INDUSTRY 4.0 FOR THE SMALL AND MEDIUM-SIZED ENTERPRISES IN THE MALAYSIAN CONSTRUCTION INDUSTRY

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ABSTRACT

Industry 4.0 (IR 4.0) is becoming a trend in a plethora of sectors despite being used for the manufacturing industry. The concept has even attracted the attention of the construction sector yet despite that, the construction industry still favours conservative technology and is reluctant in incorporating new concepts into their practices. In order to adopt this concept for the construction industry, the main focuses should be placed upon the small and medium-sized enterprises (SMEs) since they act as a critical part in influencing the economy. Thus, the objectives of this paper are to determine the challenges faced by SMEs in adopting IR 4.0 in the Malaysian construction industry, propose the enablers of IR 4.0 for the Malaysian construction industry, investigate the readiness of SMEs in the Malaysian construction industry and identify the methods to successfully implement IR 4.0 for the construction SMEs. This study employed a survey questionnaire distributed amongst 380 local contractors and consultants around the Klang Valley and the collected data shall be analysed for descriptive statistics. The survey questionnaire had a 40.3% response rate and the results indicates that the main challenges in utilizing the IR 4.0 concept for the SMEs were the lack of financial resources, absence of a process change strategy and low experiences in utilizing skilled applications and technologies. The common enablers of IR 4.0 in the construction industry agreed by the respondents in the questionnaire were Building Information Modelling (BIM), modularization or prefabrication and augmented, virtual or mixed reality (AR/VR/MR). The readiness of the SMEs in implementing IR 4.0 were high in the aspects of modelling and simulation, prefabrication and having good access to internet. They agreed that having a regulatory framework and roadmaps for IR 4.0 adoption, doing necessary trainings to upskill and reskill, and strengthen the workforces' knowledge in regards to IR 4.0 were one of the ways to improve the success for implementing IR 4.0. The results from this research will help to produce a robust framework later to hasten the adoption of IR 4.0 for the SMEs in the construction sector.

Keywords: Construction Industry, Construction SMEs, Industry 4.0, IR 4.0

1. INTRODUCTION

The concept of Industry 4.0 (IR 4.0) has been a very favoured topic amongst multiple industries in recent literatures. It was first introduced by the German government back in 2011 to helped boosts its economy (Roblek et al., 2016; Vogel-Heuser & Hess, 2016). Various researchers had tried provide their own definitions of IR 4.0 from their studies over the years. According to Kolberg et al., (2016), IR 4.0 can be defined as "The vision of smart components and machines which are integrated into a common digital network based on the well-proven internet standards". Aside from that, it can also be considered as "The enclosing of smart products combined with physical and digital operations which interacts with one another across geographical and organizational borders." (Schmidt et al., 2015). In general, the concept revolves around the ideas of digitization, smart connections of components and the interaction of machines through a common network.

Various industries have demonstrated drastic development through the ongoing introduction of innovative technologies yet despite that, the construction industry is still very hesitant in incorporating it to their common practices (Alaloul et al., 2020). A survey made by Roland Berger (2016) determined that about 93% of construction

stakeholders are on the same page that working processes in construction can be greatly affected by the concept of digitization yet only a small number of construction firms are maximizing the full potential of digital planning tools which raises a concern for the construction industry in the pathway of achieving digital transformation in the future.

In order to overcome that, focuses should be placed amongst the small and medium-sized enterprises (SMEs) since they represent the majority of groups in the construction sector. Technologies such as Building Information Modelling (BIM) amongst the SMEs is pivotal in achieving digital transformation (Tezel et al., 2019). SMEs can also be considered as a crucial factor to competitivity in the economy. Masood & Sonntag (2020) mentioned that flexibility, competitive advantage, cost, quality and efficiency are the major key benefits for the adoption of IR 4.0 in SMEs. To fully apply and introduce IR 4.0 technologies to this enterprise dimension, special approaches must be created (Rojas et al., 2017). Hence, which is why there is a call for need to determine the ideal approach such as a formulation of a framework that can bring about the IR 4.0 concept within the construction industry and SMEs.

