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Principal Strategies for Improving Building Information Modelling (BIM) Technology for Architectural Consultancy Practices During Design Phases

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Abstract: Due to the increasing growth of the building sector in Malaysia, efficient information management systems are important in Architectural Consultancy Practices (ACP). Building Information Modelling (BIM) has emerged as a revolutionary application aiming to increase efficiency in the construction process, augment competency, and boost productivity. BIM has not achieved major adoption in ACP due to the lack of comprehensive BIM guidelines for the Schematic Design (SD) and Design Development (DD) stage, low BIM competency, and increased operational expenses linked with technology, training, and software/hardware. Specifically, this study proposes to (1) evaluate the present use of BIM in the SD and DD stages, (2) identify hindrances in these phases, and (3) build a framework of best practice standards for BIM implementation to aid architects. A qualitative investigation is done via structured interviews with eight ACP specialists, each possessing over three years of BIM competence. Results emphasised three critical criteria covering technology, people, and procedures. These concepts encourage design collaboration and installation, better detect defects, and improve simulation and cooperation. Future research needs to explore other BIM tools and additional ACP phases.

Keywords: *Building information modelling, architectural consultancy practice, schematic design, design development*

1. Introduction

The advanced Malaysian community of practice has witnessed quick expansion, with dynamic technology adoption that has contributed considerably to the Malaysian economy. Meanwhile, with the global post-pandemic upturn, the Malaysian construction sector is anticipated to bounce back from the previous year by 25% in 2024 and continue recovering from worldwide demand and gradually in domestic economic activity (Lian, 2024). Some crucial information is required for efficient management of the construction business. There is no better tool for integrating the process with this ACP than information communication technology (ICT). Therefore, bring in the new technology supplied by ICT: BIM, as a scientific technique and application to handle construction-related difficulties (Srinaga, Dewi, and Gegana 2022). Better as a management method in Architecture, Engineering, and Construction Industry (AEC), BIM's extensive and innovative ways of doing things have paved the path in building the AEC Industry (Ashrof et al., 2024) and (Musarat et al., 2023). It should have been, although the technology and instruments that should have offered a great deal of support should have fared well. This study will present the particular scenarios regarding barriers and constraints to adopting BIM within the Malaysian ACP. Primary research objectives include examining BIM applications during the conceptual SDA-Phase and DD Phase and analyzing the present BIM Implementation in Malaysia ACP. Deliverables and success regarding projects are the major emphasis of any ACP. Nevertheless, it has experienced different problems that risk disrupting its smooth procedures from the SD phase to the Final Completion Phase of a project. Because of that, the Eleventh Malaysian Plan (11th MP) of the Malaysian Government has recognised the Construction Industry as one of the Key Drivers of the Malaysian Economy. Design experts have a superb BIM tool to transform AEC organisations and increase their productivity in design and construction financially and clash-free, utilizing more successful designs and more efficiency.

2. Literature Review

Architectural Consultant Practice (ACP)

In Malaysia, the local legislation defines architecture, and so it would be pertinent to refer to the national regulatory authority, the Board of Architects Malaysia (LAM), for the definition of Architectural Consultancy

Practice (ACP). According to LAM, the term ACP refers to persons registered as sole proprietorships, partnerships, or corporate bodies under the Company Act 1965 to deliver architectural consultancy services (Lembaga Arkitek Malaysia, 1986). The ACP sector in Malaysia is generally defined by a handful of medium-sized enterprises and a smaller number of major firms. Registered ACPs are shown in Table 1 as of June 1, 2024.

Table 1. List of Registered ACPs in Malaysia as of 1st June 2024

No	Categories of Architectural Consultant Practice	Number
1	Architectural Body Corporate	334
2	Architectural Partnership	382
3	Architectural Sole Proprietorship	1351
4	Multi-Disciplinary Practices	49
		1889

Source: Lembaga Arkitek Malaysia, 1986

Building Information Modeling (BIM) Implementation in ACP

In its current form, implementation strategies are hampered by various BIM challenges faced by the AEC industry in Malaysia (CIDB, 2017). BIM has become an instigator for the transformation of strategic and operational changes within firms, with authorities emphasizing its use for improved productivity (Aizat et al., 2019). It is appreciated for effectiveness and productivity in visualizing data and information within BIM technologies while allowing cost savings and time considerations by designers, such as architects, amidst the reduced chance of redesigning problems arising (Jo et al., 2018).

