

BIM ROADMAP STRATEGIC IMPLEMENTATION PLAN: LESSON LEARNT FROM AUSTRALIA, SINGAPORE AND HONG KONG

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Information and technology has produced large changes to construction industry and leads to innovative nations globally. Building Information Modeling (BIM) is one of the IT platforms to rely on the process of planning, design, construction, and operation of a building in 3D dimension to promote collaborative and integration between the parties in the construction projects environment. BIM is defined as a parametric modeling to support project life cycle through relevant data and information shared among project stakeholders. BIM roadmap is a strategic plan by the government of Malaysia to ensure a wider adoption of BIM embraced among industry players. However, despite the existence of strategic implementation plan recently developed by the Government of Malaysia through CIDB, the implementation plan has less emphasis on strategic analysis elements (i.e., capacity, support, and value). Hence, the objective of this paper is to incorporate the strategic analysis elements (i.e., capacity, support, and value) in the existing Malaysia BIM roadmap pillars based on the lesson learnt from Australia, Singapore and Hong Kong. A qualitative research technique was employed in the form of document analysis for the establishment of Malaysia's BIM roadmap, while a formal workshop with experts from representatives of Public Work Department and Ministry of Health (directly involved in the first BIM Malaysia's pilot project of National Cancer Institute) for the establishment strategic analysis elements (i.e. capacity, support, and value) to be embedded in the roadmap. The findings suggest that the strategic analysis elements (i.e., capacity, support, and value) to be incorporated in the existing Malaysia's BIM roadmap has seven pillars (i.e., standards and accreditation, collaboration and incentives education and awareness, national BIM library, BIM guidelines, special interest group (SIG); research and development (R&D). The outcomes could act as a guideline to industry players for future development of BIM-based projects in Malaysia.

Keywords: Malaysia's BIM roadmap, BIM, document analysis, implementation plan.

BIM IN MALAYSIA: AN OVERVIEW

Most of Malaysia construction projects are based on the traditional construction process which related closely to the issues of reworks, time delays, rising cost, lack of communication and coordination (Nawi *et al.* 2014b). As such, according to Nawi *et al.* (2014a), an integrated approach is one of the solutions in design and construction to minimise the fragmentation gaps. This action was a result of the client/government's awareness of the potential of BIM to reduce construction cost and avoid design problems in planning phase (Latiffi *et al.* 2013). Building Information

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Modeling (BIM) is one of the IT platforms to rely on the process of planning, design, construction, and operation of a building in 3D dimension to promote collaborative and integration between the parties in the construction projects environment.

According to Kestle (2009), the lack of project pre-planning and uncertainty of clarity in project process integration by the clients were leading to misinterpretations and miscommunications of project outcomes. This phenomenon was plague by traditional procurement process when the client appoints the consultant to act on his behalf to produce the design, and contractors to supervise the construction phase. BIM offers an integrated solution to the management and communication problems to solve the problem with traditional procurement process. Moreover, BIM is increasingly used as an IT support for complex construction projects (Latiffi *et al.* 2013), in particular for Malaysian construction industry. The notion drives Malaysian Government to formulate Malaysia's BIM roadmap. The purpose is to align BIM implementation with the national strategy to 'respond the changes in construction demand as envisaged in Malaysian Vision 2020 through BIM adoption'. Following the footsteps of various developed countries, Malaysia has adapted BIM practices into legal project through various public and private projects (Latiffi *et al.* 2013; Zakaria *et al.* 2013). Nonetheless, the practice of BIM in Malaysia and other developing countries are considered as far behind in comparison to the developed countries (Latiffi *et al.* 2013; Zakaria *et al.* 2013).

