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CHALLENGES AND OPPORTUNITIES TOWARDS INDUSTRIAL REVOLUTION 4.0 (IR 4.0) AMONG CONTRACTORS IN MALAYSIA CONSTRUCTION INDUSTRY

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Abstract*: Industrial Revolution 4.0 refers to an innovation to introduce a new concept of technologies with various potential advantages. The new concept of technology has been implemented in Malaysia and construction player such as contractor have their own perception towards the implementation. The aim of the study is to analyse the Malaysian contractors' perception on the future opportunities and challenges of IR 4.0 implementation. Hence, a comprehensive study is carried out with objectives to find out the opportunities and challenges towards the contractor in implementation IR 4.0 in construction industry. The selected respondents were from four grades of contractor in Selangor which are G4, G5, G6 and G7 Contractor. This quantitative approach uses questionnaire based on Likert Scale questionnaire. The data collected from questionnaire survey is processed and analysed by using Statistical Packages for Social Science (SPSS) version 22. The response rate is 14% which is 70 respondents out of 487 contractor G4 until G7 in Selangor. It was found that IR 4.0 in construction industry will be more challenges due to the nature of construction industry that are unpredictable, and the contractor is expected to be more competitive to face the challenges of IR 4.0. Besides, the finding shows that the opportunity of IR 4.0 offers contractors to work faster and be more strategic in planning the work programme of the project. Thus, the challenges and opportunities of IR 4.0 indeed. The results from this research can assist in producing a framework for the adoption of IR 4.0 among contractors for the construction in the future.*

Keywords*: Industrial Revolution 4.0 (IR 4.0), Contractors, Challenges & Opportunity, Construction Industry*

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Introduction

Industrial Revolution 4.0 (IR 4.0) is a phrase used to describe the developmental process of manufacturing management and production chain. IR 4.0 also indicates to a current phase in the Industrial Revolution that heavily focuses on real-time data, machine learning, automation and interconnectivity. The introduction of customised and flexible mass production technologies in IR 4.0 has taken the automation of manufacturing processes to a new level (Martin, 2017). The construction industry's potential of digitalisation may be categorised into four main groups which are digital data, digital access, automation, and connectivity (Wesam, 2008).

To erect elements of buildings, building components, and building furniture, robotic technologies have been merged with the construction industry, known as construction automation technologies (Bock, 2015). Industry 4.0 is expected to be able to enhance the quality and productivity of construction and attract local and global investors with the capability to automate both design and manufacturing processes as well as the ability to handle a diverse and substantial amount of data (Raihan, 2019).

IR 4.0 is practically initiated and will have a substantial effect on the future of construction industry and the growth describes into three criteria, (1) Digitalisation of production: method for data organisation and construction planning; (2) Automation: method for obtaining data from the construction site and further machines usage; (3) Connecting construction sites to the supply chain: comprehensive automatic information exchange (Wesam, 2008). In comparison to a numerous different industries, the construction industry has usually been late in the technological advancement (Wesam, 2008). For over the last twenty (20) years, research has revealed the construction industry failed to keep the momentum with productivity improvement seen in the manufacturing industry (Blayse, 2004). Therefore, the aim of this research is to investigate the perception of Malaysian contractors' on the future opportunities and challenges of IR 4.0 implementation.

The objectives of this research are to identify challenges of IR 4.0 among contractors and to investigate the opportunities of IR 4.0 among contractors in Malaysia construction industry.

Literature Review

The Challenges of IR 4.0 Among Contractors

Even though IR 4.0 is improving the construction industry, there are still a number of obstacles to overcome before it can be widely adopted by contractors. The difficulty encountered might be understood as a set of factors that hinder the contractor's ability to execute properly. Numerous studies have been conducted to determine the difficulties that contractors may encounter.

Risk Security issues is one of the challenges as such the new cybercrimes are typically triggered. The possibility of data being hacked or used it for malicious intent is now more prevalent when everything is connected (George, 2020). Besides, the security issues relating to privacy and data protection would represent a threat to construction companies as would data misuse and leaked information (Alaloul, 2020).

High in cost also issues to be considered. It is difficult to implement this new technology due to the uncertainty cost such as training and equipment maintenance (Alaloul, 2020). Many small

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contractors still prefer to use the conventional approach because they are unwilling to adopt with IBS system. The fact that small contractor is familiar with the new technology but reluctant to switch due to the lack of financial back up since the implementation need expensive capital (Kamar, 2009).

Technical challenges are another factor, the processes and standard must be revised and improved to fit with the construction environment. The skill to operate the technologies need to robust and improve to utilise the equipment (Alaloul, 2020). During execution stage variety of challenges relating to digital manufacturing, numerous technologies, management, standard etc. will be encountered.

Incompatibility factors also considered, the involvement of variety stakeholders show that the project is complex and unique. Unpredictable environment of a project defines the uncertainty that can lead to complication of the projects. The fragmented supply chain and short-term thinking of construction companies have limited capabilities the short-term nature of construction projects obstructs innovation. Construction industry is likewise renowned for its reluctant practices in adaptation (Alaloul, 2020).