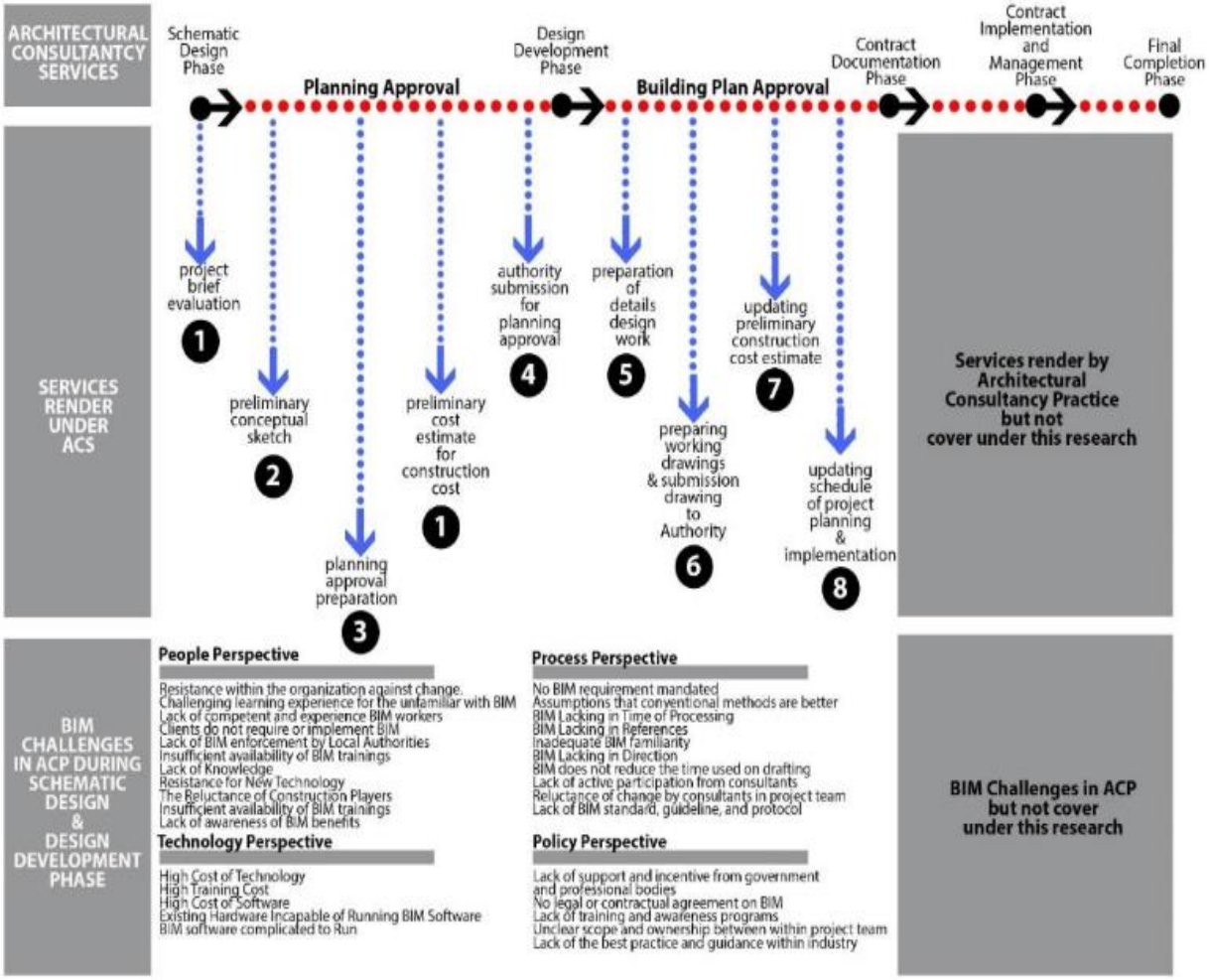
On the contrary, BIM is seen as one of the most complex and hardest technologies to get acquainted with (Ashrof et al., 2024; Eastman et al., 2018). Just like any other revolution, BIM is still open to interpretation and isn't insulated from further complications by architects while being adopted. (Jo et al., 2018). In all forms considered, it seems to be the decreasing pressure from the profession to adopt BIM in charge for the last twenty years. (Arayici et al., 2009). With the right implementation of BIM, it can uplift and change the role of practitioners in the AEC. (Arayici et al., 2009). In Malaysia's construction industry, BIM has rapidly been developed to meet the design phase's growing complexity, but is still in its early stages. The utility, awareness, and advantages of BIM are coming into focus with increasing clarity (Jo et al., 2018).

