A Review of Risks for Bim Adoption in Malaysia Construction Industries: Multi Case Study

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Abstract. In tandem with the global changes taking place oriented with industry 4.0, including digitization and automation, Malaysia also demands the innovation-led technological transformation. In the transition to digital technologies, industry 4.0 for the construction industry is bound for Building Information Modelling (BIM). The developments of BIM have posed major risk factors that might hinder construction companies for continuous change. BIM is still at an early stage in Malaysia, with that being said, little is known about its process and it is not yet clear what risk factors might hinder the early process of BIM adoption. This paper introduces the risk factors that might hinder the process towards BIM adoption; emphasis more on risk factors of each industry. Three construction industries in Malaysia were chosen to review the risk factors of each industry using purposive document analysis method. The risk in Malaysia construction industry 4.0 is divided into technical and non-technical factors. There are similar and different expectations of each construction industry toward BIM adoption and there are risks where organizations are still not fully aware of it. Each company has to decide its route and the most effective way to reach the destination. The outcomes of this article might help to support and guide Malaysia construction industries to pay major attention to such risks and plan ways to overcome

1. Introduction
The change toward major technology development represents risks, challenges and opportunities for the players and communities in the industry. These will not bring the whole system to collapse [1] but will lead to a slower reaction from society, at least in keeping with a permanent state situation [2]. According to the previous study, the efficiency of technology increases more quickly than the absorption of labor and this is the problem that needs to be solved [2]. These changes are multidimensional and complex, which leads to difficulty concluding the positive and negative perspectives [3]. Construction industry 4.0 is bound for Building Information Modelling (BIM). It is well-known that the construction industry has a strong and rigid culture as well as its strong resistance to changes [4]. More analyses and experiments on the working culture changes in the current construction network are needed [5]. However, change in construction industry seems difficult not only because the fundamental principles of an organization must be changed, but also because there appears to be a strong link between the tendency to discourage risk-taking and concentrate on accuracy in engineering and learning programs as factors to derive industry 4.0 [6]. More to that, the organization should be customized to the demands of industry 4.0 to transform an organization.
effectively. The organization is at risk for both sticking to the current organizational structure and too radically transforming the current organizational structure [7]. The risks are unlimited, however, this paper focuses on risks of three construction industries in Malaysia for the adoption of BIM.

2. Literature Review

2.1. Building information modelling
Building Information Modelling is now regarded as the key tool to digitize the construction industry [8]. BIM is a technology transforming how buildings are designed and constructed. At the same time, it can facilitate multi-disciplinary coordination whilst integrating 3D design, analysis, cost estimating and construction scheduling [7]. It has five key features which are visualization, coordination, simulation, optimization, capability to plot [9]. The excellent advantage of BIM is that the project is digitally simulated and modelled, which is made a reality at first from the beginning of project task. In essence, BIM is a revolutionary technology that digitally designs and manages construction projects by simulating a virtual building model. By supplying detailed info such as project schedules, cost estimates, material inventories, as well as technical details on construction elements such as design and spatial relations, the building information model provides the ability for all team participants to collaborate effectively over the entire life cycle of the building [10]. BIM's awareness among the construction industry is still low because BIM as a new software design system has not been clearly defined by the construction player [11].

2.2. Industry 4.0 in Malaysia
Malaysia seeks innovation-driven technological transformation with the global changes focused on Industry 4.0, including digitalization and automation. There are gaps to be filled and a huge cost to be paid by Malaysian organizations, but the future is highly promising and certainly there is value of industry 4.0. All businesses have to decide their route and how to reach their destination most efficiently. Covering the entire value chain of industries including suppliers, procurement, sales, and logistics, the cyber-physical systems with decentralized and self-governing smart factories has potential to transform Malaysian sectors in multiple ways including high productivity, efficacy and cost, enhancing organizational management enabling better quality and monitoring and developing innovators and producers [12]. Ministry of International Trade and Industry (MITI) has launched the national policy on industry 4.0 [12] on 31st October 2018. This policy is important in terms of providing industry guidelines to adopt industry 4.0. However, construction sectors play a significant role in the economy to achieve the inspiration to be a developed nation in 2020. There are three crucial changing variables in the introduction of industry 4.0, which are people, technologies and processes exist. It is important to optimize and balance the three factors by an appropriate ecosystem. The success is based on how well people, process and technology match each other.