United Kingdom, Australia, Singapore and Hong Kong are the four countries that are considered to have effectively implemented BIM due to the robust application of public and private publications, the meaningful strategies of alternatives and cumulative impacts in the BIM project report submitted/published (BCA 2011; Zakaria *et al.* 2013). Many researchers have discussed the best practice examples and maturity stage for BIM that describes the utilization of BIM process in construction projects (Eastman *et al.* 2008). Recent exemplar development includes the BIM roadmap implementation in UK construction industry that tackles the guidance at strategic and operational levels in BIM implementation (Khosrowashahi and Ariyaci 2012). Moreover, the BIM strategies and involvement of government and private sectors role to adopt BIM are being researched in Australia and Hong Kong (Staub-French *et al.* 2011), Singapore and UK (Staub-French *et al.* 2011; Zakaria *et al.* 2013). Nowadays, emerging from the various initiatives around the world, BIM approach has been proved to deliver productivity in the Architectural, Engineering, and Construction (AEC) industry. In comparison with the four countries mentioned by BCA (2011) and Zakaria *et al.* (2013), the level of adaption and practice of the implementation of BIM in Malaysia is rather questionable. Hence, the focus must be given to become competitive with other developed countries.

According to Latiffi *et al.* 2013, and Zakaria *et al.* 2013, Malaysia is still struggling in adopting BIM process which currently focusing to move from 2D working environment to 3D working environment. However, based on the development of Malaysia's BIM roadmap (CIDB, 2015), the committee are perceived to benchmark BIM practice with three countries which is Australia, Singapore and Hong Kong for the development of a Malaysia's BIM strategic implementation plan. Undoubtedly, there must be some risks that need to be faced when implementing a new technology as such BIM application. Due to that, government of Malaysia play a role to drive and assist the construction companies through the establishment of BIM roadmap that beneficial to all parties involved. As such, it is necessary to establish a common definition of maturity for BIM roadmap. Due to that, Succar (2009) creates a BIM

maturity stages for BIM implementation by subdividing the implementation plan into three stages. Referring to Figure 1, off late it can be seen that the maturity level of BIM in Malaysia is still at early stage compared to Australia, Singapore, and Hong Kong. The BIM maturity stages provide a systematic framework and used as a benchmarking tool to develop the Malaysia's BIM roadmap. This implies that, it is essential for the Malaysian construction industry to access the strategic analysis elements (i.e., value, support and capacity) to be incorporated in the BIM strategic implementation plan of seven pillars (i.e., standards and accreditation, collaboration and incentives, education and awareness, national BIM library, BIM guidelines, SIG, and R&D) for a successful development process.

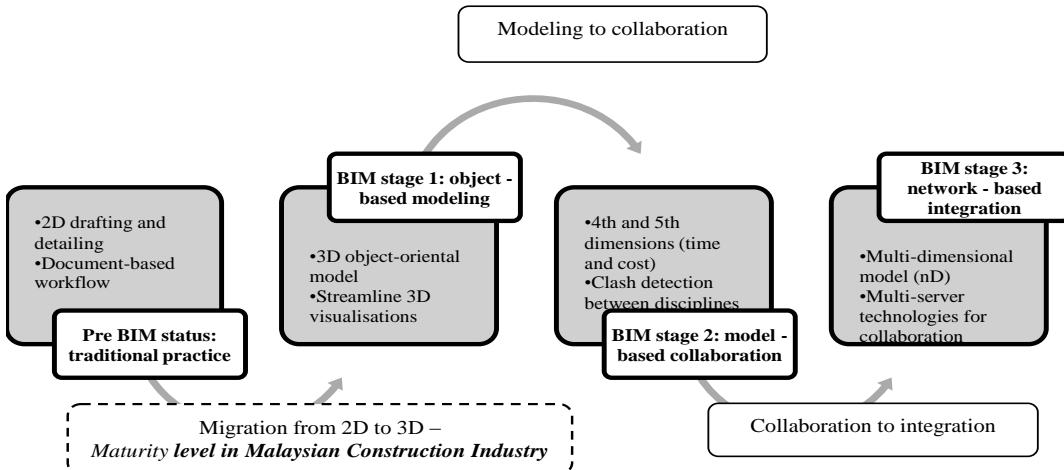


Figure 1: BIM maturity stages (Source: Succar, 2009)

Hence, the objective of this paper is to incorporating the strategic analysis elements (i.e., capacity, support, and value) in the existing Malaysia's BIM roadmap pillars based on the lesson learnt from Australia, Singapore and Hong Kong.

RESEARCH METHODOLOGY

Philosophy is a belief of the way in which data about a phenomenon is identified, gathered, analysed, and presented. Philosophical stance needs to be laid in a strong foundation of assumptions relating to epistemological undertakings, ontological assumptions, and axiological purpose (Mohd-Tobi 2013). The paper adopts an ontological position that inclines towards constructionism that is to seek the BIM roadmap strategies and providing insights on the strategic analysis elements.