The situation affects every contingent-divided party in construction, including architects. There is a disparity in BIM knowledge. (Aizat et al., 2019), which is one of the principal causes. High operational costs associated with technology, training, and software are further setbacks to the orderly implementation of BIM to minimize errors and avert design waste (Aizat et al., 2019). BIM adoption is equally necessary among the construction players in Malaysia to counteract the knowledge shortage concerning BIM processes and applications (Zakaria et al., 2013). Evidence from initial reports indicates that these costs have reportedly hindered the adoption of BIM, alongside challenges related to a lack of trained personnel and organizational process issues (Siebelink et al., 2021). In Malaysia, barriers to BIM include technical (interoperability), process, cost, legal, human, and financial issues, and resource competencies. There are also insufficient trained personnel to implement BIM in the design process effectively. (Kasim et al., 2017). However, given this deficit, BIM becomes relevant. The Construction Research Institute of Malaysia (CREAM) considers BIM one of the most strategic instruments for the management of developed properties, and the government is aiming for its implementation by the year 2016. It is crucial to provide the AEC business with individuals who are skilled in BIM.

i) BIM Challenges in Architectural Consultancy Practice during the Design Phase

To assist Architectural Consultancy Practices (ACPs) in BIM implementation from SD and DD phases, a guideline was created based on literature reviews and based on a questionnaire survey." The guideline is referred to as the BIM Implementation Guideline for ACP (*CIDB., 2016)*. Four folding challenges exist in BIM implementation: people, technology, processes, and policies. However, the lack of pressure from the government, clients, and professional organizations to enforce proper guidelines and requirements constitutes a huge problem in this regard. Barriers to BIM implementation may be classified into three major aspects: people, technology, and process, which form the variable factors for this paper. The next figure classifies the BIM challenges in further detail.

