al., 2015.)

COMPENSABLE	NON-COMPENSABLE	CONCURRENT
Undefined goals	Poor communication	Flood
Changing scope	Insufficient team skills	Storm
No accountability	Geographical dispersed team	Hurricane
Lack of risk management	Not using proper management software	Tornado
Poor communication	Issues with a team	Fire disaster
Unrealistic expectation	Resources deprivation	Earthquake
Stakeholder indifference	Sustainability social environment & economic	Landslide
Insufficient team skills	Unpaid workers	Tsunami
Organisational process & structure	Various technology among general contractors	Volcano eruption
Retirement of age boomers	Unfavourable contract terms	Lightning strike
Lack of stakeholder engagement	Lack of financial	
Lack of financial	Lack of quality management system	
Lack of quality management system	Lack of risk management	
Geographical dispersed team	No accountability	
Issues with a team	Various technology among general contractors	
Unpaid workers	Ambiguous contingency plan	
Various types of technology used by general contractors	Various types of technology used by general contractors	
Ambiguous contingency plan		

Table 2: Categories of three main factors of delay (Alaghbari et al, 2007; Hamzah et al, 2011)

According to the studies by Hamzah et al., (2011) and Alaghbari et al., (2007), there is a new category of delay which is termed as concurrent delay. Concurrent delay occurs when several causes of delay happen simultaneously. As a consequence, negotiation will be difficult to achieve in this situation. In short, delay in construction industry can be caused by three main types which are compensable, non-compensable and concurrent (refer to Table 2) (Hussein, 2014; Ahmed et al., 2003; Alaghbari et al., 2007; Assaf et al., 2006; Benz, 2018; Gebrehiwet et al., 2017; Mossalam, 2017; Mustafa et al., 2012; Hamzah et al., 2011; Rejment et al., 2015; Riemanna et al., 2014; Sambasivan et al., 2006; Sakal, 2005; Serpella, 2015 ; Szymanski, 2017 ; and Tumi et al., 2015.)

RESEARCH METHODOLOGY AND METHOD

This study adopts a quantitative analysis for the research methodology based on a strong data collection. As for the methods of collecting data, this study uses google questionnaire forms and 36 respondents participated in the study voluntarily. The responses given by them were analysed using SPSS software. According to Vaus (2002) from social research and Fadiya et al. (2014) from construction industry, a small number of sample is sufficient for the purpose of data collection and analysis for the variables.

The respondents are from construction industry background such as semi-government staff (Putrajaya Holding), consultants and contractors who are involved in the same government construction project. Pugh et al. (2005) highlighted that a research is conducted to collect information about uncertainties. Similarly, Creswell (2009) stressed the importance of methodology in collecting the data which will determine the success of the research. Correspondingly, in order to get a strong data collection, this research used a mixed method data collection using google questionnaire forms.

This study attempted to describe in detail the methodological approach adopted. In order to determine the most appropriate position, careful considerations must be made based on the nature of the problem and the established research questions. Table 3 below highlights the feedback from the questionnaires.

Construction Team	Proposed Sample Number	Response Number	Response Received %	Circulating Method (A)			Circulating Method (B)		
				By Hand	Date of Circulating	Date of Collecting	Google Form	Date of Circulating	Date of Collecting
Private Consultancy Firm	50	13	26%						
Private Construction Company	50	16	32%		4/12/2020-11/12/2020	4/1/2021-22/1/2021		4/12/2020-11/12/2020	4/1/2021-22/1/2021
Government body/GLC	50	7	14%						
Total	100	36	24%	60			90		

Table 3: Conveyance of questionnaire surveys

a) Quantitative analysis

This research adopts a quantitative analysis by distributing 150 questionnaires which is created using the Likert scale from level 1-4 and under 4 different categories. Part A is about general information. Part B focuses on the factors that contribute to problems in the construction project, and part C is centred on the mitigation methods used to overcome and avoid the problems in the construction project. Lastly, part D emphasises the purpose and benefits of Industrial Revolution 4.0 tools, applications and software which were split into two sections (Section 1 - Frequency of tools and software I.R 4.0 used during the construction of the project site and Section 2 – Benefits of tools and software of I.R 4.0 used during the construction of the project at the site). The questionnaires were then distributed to selected respondents consisting of government staff, consultants and contractors who answered the questions according to their skills and field experiences.