Lack of incentive also factors to be considered. One major drawback of this approach is that the lack of incentives would also reduce the construction company's willingness to accept environmental development because the construction company does not obtain any incentives and funding. For small and medium-sized businesses that do not have adequate resources and do not receive incentives, sustainable development is impossible to be implemented. Therefore, even if the green construction is environmentally friendly and energy efficient, the development of sustainable construction would be discouraged due to lack of resources (Chin, 2020). The government did not provide comprehensive programme to encourage the transition and migration to IR 4.0. The implementation of IR 4.0 must provide funding and incentive to adopt BIM, IBS and green building technology (Wong, 2020).

The Opportunities of IR 4.0 Among Contractors

The advancement technology increases the number of evidence and research that proofing the various opportunities of industrial revolution 4.0. They offer the chances in implementing IR 4.0 in construction industry. Previous study has reported the opportunities of implementation IR 4.0 towards construction industry.

Increase in productivity has been identify since first three revolutions where the mechanical, electrical and information technology had produced and have been enhancing the productivity of business procedure (Min Xu, 2018). The initial revolution increase efficiency through the use of hydropower, bulk production introduced in second revolution and in third revolution enhanced automation through electronics and information technology (Wesam, 2008). This new technology concept decreases both product and construction delivery time also reduce labour cost and material cost. Through IR 4.0, construction industry performance can be improved. A concept from the industry called “smart” factory” allow human to monitor the process in real time without physical presence because the cloud computing and cognitive computing make decision and stores the data quality insurance will be increased since this system would ensure from little to no error (Alaloul, 2020). All the advantages listed above shows the new technology implementation can increase the productivity.

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Improvement of efficiency by the implementation of IR 4.0 l involve mechanised automation that will be interconnected through technological advancement to operate and share data information without the need of human intervention which lead to efficiency improvement (Space , 2020). Technically robot are automated motorised tools, and it can replace human to do some works and very benefit to reduce human error. It can do an efficient job since it can do a particular work by following the instruction given (Min Xu, 2018).

The global competitiveness among local construction companies can enhance their competitiveness with the most cutting-edge technologies to deliver upmost product quality and outcomes (Alaloul, 2020). The sustainability aspects can be promoted through the energy consumption reduction and to prevent pollution to the environment and the amount of waste produced also can be regulated (Space, 2020).

Research Methodology

This paper focused on the challenges of IR 4.0 among contractors and the opportunities associated with the IR 4.0 implementation. This study involves all contractors from grade G4, G5, G6 and G7 who have experience in construction industry. A set of questionnaires will be distributed to all listed contractor using random sampling method. The questionnaire was distributed at random to 487 according to the number of contractors G4, G5, G6, and G7 in Selangor from CIDB directory.

To collect quantitative data, a questionnaire survey with 26 questions is conducted. Furthermore, the study employs a 5-point Likert scale, with 1 being strongly disagree and 5 being strongly agree.

70 questionnaires were returned, for a total response rate of 14%. After numerous failed attempts at physical contact, follow-up emails, and phone calls, this response rate was ultimately attained. It is believed that the poor response rate is a result of respondents' attitudes, hectic schedules, and refusal to do the survey. There are varieties of reasons of why the low response rate happened, each situations have to be examined and the data still reliable (Joinson & Reips, 2007).

Findings And Discussions

Demographic analysis is the study of a population based on factors such as age, race, and gender. Demographic data in this study include the respondent's age and the number of projects involved.

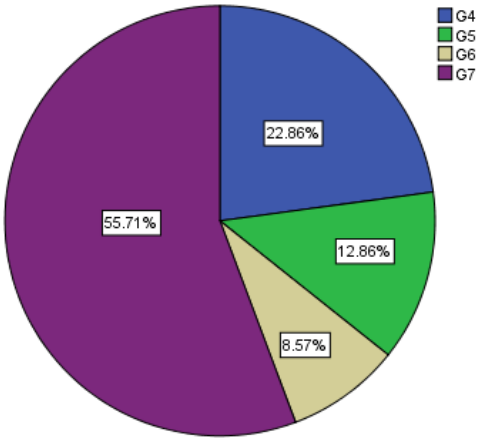

Figure 1: Grade of Contractor

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Figure1 shows the respondent's registration grade in Construction Industry Development Board (CIDB). The differences amount of contractor that were involve in this research depends on the number of questionnaire distribution to the contractor from G4, G5, G6 and G7. Most of the respondents from this research were from Contractor G7 (56%). Meanwhile, the lowest respondents were from Contractor G6 (9%). The distribution amount of the questionnaire was differ among the contractors grade and due to the bigger gap of number of contractor from G7 in Selangor which are the highest compared to G6 which can be seen as the lowest number among G4, G5, G6 and G7 in Selangor (Kementerian Kerja Raya, 2020).