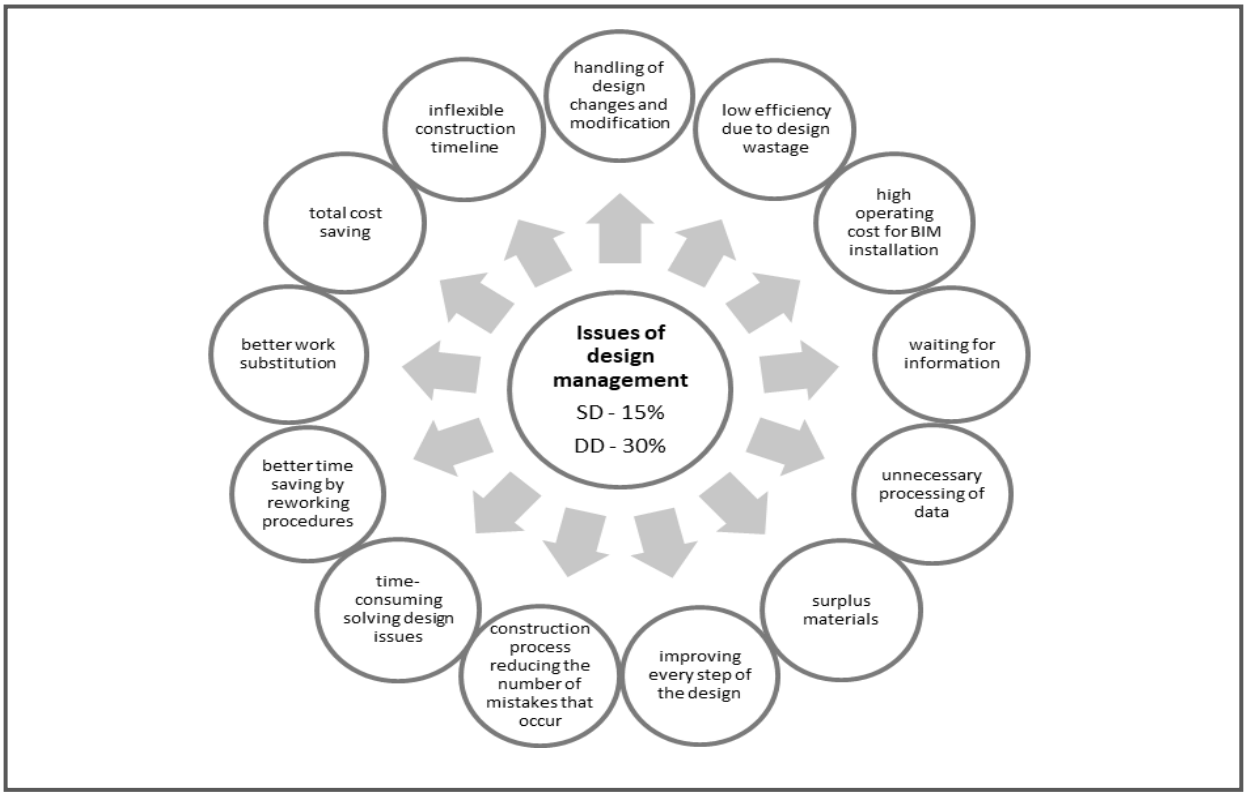
Figure 1: Diagram of BIM Challenges in Architectural Consultancy Practice during the Design Phase



The Complexity in Schematic Design and Design Development Phase

Different issues of concern affect the design phase of ACP very much in the context of the AEC industry. These include major drawbacks in operating systems and enormous wastage in construction, which takes place during the design phase. Other issues are efficiency being less proactive in the design phase, and high installation costs. The Schematic Design (SD) phase renders 15% of the services, while the Design Development (DD) phase constitutes 30% of the set of services rendered (LAM, 1986). Thus, about half-bind, almost 45% of all services, are usually offered during the design phase. ACP thus addresses waste and errors in design to help solve problems at the construction phase. It involves changes in contracts, which otherwise alter the interpretations of the contract, including the design intent, performance specifications, buildings, finishes, materials, site, and construction timelines (Matthew, 2017). Changes in design, therefore, result in delays in completion of the project, variances in additional changes, needless extra costs, and wrangling in disputes among construction teams. Enormous waste during the design phase also causes deterioration in handling design changes, waiting for information, and unnecessary processing of data and surplus material (Abdirad, 2017). And by making really honest appraisals of design change as to waste and time, the AD, among other things, will have great value in constraining what information is gathered with what requirement to justify costs or time. Moreover, BIM is criticized as an approach through which every step in the design and construction process can be improved, and mistakes can be minimized (Eastman et al., 2018; Zejnilović, 2017).

