SERIES 2

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Industry Revolution 4.0: A Study on the Readiness & Challenges in Construction Industry in Kuching Sarawak

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ABSTRACT

Fourth Industrial Revolution (4IR) has created a paradigm shift and shaped industrial sectors towards digital transformations. 4IR will bring fundamental changes in the way people live and work, and the interrelation between both. Changes in construction can only be triggered by the openness of practitioners towards emerging technologies. Being open to emerging technologies is a key that will assist in overcoming the challenges faced today and in the future. Transformational technologies, such as artificial intelligence, Building Information Modelling (BIM), Internet of Things (IoT), big data, drone and robotics, have and will continue to drive major changes for the construction industry, and beyond. This paper will focus on the readiness and challenges from workforce perspective towards the adoption of 4IR in construction industry. This is pertaining to government agenda in the latest National 4IR Policy (2021) which is to equip future workforce with 4IR skill sets and to transform semi- and low-skilled labour to highly skilled labour by 2030. The targeted sampling is the construction industry professionals within the district of Kuching, Sarawak. Quantitative approach was employed for this study and questionnaire has been used as research instrument to gather feedbacks from respondents. Findings indicate that the level of readiness towards adopting 4IR in construction industry is generally moderate. Generally, the adoption of 4IR is still at early stage. Looking into the challenges in adoption of 4IR, data suggest that training is highly in need to acquire new skillset. As 4IR transforms sectors and industries, the skills demanded for the workforce will also change. The technological adoption to construction processes requires the future workforce to be equipped and ready with new skills to enable them to adapt to the changing industry environment.

Key Words: Fourth Industrial Revolution, Construction 4.0, disruptive technology, construction industry

1. INTRODUCTION

The world is currently amidst a technological transformation of fourth industrial revolution (4IR) that will fundamentally change the way people live and works. Spread of the digitalization has the potential to transform the whole industry including engineering and construction industry. The construction industry is crucial to the Malaysian economy and its growth. It is one of the main catalysts that contributed dynamically to the Malaysian Gross Domestic Product (GDP), with more than 196 other industries relying on it for their growth and sustainability as well as providing significant employment opportunities (CIDB, 2020). Productivity increment can happen in many different ways, including deploying the latest technologies, such as of the use of scrum techniques or the use of robots to replace onsite labours (Chen et al., 2018). However, changes in construction can only be triggered by the openness of practitioners towards emerging technologies. Being open to emerging technologies is a key that will assist in overcoming the challenges faced today and in the future. Ortiz et al. (2009) stated that the construction industry lags significantly behind other industries in terms of the automation of processes and the level of digitalization. However, in recent years, driven by the pressure to improve productivity, reduce costs, improve safety and increase sustainability, there is growing momentum to introduce new technologies into

the construction industry (Loosemore, 2014). This paper will focus on the readiness and challenges from workforce perspective towards the adoption of 4IR in construction industry. This is pertaining to government agenda in the latest National 4IR Policy (2021) which is to equip future workforce with 4IR skill sets and to transform semi- and low-skilled labour to highly skilled labour by 2030.

2. LITERATURE REVIEW

2.1 Industry Revolution 4.0

According to MITI (2018), the first industrial revolution started with the advent of steam and water power, enabling mechanisation of production processes, while the second industrial revolution was driven by electric power and mass manufacturing techniques. Information technology and automation brought in the third industrial revolution. Fourth industrial revolution is exploding on the back of a range of technologies that are blurring the distinction among physical, digital and biological spaces. In addition, Fonseca et al. (2018) conclude that fourth industrial revolution will take the industry to the next level, where machines will redefine themselves in the way they communicate and perform individual functions. Fraunhofer Institute conducted a study in 2013 to review the potential for growth and expansion of companies using IR4.0 technologies. The findings of the survey indicated five main technologies areas that affect this growth. These include embedded systems, strong networks, IT security, smart factories, and cloud computing (Nagy et al., 2018). A similar study by (R¨ußmann et al., 2015), established nine technologies that will mark complete transformation into the industry 4.0. These included automated robots, integrated horizontal and vertical systems, cyber security, 3D printing (additive production), big data analysis, simulation, industrial IoT, cloud-based services, and augmented reality. Most organizations will demand upgrading of some platforms on quality management systems (QMS) and supply chain to convert the industry into a smart factory that will have the capacity of meeting the requirements of the sector 4.0.