The objectives of this paper are to determine the challenges faced by SMEs in adopting IR 4.0 in the Malaysian construction industry, propose the enablers of IR 4.0 for the Malaysian construction industry, investigate the readiness of SMEs in the Malaysian construction industry and identify the methods to successfully implement IR 4.0 for the construction SMEs.

2. INDUSTRY 4.0 IN THE CONSTRUCTION INDUSTRY

A country's economic performance is greatly influence through the contribution of various sectors such as the construction industry. A report that was made by the World Economic Forum (2018) mentioned that the world gross domestic product (GDP) for the construction industry currently stands at around 6% and is expected to increase up to 14.7% by the year 2030 (Global Construction Perspectives & Oxford Economics, 2015). The construction industry in the European Union (EU) is responsible in providing around 18 million jobs to the people with the help from various stakeholders and companies and considered as an important sector for the economy (European Commission, 2016). A good study that was highlighted by the World Economic Forum is that even a slight boost of 1% in productivity can help save $100 billion every year in cost of construction (World Economic Forum, 2016). And not only that, it can also help in contributing to a country's value of competitiveness and sustainable development growth (Despotovic et al., 2016). In the report posted by the Department of Statistics Malaysia (DOSM), the value of construction work done in the third quarter 2019 contracted around 0.6% year-on-year basis, generating up to RM36.1 billion as compared to the second quarter which amounted up to RM35.9 billion (DOSM, 2019).

Despite the economic success, the perception of the construction industry is still quite conservative, highly reliant on low technology, having poor quality image and low performance (Al-Qutaifi et al., 2018). A survey conducted by the Scape Group (2016) about 'Sustainability in the Supply Chain' with various construction contractors and suppliers had determined that the major obstacle for a modernized construction industry was the lack of skilled workforce. Nowadays, technologies that were generally used for the manufacturing industry are slowly being introduced or integrated into the construction industry. However, compared to other industries, the construction sector has been very sluggish and reluctant in introducing these advanced technologies and is not used to major business transformation (Gerbert et al., 2016). The big reason on why it is challenging for the industry to adapt new technologies is due to the unique and complex nature of the construction sector itself. Construction companies hesitated to adopt new technologies because of the investments and uncertainty concerning the resulting benefits that lies behind it (Nassereddine, 2020). And not only that the existing technologies within the construction industry are apparent and accessible yet there is still a lack of concern and implementation of IR 4.0 amongst the current construction work trend (Alaloul et al., 2020)

The introduction of IR 4.0 is not something which is new to the construction industry. Some of these examples include intelligent machines, smart materials, digital technologies, sensor systems and a central repository for gathering digital information that is mostly being used nowadays called Building Information Modelling (BIM) (Craveiro et al., 2019). This breakthrough of IR 4.0 in the construction sector is a great indication that online digital access and big digital data can be beneficial for the construction digitization and can be used automatically into the value chain in terms of electronic data gathering and processing (Alaloul et al., 2018). An ideal conceptual term that defines the integration of IR 4.0 and the construction industry is called Construction 4.0. Firstly introduced by Roland Berger (2016), it can be defined as the digitization of the construction industry based on four major aspects of digital access, automation, digital data and connectivity. However, since there is no official definition and different notions given by various researchers regarding the Construction 4.0 concept, the term will not be used for this research.