Factors contribute to the problem (delay)	**Delay in payment to contractors**		**Delay in site possession to contractors**		**Poor coordination**	
Mean	1.89		1.97		1.67	
Std. Error of Mean	.087		.074		.080	
Std. Deviation	.523		.466		.478	
Frequency/ Percentage						
Highly agree	7	19.4	4	11.1	12	33.3

Agree	26	72.2	29	80.6	24	66.7
Disagree	3	804	3	803	0	0
Highly disagree	0		0		0	
Total	36	100	36	100	36	100

Table 4: Frequency of delay (Part B)

The purpose of this survey was to explore the level of the factors that contributes to the problem in the construction project. In this section, the findings from part B of the questionnaire focused on the problem contributing to the issues in construction project. There were 10 questions in this part for the respondents to answer. The respondents were asked to select the level for the factors according to the 4-point Likert scale. Upon receiving the answered questionnaires from the respondents via google form, SPSS was used to analyse the results as shown in the table above.

Mitigation methods used to overcome the problem (delay)	**Improve payment approval period**		**Improve the work programme**		**Minimise the organisation bureaucracy**	
Mean	1.67		1.53		1.58	
Std. Error of Mean	.105		.093		.101	
Std. Deviation	.632		.560		.604	
Frequency/ Percentage						
Very effective	15	41.7	18	50.0	17	47.2
Moderate effectiveness	18	50.0	17	47.2	17	47.2
Low effectiveness	3	8.3	1	2.8	2	5.6
Not effective	0	0	0		0	
Total	36	100	36	100	36	100

Table 5: Frequency of delay (Part C)

Based on the data collection for this section (Part C), the analysis was conducted using the SPSS software in order to get the variable on the mitigation methods used to overcome the problem in construction projects. Part C consists of 9 questions. The results of the mean analysis are shown in Table 5.

Analysis of Table 4 reveals that the frequency of responses on the delay for site possession to contractors is higher (mean 1.97) compared to the frequency of delay in payment to contractors (mean 1.89). On the other hand, the frequency of delay for poor coordination secured the lowest number of frequency among the respondents (mean 1.67).

Table 5 encapsulates the analysis on frequency of response in mitigation methods used to overcome the problem under delay issues. In view of that, the method on improving payment approval period scored the highest variable (mean 1.67), followed by the method of minimising the organisation bureaucracy (mean 1.58) and lastly, the method of improving the work programme (mean 1.53).

CONCLUSION

In conclusion, the analysis of the research conducted on respondents from semi government project staff, architect firm, engineering firm, and quantity surveyor firm indicate that the contribution of I.R 4.0 gives greater impacts and substantial benefits compared to the traditional method for construction projects. The respondents utilised I.R 4.0 tools fully to ensure the delay

can be mitigated as much as possible and faster actions can be taken when problems occurred at the construction projects. This is because when the construction site personnel are aware of the problem, they are able to convey the instruction to the other personnel in charge immediately to ensure that the project is completed within the stipulated time. Ultimately, the respondents agreed on having the I.R 4.0 technologies implemented in their working environment to ensure the current technology will offer more benefits. In short, this research creates more prospects for new findings on issues related to mitigation in order to improve work performance.

In recent years, I.R 4.0 has led the way towards mitigating the problems in the construction project. It is clear that the evaluation of building design for compliance within the virtual world and building performance in the real world, called the performance gap, is substantially different. In dealing with this issue, private and government sectors will have to focus on educating the construction team on the importance of I.R 4.0 tools in construction projects.

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