Table 1: The Challenges of IR 4.0 among Contractors

Description	Mean	Std. deviation	Rank
SECURITY RISK			
Vulnerabilities to attack and data breaches driven by increased connectivity and data sharing	4.24	0.69	9
Large number of hackers attempting to gain access to the security system	4.09	0.65	11
HIGH COST			
More technology result in more maintenance cost	4.30	0.73	5
Lack of financial back up since the implementation need expensive capital	4.36	0.74	4
The wages will increase since the work require skilled worker to implement	4.21	0.80	10
INCOMPATIBILITY			
Unpredictable environment of a project define uncertainty that can lead to complication of the project.	5.07	6.09	1
Construction industry is known for its reluctant practices in adaption.	4.06	0.90	12
MISMATCH SKILLSET AND LACK OF KNOWLEDGE			
Lack knowledge on IR 4.0 among workers	4.37	0.71	3
Lack of experience and expertise to manage the usage of new technology	4.43	0.65	2
The shortage of skilled resources will lead to contractor lack of confidence to proceed	4.29	0.84	8
LACK OF INCENTIVE			
Contractor does not obtain any incentive or funding to implement the IR 4.0 technologies.	4.29	0.82	7
The development of sustainable construction would be discouraged due to lack of resources	4.29	0.73	6

Table 1 shows the rank of challenges among contractors in IR 4.0. The first three ranking will be explained. The first rank which calculated the highest mean 5.07 (SD 6.09) of the respondents agreed that the challenges of implementation IR 4.0 in construction industry because of the uncertainty can lead to complication of the project. The second rank of the challenges of IR 4.0 with mean 4.43 (SD 0.65) among contractor is lack of experience and expertise to adapt in the usage of the new technology. The third rank of the challenges with mean 4.37 (SD 0.71) is the lack of knowledge among construction workers.

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Next, the lowest three challenges are as follows. The 10th ranked of mean 4.21 (SD = 0.80) are the increment of wages in implementing IR 4.0 because it requires skilled worker. The 11th ranked of mean 4.09 (SD = 0.65) are large number of hackers will attempt to gain access to the security system. And finally, the lowest challenges are the rank 12 of mean 4.06 (SD =0.90) are the reluctant to adapt new technology in construction industry.

Table 2: The Opportunity of IR 4.0 among Contractors

Description	Mean	Std. deviation	Rank
INCREASE IN PRODUCTIVITY			
Allow contractor to monitor the process at site in real time without physical presence	4.29	0.70	4
Labor cost and material cost can be reduced while more output can be produced.	4.17	0.68	9
IMPROVE EFFICIENCY			
An automated motorised tools such as robot can replace human error	4.09	0.74	12
Allow remote monitoring for security, maintenance and deployment.	4.29	0.59	3
PROMOTES SUSTAINABILITY			
Reduce the waste produce at construction site and prevent pollution to the environment	4.27	0.72	5
GLOBAL COMPETITIVENESS			
Opportunity to the small construction company to enhance business into global	4.17	0.74	10
WORK DONE FASTER			
Allow contractors to finish the project before the estimation time (ie. using drone to monitor work progress)	4.17	0.76	11
BIM to use data from past projects to make estimation of cost in lesser time.	4.37	0.62	1
STRATEGIC PLANNING			
A simulation before commencement of work can provide a strategic planning	4.34	0.72	2
SMART DECISION			
Big data analysis helps for smart decision (big data from weather and traffic to determine optimal phasing of construction activities)	4.21	0.72	8
Sensor input from machine used on site show active and idle time to draw a conclusion buy or lease such equipment.	4.21	0.66	6
Big data from sensors built into buildings, bridges and any other construction makes it possible to monitor each one at many levels of performance.	4.21	0.70	7
SAFETY AND HEALTH			
Worker's location in the construction site can be detected by using Global Positioning System (GPS)	4.07	0.73	13
The usage of tools such as smart band that can detect workers pulse rate can help to monitor workers health	4.06	0.76	14

Based on the Table 2 , the first three highest rank are as follows; the first rank of mean 4.37 (SD =0.62) the opportunity of IR 4.0 among contractors in construction industry is BIM can retrieve data from past projects. The 2nd rank with mean 4.34 (SD=0.72) is the opportunity of simulation before commencement of work which provide a strategic planning. The 3rd rank with

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mean 4.29 (SD=0.59) allow remote monitoring for security, maintenance, and deployment among contractors.

The lowest three rank are as follows; rank twelfth with mean 4.09 (SD=0.74) is an automated motorised tools such as robot can replace human error. The 13th rank with mean 4.07 (SD=0.73) the worker's location in the construction site can be detected by using Global Positioning System (GPS) is an advantage among contractors. Finally, the least mean of 4.06 (SD=0.76) is the opportunity of the implementation IR 4.0 in construction industry is the usage of tools such as smart band that can detect workers pulse rate can help to monitor workers health. It might be ranked at last place due to the unfamiliarity to the tools.

Conclusions and Recommendations

Implementing IR 4.0 among contractors in Malaysia construction industry presents three main challenges of; uncertainty which lead to complication project, lack of experience and expertise to adapt in the usage of the new technology and lack of knowledge among construction workers. The main the opportunities that can be gained among contractors are BIM can retrieve data from past projects, simulation before commencement of work which provide a strategic planning and allow remote monitoring for security, maintenance, and deployment. Therefore, there are indeed challenges and opportunities can be achieved towards IR 4.0.

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