2.3. Barriers of BIM Adoption in Malaysia
According to Bernama (2018), construction sectors in Malaysia is still in the adoption level of Building Information Modelling [13]. Most of the construction environment industries now face major changes to meet the current trends and needs of the construction sectors[7]. It is necessary therefore to decide which obstacles limit the use of BIM in the construction industry [11]. In Malaysia, the adoption of BIM has taken on 4 categories: organizational culture, people, technology and government recognition [11]. There are barriers that will affect the speed at which BIM is introduced in Malaysia's construction industry [11]. During the development and use of BIM, multi-dimension barriers arise, examples are introduced in table 1. Such barriers are management issues, legal issues [7], people barriers [7][11], client demand [7], training and learning cost [2], lack of empirical data support, late involvement of client, lack of statement and reinforcement, lack of previous record of BIM, sharing culture, lack of cooperation, lack of guidelines, lack of communication [7].
Table 1. Example of barriers categories

| Barrier category       | Description                                                                 |
|-----------------------|-----------------------------------------------------------------------------|
| Technology Barrier    | Interoperability, compatibility and complexity                               |
|                       | • License policy                                                            |
|                       | • Risk regards to data sharing                                              |
|                       | • Version control problem                                                   |
|                       | • Data loss during file exchange                                             |
|                       | • Lack software compatibility                                               |
|                       | • No proper ICT infrastructure                                             |
| Management Barrier    | Actor                                                                       |
|                       | • Lack of skilled personal                                                  |
|                       | • Lack of knowledge of BIM implementation                                   |
|                       | • Lack of training                                                          |
|                       | • No R&D unit                                                               |
|                       | • Insufficient commitment of top management                                 |
|                       | • Lack of support from senior                                               |
|                       | • Lack of demand for BIM                                                    |
| People Barrier         | People                                                                       |
|                       | • Resistance to change                                                      |
|                       | • Lack of communication                                                     |
|                       | • The Team does not have members with vision or people who are open-minded to change |
| Financial Barrier     | Financial                                                                    |
|                       | • Lack of fund                                                              |
|                       | • Cost challenges                                                           |
|                       | • Investment includes software and hardware and human resource              |
|                       | • High initial investment cost                                              |
| Legal Barrier          | BIM Standard and legal BIM                                                  |
|                       | • Intellectual property                                                     |
|                       | • Cybersecurity                                                             |
|                       | • Ownership and licensing issues of data model                             |
|                       | • No standard contract for BIM project                                      |

The obstacle in Malaysia construction industry 4.0 is divided into non-technical and technical issues. Industry 4.0 is a challenge to move the innovative concept of industry 4.0 in the complex environment of the construction industry to address in the long term as it requires an organizational and managerial process and strategy.

3. Methodology

Purposive data collection used for this paper. The cases are determined purposely for this paper. The purposive sampling identified by Patton (2002) as the method of strategically and intentionally selecting cases of rich information [14]. Specifically, this approach is used to define the cases within the categorization of purposeful selection. The reason for this approach is to guarantee the involvement of experts from those with information-rich backgrounds that could be collected to provide information in a practical application of change, following these criterion references:

1. Construction industries
2. Attended industry 4.0 training
3. Reported on company risk factors to adopt industry 4.0 using BIM

The data is collected from companies report toward industry 4.0 for Building Information Modelling in construction industries. There are three construction industries chosen in this multi-case study, each industry has its own risks.

Document analysis is the method used for this paper. Document analysis is a systemic process for the review or assessment of printed as well as electronic documents [15]. When part of a research undertaking, documents may serve a range of purposes. These documents provide supplementary research data and used to generate knowledge from information and insights derived from documents of different construction companies. The content of the documents is analyzed through the process of organizing information into categories related to the central questions of the research. Thematic analysis is formed of pattern recognition within the data, with emerging themes becoming the categories for analysis. The document analysis represents risks mentioned by three construction industry in Malaysia.

4. Findings
The results from the documents reflect that there are potential risks for BIM adoption. The documents claim that the use of BIM would be able to speed up the process for building if the company is can overcome its risks. Three documents that were analyzed, each company addressed its risks.