According to him, interpretivism philosophy need small samples and type of research strategy is in-depth investigations to achieve agreement on the description of the issue. Thus, the interpretivism philosophy as qualitative research technique (phenomenological research) is employed for data collection in the development BIM and later is useful in BIM roadmap development to ensure a wider adoption of BIM among industry players.

In the development of Malaysia's BIM roadmap of seven pillars, a pre-determined BIM committee is established. The committee consists of relevant government agencies (i.e., Construction Research Institute of Malaysia (CREAM), Construction Industry Development Board (CIDB), Cawangan Pengurusan Projek Kompleks (PROKOM), Implementation Coordination Unit (ICU)), professional bodies (i.e., Royal Institutions of Surveyors Malaysia (RISM), Pertubuhan Arkitek Malaysia (PAM), Malaysia Asset and Project Management (MAPMA), Association of Consulting Engineers Malaysia (ACEM)), private sectors and academia (Universiti

Teknologi MARA). 5 brainstorming sessions and 2 workshops were conducted for a period of 12 months organised by CIDB and CREAM to gather relevant and precise data for the development of the Malaysia's BIM roadmap. Three countries (i.e., Australia, Singapore and Hong Kong) were selected for the benchmarking process through a document analysis process as depicted in Table 1.

The second part of the research method is to incorporate the strategic analysis elements (i.e., capacity, support, and value) that are required to be embedded in the Malaysia's BIM roadmap. In this case, a formal workshop were deployed with experts from representatives of Public Work Department and Ministry of Health through a set of questionnaires to respondents who are directly involved in the BIM-based project of National Cancer Institute (NCI) of Malaysia.

Table 1: Existing BIM Roadmap Documentations

	Country	Name/title	Author (Year)
1	Australia	National Building Information Modelling Initiatives, Volume 1: Strategy	buildingSMART Australasia (2012)
2	Singapore	Singapore 2nd BIM Roadmap	BCA & Wah (2014)
3	Hong Kong	Final Draft Report of the Roadmap for BIM Strategic Implementation in Hong Kong's Construction Industry	HKCIC (2013)

In order to reinforce the findings, separate face-to-face semi-structured interview sessions were conducted with five prominent respondents who are champion and directly involved in this BIM-based project. Respondents for this study were from the middle and top management levels. The middle and top management were chosen for the fact that these levels of management have the mandate whether to implement BIM or not in their organisations as asserted by Smith and Tardif (2009). Majority of respondents has more than 10 years' working experience in the industry and an average of 7 years in BIM (since 2007). The interviews focused on BIM roadmap pillars based on the strategic analysis elements (i.e., capacity, support, and value). The formal workshop discussion was held on the 3rd of April 2015 for a period of two hours deliberation. The sampling is shown in table 2.

Table 2: Respondent Position and Background - NCI Project

	Position	Respondent Background
P1	Top management level	Civil Engineering
P2	Top management level	Architect
P3	Top management level	Civil engineering (Structure)
P4		Failed to participate
P5	Middle management level	Architect
P6	Middle management level	Architect

DISCUSSION ON DOCUMENT ANALYSIS

Development of Malaysia's BIM Roadmap

Table 3 shows the BIM roadmap based on the lesson learnt from Australia, Singapore, and Hong Kong. As mentioned previously, these countries were selected for benchmarking comparison for the fact that they are having a good track record of performance. The comparison addresses the trend of BIM roadmap based on Strategic Implementation Plans of Australia's practice (known as work programs), Singapore (known as strategies), Hong Kong (known as perspectives), and Malaysia (known as pillars). These BIM roadmaps are discussed in turn:

The Australia's BIM Roadmap

The Australia's BIM Roadmap by the buildingSMART Australasia summarises the National BIM initiatives work programs. BIM development in Australia was driven by public organisation and to date; BIM is starting to take off. Both governments and industry associations are urged to speed up the process. The strategic implementation in Australia developed six (6) work programs as shown in table 3. Compared to Singapore and Hong Kong, BIM in Australia used time line program for the roadmap implementation plan and urge stakeholders to adhere to the target date. In spite BIM in Australia addressed on the six work programs as mentioned previously, Australia's BIM roadmap neglect to highlight on incentives to BIM adopters.