Technologies that can be apply in the IR 4.0 dimensions could be a key enabler for its implementation in the construction industry. A conceptual matrix was created by Oesterreich & Teuteberg (2016) where they categorized technologies of IR 4.0 in the construction sector into three (3) parts which were simulation and modelling, digitization and virtualization and last but not least, smart factory. Technologies such as cyber physical systems (CPS) can help smoothen the coordination between the real physical construction and virtual models in smart factory (Akanmu & Anumba, 2015). In terms of simulation and modelling, a shift will need to be made from automated production to advanced digitization to transform the industry towards the fourth industrial revolution and one of the simple method in achieving it is through the BIM system (García et al., 2017). This system combines the information of the physical and virtual structure and help stakeholders to work as close as possible in real time regardless of the locations for their projects (Birje et al., 2017). Cloud computing plays a significant role alongside the BIM system too (Tang et al., 2019). The majority of the construction industry companies are made up of SMEs and because of this, it hinders their capabilities to invest in advanced technologies. To overcome this issue, most SMEs will have to rely on the assistance from governing bodies and authorities through partnership and funding programs to help with the IR 4.0 implementation (Alaloul et al., 2020).

In Malaysia, the topic of IR 4.0 in relation to the construction industry is becoming somewhat popular. One of studies that focuses on the digitization and the advancement of technologies in the Malaysian construction industry is by Yap et al. (2021) which is an empirical study paper that explores about the safety enablers of construction projects using advanced technologies such as BIM, unmanned aerial vehicles, VR, AR, 3D laser scanning and digital signage. Another study that dives into this topic as well is by Abdul Halim et al. (2021) in which they tried to investigate the level of attitude, barriers, readiness and awareness of the construction industry players in East Coast Malaysia specifically Kelantan towards Internet of Things (IoT). IoT is considered as a major key concepts of IR 4.0 and defined as an intelligent network that is connected to the Internet and capable of connecting, detecting and controlling physical devices for communication and information exchange (Kumar et al., 2019). However, this research only focuses on the large sized construction companies as compared to the SMEs. This signifies a lack of attention given towards the SMEs and there is still a low amount of study or publications being made on the subject of IR 4.0 within the construction industry SMEs in Malaysia.

An evaluation tool such as a readiness assessment can be used to analyse and identify the degree of preparation of a company based on their attitudes, resources, and conditions in achieving the company's goals (Benedict et al., 2017). This readiness assessment tool can be used as an instrument in measuring the preparedness of the SMEs in achieving IR 4.0. Schumacher et al., (2016) suggest a maturity index that puts their attention on different organizational aspects that were collected from quantitative and qualitative process in their study. The key areas that should be focused on are strategy, customers, operations, people, technology, leadership, products, culture and governance.

3. SMEs IN THE CONSTRUCTION INDUSTRY

SMEs are considered to be an efficient engine of growth since they contributed a lot towards job opportunities and economic development (Arthur-Aidoo et al., 2015). The definition of SMEs can be categorized through various aspects such as capital assets, labour skills, turnover level, method of production and legal status. Several literatures regarding SMEs usually defines them based on two characteristics which are the number of employees and or the firm's fixed assets which is in line with their function. A good thing to take note as well is that there is no accepted standard definition of SMEs and they are highly dependent upon the industries and countries (Matt & Rauch, 2020).

Around 99% of businesses in the EU consist of SMEs and the European Commission defined them by taking into consideration the following three aspects whereby the first one is the annual balance sheet, the number of staff and finally the amount of annual turnover (European Commission, 2015). Micro, small and medium-sized enterprises normally have fewer than 250 working units, have an annual balance sheet total of less than EUR 43 million and an annual turnover less than EUR 50 million. Table 1 shows the comparison between micro, small or medium-sized enterprises.

Table 1: SMEs thresholds

Size of Enterprise	Annual work unit	Annual turnover		Annual balance sheet total
Micro	< 10	≤ EUR 2 million	**or**	≤ EUR 2 million
Small	< 50	≤ EUR 10 million		≤ EUR 10 million
Medium	< 250	≤ EUR 50 million		≤ EUR 43 million

Source: European Commission, 2015

In Malaysia, construction SMEs can be defined as an enterprise that has a tendering capacity less than RM 5 million and a paid-up capital which is less than RM 250,000 according to Construction Industry Development Board (CIDB, 2018). The paid up capital and tendering capacity are used by CIDB in categorizing the grade of contractors from G1 until G7. Therefore, it can be said that for SMEs, it can be graded from G1 until G5 grade of contractors. Table 2 shows the contractors' grades of registration which has been suggested by CIDB.