2.2 Human Capital for Industry Revolution 4.0

The global economy is being fundamentally transformed by breakthroughs in technology, cutting across the physical, digital and biological worlds. Emerging technologies such as automation, robotics, artificial intelligence (AI), machine to machine (M2M) and the internet of things (IoT), are changing the way the world operates. Referring to National 4IR Policy (2018), the process of cultivating human resources, nurturing capacities and skills to serve the goals of society, is the very essence of societal development. Regardless of the technology a nation might create, the ability to capitalise or squander this knowhow, depends on the quality of its human capital as the instrument of development (MITI, 2018). The National 4IR Policy focuses on 10 key sectors, along with six supporting sectors as in Figure 1. The selection of key focus sectors is based on their contribution to the GDP, as well as their role to influence the growth of other sectors. The application of 4IR technologies in these sectors is anticipated to create the highest impact on the nation.

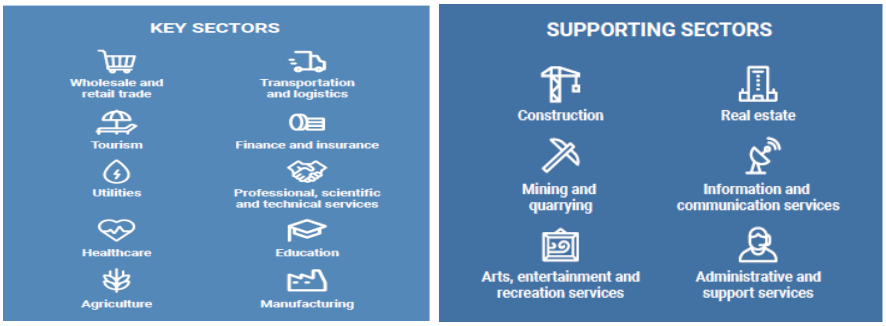

Figure 1: Key focus sectors of the National 4IR Policy

Findings by Mohd Rahim et al. (2016) shows that construction is a labor-intensive industry and having shortage of skilled labor. Hence, a cultural shift is vital for successful implementation of the

industry 4.0. The change in cultural practices calls for additional investment in both people and change management (Shamim et al., 2016). The staff hiring process on industry 4.0 setting should be based on competence, skills, and heterogeneity of knowledge (Prieto and P´erez-Santana, 2014). Competency frameworks, incorporating redesigned jobs, and new roles and skills, are also needed to provide the necessary information to guide the development of a highly skilled talent pool. This will enable industries to adopt and harness 4IR technologies to uplift productivity and competitiveness.

2.3 Construction 4.0

Construction 4.0 is defined as the process to implement modern technology in order to encourage the digitisation of the construction industry and its supply chain. Significant to the situation, Construction 4.0 Strategic Plan 2021-2025 is a roadmap for the Malaysian Construction Industry to embrace the 4IR in ways that would transform its productivity and competitiveness (CIDB, 2020). The implementation of the Construction Strategy Plan 4.0 will be driven by 4 enablers which are people, integrated technologies, economy and governance. The future of the construction industry will be highly dependent on the adaptation of new technologies and innovations as in Figure 2. Alaloul et al., (2018) and Maskuriy et al., (2019) stated that revolution in the engineering and construction industry was largely catalyzed by innovations and technology with the aid of AutoCAD, Building Information Modelling (BIM), Enterprise Resource Planning (ERP), cloud solutions, analytics, drones, and hand-held tech. Essentially, the industry's revolution is its version of Industry 4.0, a move toward greater digitization while many new technologies and equipment's like prefabrication, automation, 3D printing, virtual reality, drones, sensors and mainly robots are used to help the industry understand better the industry process almost in real time.