4.1. Risk Of Technology And Software
Two companies have addressed the risk of technology and software. Software/app to be abandoned is the biggest nightmare of Company 1. This is because of (1) developing mobile app that might be unlikely to utilize by users, (2) App development requires an amount of budget for instalment and maintenance, (3) takes time to plan and reach to the required software. Company 2 has acknowledged the risk factor of technology that comes from acquiring new equipment, using manufacturing automation technology which is in market or under development. The risk of technology to make a specific choice on the required technologies and software is the companies issue when all will be wasted if no one uses the app. This happens when approaching technology and software development from the wrong perspective, complicated and not friendly user.

4.2. Risk Of Unsustainable User Growth
The risk of unsustainable user growth is mentioned by two companies. Company 1 found the challenge of “what happens if too many people started using the app? What if it takes off faster than it could ever be expected?” in this case, the company will be stuck supporting hundreds and thousands of users. For that, only approved users to be allowed using the software and app. Company 3 considered unsustainable user growth from a different perspective. The tester app is much cheaper than other vendors offering single feature in different software which is costly. This will affect the users’ development whereby company 3, sometimes, is unable to pay for each feature.
4.3. Risk Of Security Breaches
the risk of security breaches was the focus of two companies. the danger here lies in underestimating the need for proper security precaution within native apps resulting in weak server-side control. Therefore, any communication that happens between the app and user happens through a server. Thus, this becomes a primary target that gets exploited by hackers.

4.4. Risk Of Choosing The Wrong Development Partner
A company has addressed the risk of a wrong development partner. The fact is, the company can’t afford to develop its mobile app in house. As a result, the company must turn to outside agents which adds a layer of risk to the project. After all, the wrong development partner can ruin everything. So the issue is how to avoid choosing the wrong development partner? While there is no single answer that applies to every situation

4.5. Engineering Risk Factor
The risk comes from new system architecture, engineering requirements that are not finalised or the failure on following industry standards. Risk consideration in terms of design, production, installation and maintenance.

4.6. Communication Risk Factor
A communication risk could be between people, technology and process or can happen within a management team with clients, design teams, project team peers. The main communication risk in Industry 4.0 resulting competitive between people and machines.

4.7. Unintended Data Leakage
Several risks have been identified while the test app development. Unintended data leakage is a risk due to the storage of critical app data on insecure location on the mobile. The data stored in a location on the device that is easily accessible by other apps or users. This results in the breach of user privacy leading to the unauthorised use of data.

Based on the literature review and documents analysis, there are multi-dimension barriers arise to each company that might hinder them to implement BIM. The awareness of BIM is still low in the construction industry, as the construction player has not clearly defined BIM as it is a new design software system. The lack of understanding BIM makes construction owners reluctant to adopt it. The fear of the unknown technology and user growth are common issues that these companies face in working conditions.

The construction industries in Malaysia not only facing technical risks but also non-technical risks. To succeed in industry 4.0 environment, organisations are required to pay attention to learning, knowledge management and capacity for innovation. These are amongst the ways to avoid risk factors that might hinder the early process of BIM adoption. Organizations need creative and innovating employees who are able to work with smart, uncertain and competing environments such as industry 4.0 to sustain smartness, innovative capability and performance to prevent the unsustainable user growth risk. Therefore, as an enabler to make the transition towards BIM, Malaysia construction companies have to equip its human at the first place, to be able to facilitate its grant recipients to be competent in the domain of industry 4.0

5. Discussion and Conclusion
It's almost a truth that industry incumbents have trouble adapting to a dramatic technological change in which organization needs to adapt in order to survive [16]. The organisation would not survive without the planned organisational change
Construction industries are at risk to adopt BIM which includes technology and software, unsustainable user growth, security breaches, choosing the wrong development partner, Engineering risk factor, communication risk factor, unintended data leakage. These are considered amongst critical success factors that should be carefully managed when introducing industry 4.0. Leaders need to take responsibility to drive the digital transformation of the organization, and to explain what it entails as well as its potential. Thus, leaders’ language of the digital journey will strengthen its value and importance. In an uncertain environment like industry 4.0, the key to success is to spread the culture that meets the requirements of industry 4.0 that materializes the industry strategy for filling in the blanks around their dynamic capabilities to adapt and survive in the 4.0 market.

Focusing more on Malaysia construction industry, limited research work has been found on the transformation of industry 4.0. The novelty of the research came forward when there is limited prior research was found in this domain to empirical development for industry 4.0 particularly in the context of Malaysia construction industries. The research regarding the subject is still in the very initial phases and the scientific resources are scarce.

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