Table 2: Contractor's registration grade by CIDB

Registration grades of contractor	Capacity of tendering	Paid up capital	Company's size
G7	No limit	RM 750,000	Large construction company
G6	Not exceeding RM 10 million	RM 500,000	
G5	Not exceeding RM 5 million	RM 250,000	Medium size construction company
G4	Not exceeding RM 3 million	RM 150,000	
G3	Not exceeding RM 1 million	RM 50,000	Small size construction company
G2	Not exceeding RM 500,000	RM 25,000	
G1	Not exceeding RM 200,000	RM 5,000	

Source: CIDB, 2018

A study by Sexton & Barrett (2003) concluded that organizations which are small in size will normally encounter four characteristics and challenges. The first one is the capability and capacity limitation of staff that may hinders the company's ability to undergo through necessary R&D. Second, is the limitation for external interaction in terms of time and resources that can slow down the movement of information within the company while the third issue is the high chances using incorrect skills and strategies from a single owner or small team. And the last one is having a hard time in maintaining an adequate cash flow. This can cause a limited scope for capital or disrupt the ongoing investment in innovation activity. In order to move digitization forward, challenges need to be addressed amongst the SMEs in order to ensure a successful implementation of IR 4.0 in the construction sector.

4. METHODOLOGY

This study employed a survey questionnaire research method to obtain its quantitative data. The survey questionnaire was distributed amongst the registered local G1, G2, G3, G4 and G5 contractors and consultants around the Klang Valley. Klang Valley was selected for this research due to the high level of growth and development (IQI Global, 2018). Contractors and consultants were chosen for this research since they are categorized as primary stakeholders in a construction project (Elnaz et al., 2019) and hold a power position in a construction project development (Jin et al., 2017). The contractors for this study were obtained from the Centralized Information Management System (CIMS) in the CIDB website. As for the consultants on the other hand were selected based on the Board of Engineers Malaysia (BEM) registration directory link in their website. A stratified sampling was used to determine the sample for this research and a pilot study was conducted prior to the main data collection. Stratified sampling was chosen in order to reduce biases in the sample (Sharma, 2017) and allow a high representation of every subgroup of G1, G2, G3, G4 and G5 contractors and consultants. A study performed by Abdul Malik & Adeleke (2020) displayed a good usage of stratified sampling in determining the relationship between material risk and organizational culture among registered G7 contractors around Kuantan, Malaysia. Another display of stratified sampling in the construction environment was conducted by Othman et al. (2021) to determine its sample amongst client, consultant, and contractor in Egypt in regards to the topic of value management implementation.

The questionnaire consists of five sections in which the first section, consists of the general background information of the respondents, such as designation, specialization, years of working experiences and the contractor's grade. The second section will ask about what they thought about the challenges of implementing IR 4.0 in the construction industry SMEs, the third section discusses about the enablers of IR 4.0, the fourth section examines the readiness of the construction industry SMEs for IR 4.0 and the last section asked about the method to improve the implementation of IR 4.0. Each item in each section in the questionnaire were obtained from early literature review. Table 3 shows the number of registered contractors and consultants used for the primary data collection.

