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Reinforcing Building Information Modelling (BIM) using Kaizen in the Facilities Management Industry

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Abstract
Purpose: This article apply Kaizen approach in identifying significant leadership attributes that can influence facility managers' intention to adopt Building Information Modelling (BIM) in their organisations.
Design/methodology/approach: Data were collected using a questionnaire survey from 302 facility managers categorised as line and middle management level. A total of 56 elements were tested using a seven Likert-scale and seven hypotheses were verified. Kaizen approach are suggested as the primary resolution for the insignificants attributes. .
Findings: The structural model assessment confirmed a positive significance between three attributes and intention to adopt, specifically leadership behaviour, team leadership, and vision. This research recommends the use of the Kaizen approach as the process improvement technique for four non-support attributes, namely achievement, empowerment, teaching, and change management.
Research limitations/implications: The results of this study are drawn from a general FM organisations as BIM is not widely use among FM team in Malaysia.
Practical implications: The study was an attempt to promote the Kaizen approach for the resolution of facility managers' intention towards BIM adoption. As a tools for the collection of databases with a digital visualisation, BIM brings lots of potential in FM operations.
Originality/value: This research emphasises that the introduction of Kaizen approach for the resolution of non-support attributes will reinforce facility managers' decision and effort to implement BIM in their organisations.

Keywords: Building Information Modelling, Facility Management, Intention to Adoption, Kaizen

Introduction

The issue of poor Facilities Management (FM) is often due to a department's doubtful ability to support the core business objective. As such, a survey of FM managers done by Aziz, Nawawi, & Ariff, (2016) has mentioned that FM is often misunderstood as a profession focused on maintenance management. Even within the scope of maintenance management, they are

often associated with misjudgement, miscommunication, and recurring mistakes. By looking at the comprehensive research done by Berahim, Jaafar, & Razali (2013), in the aspect of Malaysian local authorities' asset management, it has resulted in the identification of several issues causing facilities failures. They include repeated maintenance, asset mismanagement, asset misappropriation, mismanaged assets disposal, and asset under optimisation or wastage. Despite FM being a profession that encompasses multiple disciplines to ensure the functionality of the built environment by integrating people, place, process and technology (IFMA, 2014), its practical role is often distorted from its actual function.

In fact, many recent scholars have recommended for software adoption, which may aid FM in centralised information management. Subsequently, the Government of Malaysia as the most prominent property holder has concluded the Building Information Modelling (BIM) as a valuable tool to manage assets in the future (CREAM, 2014). In the FM aspect, BIM is a digital visualisation in the form of tools for the 'collection' of database, otherwise known as a repository, particularly for the final FM in building operations (Aziz et al., 2016). Interestingly, a recent system developed by Hu, Zhang, Yu, Tian, & Xiang, (2016) has associated the inspection-repair process with a digital three-dimensional (3D) model, BIM repository, GUIs, and image classification algorithms, which are expected to update the maintenance management. Their efforts should be applauded as the research has enabled accurate and rapid data delivery. The method of collecting data in asset management information collected in their study may help FM departments to make a good decision pertaining to asset management. BIM, if correctly applied, can provide organisations with the tactical tools and robust strategies, which will, in turn, bring significant advantages in promoting and strengthening their competitiveness (Buhalis, 2004).

In a nutshell, it is recommended that issues associated to FM can be prevented with the aid of BIM (Azhar, Khalfan, & Maqsood, 2012; Korpela, Miettinen, Salmikivi, & Ihalainen, 2015). Moreover, BIM promises a high level of Quality of Life (QOL) at the workplace (Aziz et al., 2016a; Aziz, Nawawi, & Ariff, 2016b). The main implication of this study was to lead FM decision-makers both in the private and public sectors towards having the necessary and explicit leadership competencies in order to harbour the intentions to adopt BIM in their organisations. Meanwhile, the scope of this paper was limited to a discussion on the relationship between leadership competencies and the intention to adopt BIM by facility managers. At the end of this study, the non-correlating variable will be explained further to provide some necessary improvements to the processes undertaken by facility managers.

Literature Review

Intention of BIM Adoption in FM

Even though BIM is claimed to be able to solve the abovementioned issues, the adoption of BIM is challenging. BIM is not widely used in Malaysia's FM industry (Aziz et al., 2016b), not fully implemented, and not entirely integrated still because its stakeholders such as facility managers, owners, contractors, and consultants are still wary of using the model (Volk, Stengel, & Schultmann, 2014). This situation is a critical determinant as leaders and decision-makers in the industry have a very substantial effect on the rate of BIM adoption. This statement is strongly supported by a researcher who has posited that one of the reasons for low adoption in FM is the small amount of participation amongst facility managers (Volk et al., 2014).