Table 3: The Strategic Implementation Plan of Australia, Singapore, and Hong Kong

Strategic Implementation Plan		
Australia (6 Work Programs)	Singapore (6 Strategies)	Hong Kong (9 Perspectives)
1) Procurement	1) Drive BIM collaboration throughout value chain	1) Collaboration
2) BIM Guidelines	2) Building BIM capability of specialist contractors	2) Incentive and proven benefits
3) Education	3) New training programmes at all levels	3) Standard and common practice
4) Product data and libraries	4) BIM research and development	4) Legal and insurance
5) Process and data exchange	5) BIM for Design for Manufacturing and Assembly	5) Information sharing and handover
6) Regulatory framework	6) BIM for facilities management	6) promotion and education
		7) Sufficient digital capability and vendor support
		8) Risk management
		9) Global competitiveness

The Singapore's BIM Roadmap

Currently, Singapore is working on developing the second BIM roadmap with focused to transformation process, research and development and BIM application in facilities management as compared to the previous Singapore's BIM roadmap developed in 2010 (Wah 2014). The BIM roadmap of Singapore is quite similar to the Hong Kong's BIM roadmap which takes into consideration BIM collaboration, R&D, barriers, and productivity achievements. The strength of Singapore's BIM roadmap is two folds: firstly, Singapore using BIM through CORENET (Construction and Real Estate NETwork). The Building Construction Authority (BCA) is the first multi-agency in the world that implements BIM electronics submission (BIM e-submission). Secondly, the roadmap is focussing on Design for Manufacturing and Assembly (DfMA) for off-site manufacturing and on site assembly and installation (Boothroyd 2011). The BCA long term goal is to create a highly integrated and technology advanced application in construction industry which led by the progressive firm and supported by skilled and competent workforce in 2020. Under the strategy plan, BCA has set a target of getting the construction industry to use BIM by identification of six (6) strategies in BIM roadmap as shown in table 3.

The Hong Kong's BIM Roadmap

Following the perceived success of BIM implementation in Australia's and Singapore's BIM roadmap, Hong Kong's BIM roadmap was published in 2014 despite BIM has been introduced since 2006. The Hong Kong's BIM Roadmap by the

Working Group on Roadmap for BIM Implementation established under the Committee on Environment and Technology of the Construction Industry Council (CIC) outline views of the Working Group on the strategic implementation of BIM in Hong Kong's construction industry. Since then, the use of BIM have been spread involving various types of projects, i.e. commercial and industrial. Hong Kong's Housing Authority has set a target to apply BIM for new projects by 2014/2015. However, a timeline is not included in the roadmap as it will proposed after the Hong Kong's industry understand the benefits of BIM achieved. The roadmap focused on nine (9) areas and seventeen (17) recommended initiatives as shown in table 3. The strength of Hong Kong's BIM roadmap are: the BIM roadmap emphasises on incentives and proven benefits to BIM adopters, adopting risk management in the perspectives, and global competitiveness.

The Malaysia's BIM Roadmap

In the context of Malaysia, the strategic implementation plan through the establishment of seven (7) pillars have been recognised for BIM roadmap via several discussion, brainstorming, and workshop held by CIDB, CREAM and industry players. This roadmap has been published in March 2015 by CIDB, Malaysia (Malaysia BIM Center). The seven pillars include: standards and accreditation; collaboration and incentives; education and awareness; national BIM library; BIM guidelines and legal issues; special interest group; and research and development as described in Table 4.

Table 4: Spectrum of Malaysia BIM Roadmap Pillars upon Best Practice

Malaysia (7 Pillars)	Australia (6 Work Program)	Strategic Implementation Plan	
		Singapore (5 Strategies)	Hong Kong (9 Perspective)
1) Standard and Accreditation	√	√	√
2) Collaboration and Incentives	√	√	√
3) Education and Awareness	√	√	√
4) National BIM Library	√	√	
5) BIM Guidelines and legal Issues	√	√	√
6) Special Interest Group (SIG)		√	
7) Research and Development (R&D)		√	

These pillars are compared to the strategic implementation plan practiced by Australia, Singapore and Hong Kong to trace the similar needs, matching the trend, and clarify the construction practices. It can be seen that the Malaysia's BIM roadmap has incorporated most of the variables amalgamated from Australia, Singapore, and Hong Kong by considering the Malaysian construction practices. This implies that the establishment of the seven (7) pillars is comprehensive and significant. To enhance the Malaysia's BIM roadmap, strategic analysis elements (i.e., capacity, support, and value) should be embedded for future development of BIM process as practiced by Singapore in updating their BIM roadmap.