Table 3: Registered local contractors & consultants in Klang Valley

Contractor's Grade	***Total number registered under CIDB***
G1	5115
G2	4170
G3	4370
G4	1379
G5	1723
Local consultants	**Total number registered under BEM**
Body corporate	833
Partnership	95
Sole proprietorship	937
TOTAL	**18,622**

Source: Accessed from the CIDB website on the 27th July 2020

Based on Table 3 above, the feasible number of sample sizes from the overall population of 18,622 were somewhere around 375 to 377 using the Krejcie's Table (Krejcie & Morgan, 1970). A 5-point Likert scale of 1 to 5 was used as an indicator for the respondents' responses to each question. The value 5 represents the highest degree such as very high, strongly agree, and most important while the value 1 represents the lowest degree such as never, strongly disagree, and least important. A 5-point Likert scale system was introduced for this research since the existence of a midpoint in the scale allows an indifferent opinion from the respondents and ease the statistical analysis process later on (Chyung et al., 2017). Statistical Package for the Social Sciences (SPSS) version 27 was used in analysing the collected quantitative data for descriptive statistics.

5. RESULT

The amount of responded questionnaires were about 153 out of 380 which represents a 40.3% response rate. There is currently no consensus on the acceptable level of response rate for a survey (Sataloff & Vontela, 2021) but an ideal range should be somewhere between 40% t0 75% amongst all field researches (Reinisch et al., 2016; Story & Tait, 2019) thus the response rate for this study can be considered as acceptable. The results were tabulated and ranked accordingly with their ranking based on the mean value except for the first section whereby it only displays the respondent's background information. Table 4 below shows the overall respondent's background information.

Table 4: Respondents' information

		Frequency	*Percentage (%)*
Designation	Architect	19	12.4
	Quantity Surveyor	45	29.4
	Engineer	57	37.3
	Project Manager	32	20.9
Specialization	Residential	29	19.0
	Industrial	43	28.1
	Heavy Construction	24	15.7
	Commercial	42	27.5
	Highway Construction	15	9.80

Years of Experience	< 2 years	30	19.6
	3 – 6 years	48	31.4
	7 – 10 years	29	19.0
	> 10 years	46	30.1
Contractors' Grade	G1	31	20.3
	G2	19	12.4
	G3	41	26.8
	G4	15	9.80
	G5	28	18.3
	Consultants	19	12.4

The second section of the questionnaire discussed about the challenges that could possibly be faced by the SMEs in implementing IR 4.0 in their practices. Introducing a new foreign concept such as IR 4.0 does come with its unique challenges and it is important to explore on each factor that may slow down or hinder the execution of it in the construction industry. Identifying the critical challenges that exist may provide the answers to facilitate the implementation and assist in the formulation of a good framework. The result of it was displayed in Table 5 below.

Table 5: Challenges faced by Malaysian construction industry SMEs in adopting IR 4.0

Rank	***Challenges faced by Malaysian construction industry SMEs in adopting IR 4.0***	***Mean***
1.	Shortage of financial resources	4.14
2.	Absence of an ideal process change strategy	4.08
3.	Not used to utilizing highly skilled applications and technologies	3.99
4.	Concerns of cyber security, the crimes of hacking and risk assessment	3.96
5.	Lack of a skilled workforce	3.94
6.	Lack of awareness	3.89
7.	Low degree of standardization and legislation	3.88
8.	The possibilities of inequality of labour markets in all sectors	3.86
9.	The uncertainties and profitability that exist in the tendering systems	3.80
10.	Lack of understanding of integration and systems architecture	3.78
11.	Organizational resistance	3.76
12.	The differences that exist between the manufacturing and construction industry	3.73
13.	Unwillingness to invest in the latest technology	3.73

The third section of the questionnaire asked about the respondents' opinion on whether these technologies and applications may facilitate and become the enablers for the adoption of IR 4.0 for the construction SMEs. This part of the questionnaire will help to pinpoint out the crucial enablers that will help to assist the SMEs in the implementation of IR 4.0. The result was presented in Table 6 below.