Although facility managers acknowledge that the adoption of BIM during building operations can decrease the chance of errors and increase efficiency, current BIM adoption in the global context is still low (Becerik-Gerber, Jazizadeh, Li, & Calis, 2012; Motamedi, Hammad, & Asen, 2014). Therefore, facility managers' leadership in managing and introducing innovation is questioned. Strong leadership in management is vital to enhance BIM adoption in the FM

industry. According to Gu & London (2010), leadership competency in the information system (IS) cluster is a set of related but different sets of behaviour organised under the underlying construct of 'intent'. The study has also agreed that the alternative manifestations of intent are behaviours as deemed appropriate at various times or situations. Therefore, related theories that may be applicable must consist of the intention of adoption among leader consumers.

Several BIM adoption topics have been discussed in the global architecture, engineering, and construction (AEC) industry (Gardezi, Shafiq, Nurudinn, Farhan, & Umar, 2014; Gu & London, 2010; Rostami, Khodadadyan, Sommerville, & Wong, 2015; Succar & Kassem, 2016). However, there is a lack of studies related to FM practices, particularly studies emphasising on leadership competencies in any macro BIM adoption. This possible gap in the theme of leadership competencies and technology adoption has motivated researchers to justify the parameters of BIM adoption in the Malaysian FM industry.

Hence, this study emphasised on the Innovation Diffusion Theory (IDT) by relating it to behaviour intention. It is crucial to review the diversity of technology adoption as gaps in the topic of leadership competencies are specific to the intention to adopt the technology. Nonetheless, this study was correlated with psychology organisation behaviour theories by emphasising on leadership competencies to form seven constructs, namely: visionary, achievement, empowerment, team leadership, teaching, change management and leadership behaviour. These competencies are vital to form the driving factors of FM leaders as the decision-makers for the adoption of BIM in the Malaysian FM industry. Knowing that these parameters will increase facility managers' confidence, the intention to adopt BIM to achieve organisations' objectives may thus attract and catalyse BIM adopters among its followers in an organisation.

Kaizen Approach

The 'Kaizen concept' is widely recognised in many organisations and refers to the significant and continuous improvement of an organisation's competitiveness (Kumiega & Vliet, 2011; Maarof & Mahmud, 2016). The Kaizen's continuous approach deals with the sense of embedded natural practices and never-ending journey towards efficiency and quality (Delgado & Castelo, 2013). Kaizen is a Japanese term that refers to continuous improvement, whereby the primary goal of a business strategy is to eliminate waste in business processes (Kumiega & Vliet, 2011). Although the Kaizen approach is well-accepted in FM practices, especially those specific to lean management (RICS, 2014), the approach seems to be rarely discussed in FM literature.

The Kaizen approach is a common sense-based and inexpensive approach to management that is focused on waste reduction in terms of activities and materials (Sonobe & Otsuka, 2014). The word "Kai" refers to change in Japanese, while "Zen" is defined as better (Maarof & Mahmud, 2016). According to Imai (1986, 1998), Kaizen was initially an initiative implemented after World War II by the Japanese manufacturing industry to resolve difficulties in obtaining raw materials due to limited resources. The approach was designed by Imai from the Toyota Motor Company, who initially tried to optimise processes' efficiencies and minimise waste in order to improve the production processes. The scholar has also explained that the Toyota Motor Company had adopted the Kaizen initiative to achieve its aim for becoming the world's automotive leader. Efforts made by them have emphasised on incremental changes, employee empowerment, low-cost problem solving, and process improvement, rather than result-oriented efforts.

Sonobe & Otsuka (2014), have proposed building effective Kaizen institutions to facilitate the adoption of innovative technology and the dissemination of management practices in earnest. In the Malaysian context, the Kaizen approach that leads to lean practices is well-known in the

automotive, electrical, and electronics industries (Jabatan Perdana Menteri Malaysia (JPMM), 2009). The adoption of lean management in the manufacturing industry aims to enhance organisational performance by reducing delays, wastage, and more; it includes the processes involving decision-making by staff (Baril, Gascon, Miller, & Côté, 2016). Delgado & Castelo (2013), have summarised the main Kaizen principles developed by Imai (1987, 1998) as follows:

a. **Process and outcome**
   Both outcome (company goals) and process (consistent with the obtained result and commitment for desired coherent and consistent effect) are equally crucial in the Kaizen philosophy.
b. **Holistic view**
   It is vital to view the whole system without losing the notion of integrating all congruent processes.
c. **Do not judge or blame**
   Avoid blame when detecting a failure; instead, determine its cause. The cause should be seen as an opportunity for an organisation's improvement. Kaizen-oriented management teams will target on finding (inexpensive) ways to reduce waste through improving its people, place, processes and technology.