Figure 2: 12 emerging technologies in construction

3. METHODOLOGY

3.1 Research Design

This study addresses the readiness and challenges from workforce perspective towards the adoption of 4IR in construction industry. The targeted group is the construction industry professionals within the district of Kuching, Sarawak, specifically G7 contractors who are likely to involve with prefabrication and use more advanced construction-related technology. Quantitative approach was employed for this study and questionnaire has been used as research instrument to gather feedbacks from respondents. The questionnaire is divided into three (3) sections. Section A requires the demographic profile of the respondents such as position and year of working experience. Section B consists of the statements on readiness while Section C address challenges towards the adoption of 4IR in construction industry. Due to the alarming COVID-19 risk, businesses were under strict standard operating procedure (SOP) therefore questionnaires were distributed using Google form. Various communication platform is used to reach out to respondents such as through phone, email and shared link. 54 questionnaires were returned to researcher and be used for the data analysis. The measurement on statements related to readiness and challenges towards the adoption of 4IR in construction industry use Likert Scale from scale 1(strongly disagree) to 5 (strongly agree) for respondents to choose indicating their opinions.

3.2 Reliability Test

Reliability is concerned with the ability of an instrument to measure consistently. Pilot study has been conducted with 25 samples (presented in Table 1) and result from reliability test shows that Cronbach's alpha value of 0.804 for items under Section B and C exceeds the minimum standard of 0.70 (α>0.70) as recommended by Nunnally JC (1978). This indicates that the value is acceptable and reliable for measuring the variable under study.

Table 1 Reliability Statistics

Cronbach's Alpha	Sample, N	Quantity of Items
0.804	25	15

4. RESULT AND DISCUSSION

Findings from the questionnaire were analysed using Statistical Package for the Social Science software. Gathered data was computed in a form of percentage and weighted mean of responses to interpret the feedbacks from the respondents.

4.1 Demographic Information

Information on respondents' background were collected for work position and years of working experience. For Section A, data shows that majority of respondents which is 40.7% work as project engineer, 27% are site supervisor and management team makes up the balance percentage. 50% of them been working for less than 5 years, 37% working in a duration of 5 to 10 years while the remaining small group of 13% has been working for 11 years or more.

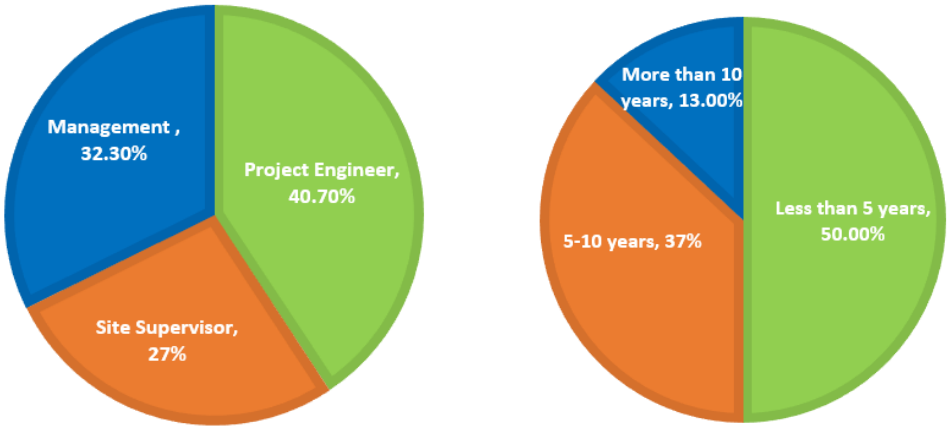

Figure 2: Demographic profile of respondents

4.2 Readiness and Challenges towards the adoption of 4IR in construction industry

Section B comprises of 10 items that are developed to identify readiness while Section C comprises of 5 items which has been developed to identify challenges towards the adoption of 4IR in construction industry. Likert Scale from scale 1(strongly disagree) to 5 (strongly agree) is used to indicate respondent's feedback and Table 2 shows the verbal interpretation of the mean ratings as recommended by Riduwan (2012).