DISCUSSION ON FORMAL WORKSHOP

Incorporating Strategic Analysis Elements – Capacity, Support, and Value

This section initially presents and interprets the interview findings from the organisations involved in first pilot BIM-project in Malaysia in qualitative method. The implementation of any strategy and guidelines to response to any technological system should accommodate strategic analysis elements in terms of capacity, support,

and value. Every strategy and guidelines has its own purpose to convey it comprehensively, longer-term, or result oriented. For the Malaysia's BIM roadmap to be successful and effective, a strategic analysis of construction management perspectives was found to be useful to capture the organisation readiness that they faced in a more coherent and comprehensive way. Hence, BIM roadmap should deployed these three (3) strategic analysis elements to ensure that the plan derived by the government is worth to all parties involved. Table 5 shows the result of the three (3) strategic elements that are important for Malaysia's BIM roadmap.

Table 5: Result of Semi-structured Interview

Strategic Implementation Plan		Strategic Analysis Elements		
Malaysia (7 Pillars)	Capacity	Support	Value	
1) Standard & Accreditation	P1, P2, P5	-	-	-
2) Collaboration & Incentives	P2, P3	P1	-	-
3) Education & Awareness	-	P3, P6	-	-
4) National BIM Library	P1, P2	P1	P1, P2	
5) BIM Guidelines & Legal Issues	P5	P1, P5	-	-
6) Special Interest Group (SIG)	P5, P6	-	-	-
7) Research & Development (R&D)	-	-	P2, P3, P6	

Unanimously, it was found that the strategic elements mentioned earlier have been asserted by all respondents as the critical elements to be implemented for Malaysia's BIM roadmap which is in line with the framework originated by Leonard (2002; 2008). According to Leonard (2002; 2008), the primary strategic elements are theorised as the key determinants for successful BIM implementation, namely: Capacity: first elements to inquire about whether the existing capacity of the strategy is adequate to carry out the roadmap that is being analysed; Support: people or organisations whose support in term of trust, belief, and shared the same understanding; Value: the creation of outcomes for any program that valuable to the users. As such the seven pillars of Malaysia's BIM Roadmap should incorporate the three strategic analysis elements for developing a feasible and viable successful plan.

Standard and Accreditation

Based on the results, P1, P2, and P5 agreed that a 'standard and accreditation' pillar is an important element in form of unified standard template and certification for completed BIM-based projects to ensure that the Malaysia's practice is aligned with international standards. It is supported by P2 that emphasised on 'the capacity need of people, authority, and time in establishing the national BIM standards and common practices to allow maximum benefit of building information over building life'. This is due to the fact that standards should be developed sufficiently to facilitate a BIM services and directly offering a significant savings in construction as mentioned by Eastman *et al.* (2008).

Collaboration and Incentives

Based on the results, P1, P2, and P5 agreed that a 'standard and accreditation' pillar is an important element in form of unified standard template and certification for completed BIM-based projects to ensure that the Malaysia's practice is aligned with international standards. It is supported by P2 that emphasised on 'the capacity need of people, authority, and time in establishing the national BIM standards and common practices to allow maximum benefit of building information over building life'. This is due to the fact that standards should be developed sufficiently to facilitate a BIM

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Education and Awareness

Furthermore, P3 and P6 indicated that another element worth to consider is 'education and awareness'. According to Khosrowshahi and Ariyaci (2012), education has been an important part in BIM implementation due to the technological and process changes nowadays in the organisations. All the interviewees agreed that all people that involved in BIM require an updated skill for successful implementation. Besides, P6 stated that 'in Malaysia, our BIM maturity is still at awareness level where we need a support from all parties including academia to spread the use of BIM'.