Kaizen experts are expected to provide recommendations to solve business issues (Veloso, Melo, & Banzhaf, 2017). Kaizen teams and risk managers should be responsible for the continuous improvement of current systems through the identification of causes for any variation and innovation that can extend the maturity stage of an investment or trading system (Kumiega & Vliet, 2011). The technique of communication and data collection across small Kaizen groups within a firm can foster the capacity of knowledge transfer beyond firm boundaries (Machikita, Tsuji, & Ueki, 2016). Therefore, the Kaizen approach uses both common sense and scientific methodology and is agreeable on the beliefs or values in an adaptive framework (Dellen, 2016). Interestingly, Dellen (2016) has stated that Kaizen's starting point is the acceptance that every process and the current problem is considered soluble, or as the opportunities or solvent for continuous improvement. He is also of the belief that Kaizen's involvement in all aspects empowers cross-functional teams to challenge the status quo. In a nutshell, according to Moore (2007), the critical approaches in Kaizen include:

- Kaizen teams go to 'Gemba' (workplace) and eliminate the barriers towards workers' success.
- Little daily improvements and innovations (to support the main innovation)
- The importance of understanding and improving process orientation to get better results.
- Avoid wastage (any additional cost). Maarof & Mahmud (2016) have stated that the wastage that needs elimination is categorised into seven types, namely: over-processing, defects, waiting, overproduction, transportation, motion, and inventory.
- Insisting on high standards and quality of work is the management's responsibility
- Implementation of excellent five (i.e. Seiri, Seiton, Seiso, Seiketsu and Shitsuke) housekeeping as the prerequisites for Total Productive Maintenance (TPM).

Method

The unit of analysis of this study comprised of facility managers categorised as line management and middle management. The instrument used was a self-administrated questionnaire. Simple random sampling method was used to recruit the respondents. The distributed questionnaire was prepared using a Google form. This online questionnaire was

distributed via two channels, which were: 1) an email linked to a Google Drive account, and 2) a WhatsApp application linked to a smartphone application. However, the response rate received from the online approach was low and did not reach the adequate sample size for analysis. This situation was expected as Maarof & Mahmud (2016) stated that one of the weaknesses of online questionnaires was its low rate of response. Therefore, to achieve the acceptable sample size, the remaining samples were surveyed using a paper-based questionnaire.

In an attempt to improve the facility managers' incomplete understanding on their intention to adopt BIM, the study primarily focused on answering the study's research question (RQ): Which parameter(s) significantly influences leaders to adopt BIM in the FM industry? Using the RQ as a guide, the hypothesis for this study was thus developed and a total of 56 elements using a Likert-type answer scale were examined. The Likert scale ranged from 1 (strongly disagree) to 7 (strongly agree) in order to identify the respondents' level of agreement for all 56 elements.

The Statistical Package for the Social Sciences (SPSS) software was employed to conduct the descriptive analysis, which included the mean, standard deviation, skew-normal distribution test (data normality test), and the Kolmogorov-Smirnov test. Meanwhile, the partial least squares structural equation modeling (PLS-SEM) software was used to test the constructed hypothesis. The study used second-generation qualitative data analysis as neither covariance-based (SEM CB-SEM) nor PLS-SEM was justified by the fit's statistics of data. Among all 56 elements, an indicator in 'Visioning' attribute showed non-normal distribution and the model fit for the non-parametric measurement technique. Rather than CB-SEM, the selection of PLS-SEM was based on the non-parametric measurement and might develop estimates of the variable score of higher accuracy. The selection might also elude the factor indeterminacy problem due to difficulties in estimating the stable factor scores (Hair, Hult, Ringle, & Sarstedt, 2017). Therefore, the data distribution of this study fit to adopt PLS-SEM.

According to Hair et al., (2017), hypotheses are individual predictions, whereas a theory links multiple hypothesis that can be tested empirically. This study established a set of hypotheses as follows:

H1: Visionary (VIS) is correlated to the Intention to use (INT) BIM
H2: Achievement (ACH) is correlated to the Intention to use (INT) BIM
H3: Empowerment (EMP) is correlated to the Intention to use (INT) BIM
H4: Team Leadership (TEL) is correlated to the Intention to use (INT) BIM
H5: Teaching (TEC) is correlated to the Intention to use (INT) BIM
H6: Change management (CM) is correlated to the Intention to use (INT) BIM
H7: Leadership behaviour (LED) is correlated to the Intention to use (INT) BIM

The rejecting hypotheses for h-null with a p-value < alpha is part of the rule of thumb in statistics (Maarof & Mahmud, 2016). Hence, to measure the hypotheses, path models were developed using the PLS-SEM software. In this study, the development of path models required two types of theory: measurement theory and structural theory (Hair et al., 2017). A value is said to be significant if its t value is greater than 1.645 ($p<0.05$) or 2.33 ($p<0.01$) for one-tail, and if the t value is greater than 1.96 ($p<0.05$) or 2.58 ($p<0.01$) for two-tail (Ramayah, 2012).