Table 2 Interpretation of Mean Score

Mean Score	Interpretation
1.00-2.40	Low
2.41-3.80	Moderate
3.81-5.00	High

(Source: Wiersma William, 1995)

(a) Analysis on technology readiness towards the adoption of 4IR in construction industry

According to findings from Table 3, feedback from respondents show that the use of technologies is ranging between low to moderate level. Highest mean score 3.66 is obtained for the use of software application such as Primavera and Microsoft Project in scheduling project activities. Item B2, B8 and B9 show low mean score respectively for the use of 3D printing hardware, autonomous robot and simulation in the construction industry. The usage of autonomous robot has the lowest mean score which show disagreement to the given statement. Building Information Modelling (BIM) has multiple benefit such as reduces planning faults, provide fast calculations, quantifies further costs and displays replacements (F. Khosrowshahi et al, 2012). Hence, the adoption indicates moderate level with mean score of 3.06. BIM with its various digital tools and practices can significantly enhance the workability of the construction industry.

Table 3 Data analysis for technology readiness towards 4IR

No.	Item	Mode	Mean Score	Interpretation
B1	Use of BIM in construction project	3.00	3.06	Moderate
B2	Use of 3D printing hardware to create building model	3.00	2.24	Low
B3	Use of big data and data analytics	3.00	3.09	Moderate
B4	Use of online platform for meeting to interact	3.00	3.61	Moderate
B5	Use of 3D virtual reality to create project design	2.00	2.43	Moderate
B6	Use of software application for project management	4.00	3.66	Moderate
B7	Use of modern tool for project monitoring (i.e drone)	3.00	2.94	Moderate
B8	Use of autonomous robot to perform construction task	1.00	1.83	Low
B9	Use of simulation to visualize more productive construction work pattern, identify problem	2.00	2.35	Low
B10	Use of cloud storage to store firm data securely	4.00	3.65	Moderate

(b) Analysis on challenges towards the adoption of 4IR in construction industry

Referring to data analysis shown in Table 4, it indicates that the highest challenge in adopting 4IR in construction industry for the employee is to acquire new skill set. The mean score 3.85 is from item C2 that indicates urge of needs to enhance knowledge and skills and in facing rapid development in technology. Use of disruptive technologies such as BIM, virtual reality, modular construction and autonomous construction will change the construction landscape. Feedback from respondents also show concern in the aspect of data protection using cloud storage with mean score of 3.85. Apart from that, findings also show that respondents are not quite agree that technology are able to replace manpower.

Table 4 Data analysis for challenges towards 4IR

No.	Item	Mode	Mean Score	Interpretation
C1	Data protection- increasing amount of data stored in cloud	4.00	3.85	High
C2	Training for new skillset (high skilled workforce)	5.00	4.37	High
C3	Increase of cost- deployment of technologies	4.00	3.89	High
C4	Technology able to replace manpower	3.00	3.48	Moderate
C5	Increase global competitiveness & improve quality	4.00	4.11	High

5. CONCLUSION AND RECOMMENDATION

This study shows that the level of readiness towards adopting 4IR in construction industry particularly in Kuching Sarawak is generally moderate. Findings indicate that level of readiness is moderate for use of software, simulation and cloud storage while low level of readiness can be seen for use of autonomous robot to perform construction task and 3D printing hardware. Generally, the adoption of 4IR is still at early stage. Looking into the challenges in adoption of 4IR, data suggest that training is highly in need to acquire new skillset. As 4IR transforms sectors and industries, the skills demanded for the workforce will also change. It is important to enhance the readiness of existing workforce to thrive in a fast-changing work environment. The technological adoption to construction processes requires the future workforce to be equipped and ready with new skills to enable them to adapt to the changing industry environment. The industry would be able to achieve the next level by adopting strategies, such as educating potential candidates, deliverable of knowledge, training and upskilling the existing employees.

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