Table 6: IR 4.0 enablers in the Malaysia construction industry

Rank	***Enablers of IR 4.0 for the construction industry in Malaysia***	***Mean***
1.	Building Information Modelling (BIM)	4.28
2.	Modularization/Prefabrication	4.05
3.	Augmented/Virtual/Mixed Reality (AR/VR/MR)	3.95
4.	Cyber-Physical systems (CPS)	3.90
5.	Cloud Computing	3.89
6.	Product-Lifecycle Management (PLM)	3.86
7.	Mobile Computing	3.85
8.	Internet of Things (IoT)/Internet of Services (IoS)	3.84
9.	3D printing/Additive manufacturing	3.82
10.	Energy Construction Simulations	3.79
11.	High Performance Computing	3.76
12.	Adaptive Building System	3.75
13.	Smart Home (AI Assistants)	3.71

14.	Big Data Analytics (Deep Learning)	3.65
15.	Data Driven Generative Design	3.65
16.	Big Data Analytics	3.65
17.	Embedded sensors/Radio-Frequency Identification (RFID)	3.65
18.	Human-Computer Interaction (HCI)	3.64
19.	Robotics and Automation	3.56
20.	Autonomous Robots	3.47

The fourth section asked about the readiness of the construction industry SMEs in preparing for IR 4.0. Having a proper knowledge on the current environment and technological structure of the SMEs can provide a good insight on the aspects that needs to be improved and ensuring a smooth transition of IR 4.0. The results were highlighted in Table 7 below.

Table 7: Readiness of Malaysian construction industry SMEs in adopting IR 4.0

Rank	***Readiness of Malaysian construction industry SMEs in adopting IR 4.0***	***Mean***
1.	Modelling and simulation e.g (AutoCAD, BIM)	3.40
2.	Access to internet	3.29
3.	Modularization/Prefabrication	3.03
4.	Skill development	3.03
5.	Openness of employees to new technology	2.99
6.	Digitization of sales and services	2.98
7.	ICT competences of employees	2.93
8.	Customer's digital satisfaction	2.91
9.	Information sharing e.g (Cloud Computing)	2.90
10.	Autonomy of employees	2.90
11.	Suitability of technological standards	2.90
12.	Existence of modern ICT	2.90
13.	Utilization of mobile devices	2.89
14.	Utilization of social media	2.88
15.	Implement KPIs with focus on digital innovation	2.88
16.	Information and Communication Technologies (ICT) value	2.88
17.	Knowledge sharing	2.86
18.	Employee's mobilization to digital innovation projects	2.86
19.	Operations data collection	2.86
20.	Cybersecurity e.g (IT and data security)	2.84
21.	Product digitization	2.79
22.	Operations data usage	2.78
23.	Risk management	2.78
24.	Digital media competence of customer	2.76
25.	Protection of intellectual property	2.73
26.	Individualization of products e.g (Personalization)	2.71
27.	Management of (digital) competences and methods	2.70
28.	Utilization of customer data e.g (Analytics)	2.68
29.	Interdisciplinary and interdepartmental collaboration	2.67
30.	Resources availability for digitization and smart construction	2.63
31.	Collaborative partnership with governing bodies and authorities	2.61
32.	Decentralization of processes	2.61
33.	Open innovation and cross company collaboration	2.58
34.	Willingness of leaders to embrace IR 4.0 paradigm	2.58
35.	Adaption of business model(s)	2.58
36.	Investment in IR 4.0 technologies	2.56
37.	The integration of product into other systems e.g (Smart building)	2.56
38.	Top management skills for IR 4.0	2.52

39.	Utilization of machine-to-machine (M2M) communication	2.45
40.	IR 4.0 strategic requirements	2.37
41.	Implementing an IR 4.0 road map	2.33
42.	Labour regulations for IR 4.0	2.33
43.	Regulatory framework and adoption for IR 4.0	2.29
44.	Central coordination for IR 4.0 strategy	2.29

The final section of the questionnaire asked about the necessary steps to successfully implement IR 4.0 for the SMEs. The respondent's response from this section can greatly help in providing their opinion on how to overcome the challenges that exist during the IR 4.0 implementation and set a baseline on which part that should be focus on in order to guide them throughout the shifting process. Table 8 below showed the results given from the respondents.