Findings and Discussion

Overall, the structural model was significantly predicted ($Q2= 0.818$). Team leadership ($\beta = 0.250$, $p<0.01$) and leadership behaviour ($\beta = 0.150$, $p<0.01$) were proven to be significant predictors of intention to adopt at the 0.01 level, whereas visionary ($\beta = 0.101$, $p<0.05$) was shown to be a significant predictor of intention to adopt at the 0.05 level. However,

achievement (β = -0.031), empowerment (β = -0.059), teaching (β = -0.066), and change management (β = -0.008) were not significant predictors of intention to adopt. The results of hypothesis testing are demonstrated in Table 1.

Table 1: T-value results as analysed via bootstrapping analysis in PLS-SEM.

Hypothesis	t- value	Conclusion of analysis
VIS to INT	1.735*	Supported
ACH to INT	0.500	Not supported
EMP to INT	1.076	Not supported
TEL to INT	3.881**	Supported
TEC to INT	1.077	Not supported
CM to INT	0.113	Not supported
LED to INT	2.543**	Supported

The visionary, team leadership, and leadership behaviour elements were found to be significant predictors of intention to adopt, whereas achievement, empowerment, teaching and change management were proven to be insignificant predictors of intention to adopt. Therefore, the researchers suggest for the Kaizen approach be the primary resolution for facility managers' intention to adopt BIM in consideration of a series of constructs, specifically achievement, empowerment, teaching, and change management.

According to Imai (1998), Gemba in Kaizen is unlike survey or focus groups; the principle of Gemba Walk in Gemba allows a leader the possibility to see the actual process, understand the work, ask questions, and learn the procedures as a whole by himself. Furthermore, during the Gemba walk, leaders have an opportunity to gain information and advice from the sensei-coach (person-in-charge) or the technical person on-site. Leaders can understand the value stream and its problems rather than just reviewing the results and giving comments. Leaders can practice Gemba Kaizen to set the vision for BIM adoption in an organisation by determining the existing workforce's strength and opportunities, and evaluating both their ability and contribution when working in a group.

In addition, during the Gemba walk, rather than doing vision planning, facility managers should perform observations regarding improvement strategy in change management to genuinely structure the organisation process. Leaders should take into consideration at this point that the typical observation method is extraordinarily ineffective and can decrease a team's morale. The essence of observation, engagement, and improvement in Gemba allows facility managers to communicate without prejudice and then act decisively to improve the process in the most efficient manner possible.

The Kaizen team (either a temporary or official appointment) should conduct brainstorming sessions to eliminate or remove obstacles to the BIM adoption's success. According to the Kaizen principle, little daily improvements can possibly assist in innovation adoption. Therefore, small simulations with regular observatory activities will result in an improvement. Understanding the process orientation and progression in delivery will enhance the expected results. According to Imai (1998), the regular Gemba Kaizen is also applicable to post-adoption, whereby Muda (waste) is present and needs to be eliminated to avoid inefficiencies. While continuous simulation takes place in the workplace, the Kaizen team should formulate the improvement process to sustain the BIM adoption in the organisation. The improvement process must be consistently applied and practised. Once it becomes a routine, a leader's intention and behaviour to adopt BIM will become greater due to the acceptance of his/her responsibility. This approach will prevent the facility manager from being demotivated if obstacles are encountered during the BIM adoption. Reluctance to adopt the BIM and

termination of BIM adoption can be further avoided as the facility manager progressively enhances his/her acceptance to change.

Conclusion

Despite its capacity to bring significant advantages in promoting and strengthening organisational competitiveness, BIM is not widely used in the FM industry. In this study, the facility managers' leadership in managing and introducing innovation was questioned. The study revealed that strong leadership in management was vital to enhance BIM adoption in the FM industry. Therefore, related theories emphasising upon the IDT theory related the concept with behaviour intention and highlighted leadership competencies developed, which consisted of seven constructs: visionary, achievement, empowerment, team leadership, teaching, change management and leadership behaviour. Following this, the data collected via surveying the facility manager's perception were further explained by using the PLS-SEM software. The structural model assessment confirmed a positive significance between three constructs and intention to adopt, specifically leadership behaviour, team leadership, and vision. This research thus recommends the use of the Kaizen approach as the process improvement technique for four non-support attributes, namely achievement, empowerment, teaching, and change management. This research emphasises that the introduction of the Kaizen approach for the resolution of non-support attributes will enhance employee morale towards the implementation of BIM in organisations. In future research, the attributes developed in this study can be applied to other professions/technology that are facing similar issues. These measurement instruments should be able to measure their level of technology intention based on the leadership competencies. Moreover, future research is recommended to review appropriate methods in the Kaizen approach according to the outcome of the tested significance results.

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