National BIM Library

Meanwhile, P1 and P2 claimed that 'the establishment of BIM library is a role of government to maximise the utility of BIM processes'. It is supported by the statement of P1 emphasised that 'the government should identify a specific BIM platform to suit to Malaysian construction practice'. Based on BCA (2011), 'BIM library' should consist of open standards of generic BIM objects and information for manufactured products that comply with industry practices. However, this requires a collaboration and support from all parties involved. In any case, there is a need to appoint an organisation (i.e., public agency) to monitor the BIM library for universal access.

BIM Guidelines and Legal Issues

'BIM guidelines' relate to the overall process of BIM and 'legal issues' describe in the procurement document and contract provisions. According to P5 'a BIM guidelines must establish a reference document providing the roles and responsible parties, unified methodology and family of BIM components'. Based on HKCIC (2014), legal issues focused on amendments to enable BIM operation in-line with the current contract agreements, scope of work, IP right and data ownership. This statement is supported by P1 where 'an agreement of legal issues relates to BIM operation including approval and payment practice that must be agreed at the initial phase of commencement'.

Special Interest group (SIG)

Special interest group emphasised on a 'special group' of people forming a committee to provide a strategic direction and guidance on the development of local BIM standards and supporting resources (BCA 2011). It is highlighted by P5 that 'establishment of SIG could oversee the implementation of standards and addressing any issues that could impede the adoption of BIM'.

Research and Development (R&D)

Lastly, P2 and P3 indicated that 'R&D is an important element of innovation and the value of BIM implementation in R&D could be seen in collaboration between the industry and academia to produce BIM value for industry used'. It has been verified by Someya (1992), that technological development is rapidly changing and industry cannot remain competitive unless keep up with changing of technology by committing research and development. The idea corroborates with P6 that 'R&D priorities should be based on the current issue faced by the construction industry sector'.

Finally, the outcomes revealed that in term of Capacity elements; education and awareness; and R&D have not been addressed by the participants. The reasons could be the respondents are practitioners and not directly involved in education and R&D perspectives. In term of Support, once again the respondents failed to address standard and accreditation, SIG, and R&D. The reasons could be the respondents are unable to

appreciate on the development of standards and accreditation, formation of SIG, and development of R&D for the fact that these respondents have different interest in business needs. In term of Value, the respondent's failed to identify standards and accreditation, collaboration and incentives, education and awareness, BIM guidelines and legal issues, and SIG as the important elements for the development Malaysia's BIM roadmap. The reasons could be the respondents are yet to appreciate the outcomes and benefits of the related pillars. Despite, the outcomes are not fully supported by the respondents, the establishment of seven (7) pillars components are regarded as comprehensively developed by CIDB. The reason is that the government BIM-based pilot project was completed before the development of Malaysia's BIM roadmap. This predicament is unable to disregard the findings.

CONCLUSIONS

This paper is to establish the strategic analysis elements (i.e., capacity, support, and value) in the existing Malaysia BIM roadmap pillars based on the lesson learnt from Australia, Singapore and Hong Kong. Through a detailed analysis, seven significant pillars (i.e., standards and accreditation, collaboration and incentives education and awareness, national BIM library, BIM guidelines, SIG, R&D) were derived for the development of Malaysia's BIM roadmap. In order to enhance the existing roadmap, strategic analysis elements (i.e., capacity, support, and value) need to be embedded in the existing pillars. Through a formal workshop of expert panels, five out of seven pillars were incorporated as the capacity elements. These are: standards and accreditation, collaboration and incentives, national BIM library, BIM guidelines and legal issues, and SIG. In terms of support, four pillars were recorded incorporating support elements. These are: collaboration and incentives, education and awareness, national BIM library, and BIM guidelines and legal issues. The value for strategic elements however, is in another two pillars. These are: national BIM library, and R&D. By and large, all the strategic analysis elements (i.e., capacity, support, and value) should be embedded entirely in the seven pillars of Malaysia's BIM roadmap to ensure the implementation plan is comprehensive and viable as practised by Singapore in updating their BIM roadmap. As such the enforcement by the Government is inevitable to implement the Malaysia's BIM roadmap to be applied to all BIM-based projects. A continuous support within all parties involved is essential to drive the successful mission of BIM in Malaysia.

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