Table 8: Methods to improve the implementation IR 4.0 for the SMES in the Malaysian construction industry

Rank	***Methods to improve the implementation of IR 4.0 for the Malaysian construction industry SMEs***	***Mean***
1.	Regulatory framework and adoption of IR 4.0 in the company	4.24
2.	Provide roadmaps for the IR 4.0 adoption	4.19
3.	Enhancement of workforce's knowledge and re-skill, up-skill training	4.16
4.	Formulate a national policy of IR 4.0 that focuses on the construction industry	4.16
5.	Have a clear written change strategy	4.12
6.	Create fund for internet access and adoption of new IR 4.0 technologies	4.10
7.	Provide tax incentives and subsidies to companies that adopt IR 4.0	4.10
8.	Internal issues such as digital culture, organisation, leadership towards IR 4.0	4.08
9.	Good access to digital infrastructure, internet, and platforms	4.08
10.	Collaboration with government and experts for SMEs transformation	4.06
11.	Developing a digitization network and IR 4.0 business advisors for SMEs	4.05
12.	Provide good practices internet usage and advance IR 4.0 technologies	4.05
13.	Developing formal training curricula for IR 4.0	4.04
14.	Provide companies and future staff members good access to advanced technologies relevant to IR 4.0	4.04
15.	Facilitate access to funding support and programs to motivate SMEs	4.03
16.	Create platform for SMEs to learn from successful IR 4.0 implementation	4.03
17.	Vocational training in IR 4.0 relevant technologies	4.03
18.	Combining practical and academic education	4.03
19.	Collaboration with academic institutions to raise awareness and benefits of IR 4.0	4.03
20.	Funding highly qualified experts at SMEs	4.02
21.	Mobilizing for digitization and IR 4.0 for the company	4.01
22.	Offer digital innovation consultancy services/coaching support to SMEs	4.01
23.	Increase level of standardization and legislation	3.99
24.	Personalize the consulting support to SMEs needs that prioritizes on business impact	3.99
25.	Provide learning experiences for SMEs	3.98
26.	Skill development on operational and strategic levels to be prepared with IR 4.0	3.98
27.	Removing issues related to data security and data protection/cybersecurity	3.97
28.	Awareness creation for SMEs to become IR 4.0 ready	3.97
29.	Display SMEs digitization successes in education and research	3.97
30.	Provide mentorship to increase the readiness for IR 4.0	3.97
31.	Good talent management	3.95
32.	Encourage staff to contribute to digital innovation projects	3.95

33.	Collaborate on digital innovation projects with large companies e.g (G6 & G7 contractors)	3.80
34.	Online training platforms/workshops	3.78
35.	Sponsor digital innovation awards and hubs	3.73

6. DISCUSSION

According to Alaloul et al. (2020), the inexistent of a changing strategy can hinder or slow down the progression of IR 4.0 in the construction sector. Based from the questionnaire results, the low amount of financial resources provided to the SMEs can potentially discouraged SMEs from utilizing new innovative technologies. Schröder (2016) mentioned that there exists a crucial relationship between how IR 4.0 is implemented and the size of the company it is being done upon. Large companies have an added advantage such as they are much more advanced in the application of their production plants and IT systems as compared to the small and medium-sized companies. Lack of knowledge in handling new technologies was also found to be the main challenges of adopting IR 4.0 (Vrchota et al., 2019).

A study made by (García de Soto et al., 2019) found that productivity seemed to be at a higher pace when using robotic construction method as compared to the conventional method of constructing walls. This signifies that there is a possibility of significant economic benefit from the usage of additive digital fabrication in construction. From Table 6 above, most of the enablers are very common to the usage of the construction nowadays such as BIM and prefabrication. BIM is specifically useful during for monitoring cause it gives better understanding environmental conditions and also an effective process for design evaluation and construction (Habibi, 2017). Several studies also suggested that the usage of mobile technology can assist in capturing real time information on-site personnel in construction (Igwe et al., 2021; Núñez et al., 2018; Osunsanmi et al., 2020). Real time collaborative work amongst the project designer and other members can be executed regardless of the location and virtual meeting can also be hosted through cloud computing technology (Bello et al., 2021). Although there is a huge opportunities for mobile technologies in construction yet many other SMEs still haven't discovered or fully grasped its practicality and competitiveness it brings to the industry (Sattineni & Schmidt, 2015).

There are four significant keys to digital transformation and they are digital data, automation, connectivity and digital access (Roland Berger, 2016). Based on Table 7 of the results, it mentioned accessibility to internet, digitization of sales and services, information sharing and openness to new technology as one of the top ten aspects in regards to the readiness of the SMEs in preparing for the implementation of IR 4.0 which signifies a positive sign that they are aware of the concept of embracing connectivity and the importance of digital transformation for the businesses. The nature of the construction industry is inherently complex thus a transformation is proven to be essential in order to move forward and align with the current need of the construction industry.

The need for a regulatory framework, roadmaps and adoption of IR 4.0 and provide training to enhance the workforce's knowledge for IR 4.0 were found to be the top ways on how to adopt it to the company. Chladkova & Formankova (2016) mentioned that a well-defined strategy greatly helps in influencing the implementation of IR 4.0 into SMEs. A study by Agostini & Nosella (2020) showed that there is a positive and significant impacts for the SMEs from strong management support for the IR 4.0 technologies adoption. Different approaches such as talent management could become a determining factor in implementing IR 4.0 (Vrchota et al., 2019). The involvement of the government is also significant during the whole implementation of IR 4.0 since the respondents were very concerned about the policy that revolves around it. Aside from that, there is also the concern of incentives or monetary assistance for the SMEs in order to adapt to the digitization process.

In terms of study limitation, this research only covers the quantitative aspects of the data through a survey, which is subjective in nature and only focuses around the Klang Valley area. Future studies can suggest a sit-down or face to face interview with the respondents which may bring a more genuine response or concerns from the questions provided in the questionnaire and cover another part of the state such as East Malaysia. Hence, it can bring a more robust data and be presented in a systematic manner. Validation from the experts of IR 4.0 from all aspects of the construction can also assist in ascertaining and verifying the results provided. The findings from Malaysia in this research can also be used as a comparison with other regional countries such as Singapore or Thailand.

7. CONCLUSION

The concept of IR 4.0 has been a very popular topics amongst multiple industries in recent years and due to this increasing demand, there is a need to fully grasp the benefits of applying it in the construction industry since it showed huge potentials. Challenges such as the lack of financial resources and absence of a process change strategy may slow down the implementation efforts and not only that, utilization of new innovative technologies may require trainings especially for the SMEs. Several technologies have already had its placed in the industry now yet many others such as robotic and automation needs more exposure for the SMEs. Another thing that should be taken note as well is that management in the organization context plays a huge role in ensuring that the implementation could be a success (Agostini & Filippini, 2019). The sizes of the company can affect how the adoption is going to be executed since the nature of the firms varies between small/medium and large sized enterprises (Schröder, 2016). Supports from the government and CIDB are also significant in ensuring that the adoption can be realized such as the existence of a change strategy or making an IR 4.0 policy that prioritizes the construction industry SMEs. Hosting online trainings or webinars for the SMEs were also proven to be an effective approach to promote IR 4.0 too nowadays. The results from this research can assist in producing a framework for the adoption of IR 4.0 for the construction SMEs in the future.

8. ACKNOWLEDGEMENT

This research was supported by a fundamental grant scheme (FRGS/1/2019/SSI11/UITM/02/10) funded by the Ministry of Higher Education Malaysia (MoHE).

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