Figure 2: Issues reflected during the Schematic and Design Phases



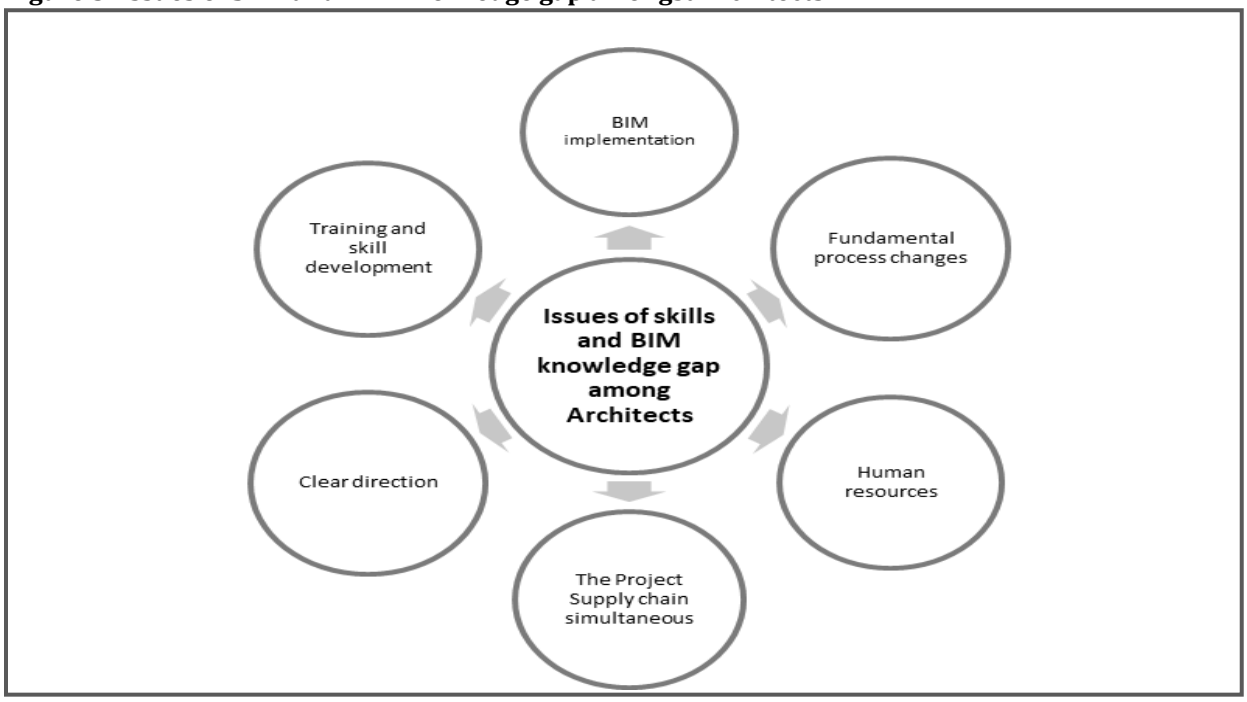
Source: (Abdirad, 2017; Zjnilovi, 2017; Eastman et al, 2008; LAM, 1986).

iii) Skill and knowledge in BIM amongst Architects

An important mitigating factor towards the adoption of BIM is limited knowledge about how BIM works, which can lead to improper identities or in implementation of BIM within organizations (Jo et al., 2018). In most successful BIM cases, there is always a knowledgeable person or a team of specialized advisors. BIM introduces fundamental changes in business and industry processes (Eastman et al., 2018; Zejnilović, 2017). This change also requires enhancements in concurrent capabilities across the project supply chain, embracing the full set of players: ACP, consultancy firms, developers, contractors, and officials within approval agencies, all of whom have to be competent in BIM skills in line with either the Bews-Richards Model or the AIA BIM Standards. Though some companies have started BIM applications, they are still hesitant regarding how to proceed. Some firms struggled in the early phases of adoption, but most completed the endeavor (Abdirad, 2017; Zejnilović, 2017).

This suggests that research has shown that the SD and DD phases have not been fully embraced in recent BIM design approaches. After the design, BIM implementation will also use ACP standards to minimize errors and speed up the design process. The next step is to focus on how the ACPs would satisfy their primary needs about product creation, development, training, software, and hardware. This study explored the current status of BIM application and challenges and advantages for design phase implementation to gain public efficiency on ACP deliverables.

Figure 3: Issues of Skill and BIM knowledge gap amongst Architects



Source: (Arayici et al, 2009; Zejnilovi, 2017)

3. Methodology

The research investigation involved structured interviews with eight BIM practitioners from the private construction sector. The preference for the expert panel in Kuala Lumpur and Selangor was due to a lack of time and the availability of the researcher for fieldwork. All eight selected interviewees belonged to the older male group of age ranges between thirty-two to forty years, all of whom had experience with either BIM or BIM on the design stages in projects. Interviewees also included Director, Principal Head of BIM/Architect, BIM Architect, and BIM Coordinator, having experience ranging from six to twenty years for BIM and ten to eighteen years for ACC practice.

With views and experiences extrapolated about the projects covered by the study, it was concluded that all respondents had good knowledge of BIM implementation at the project design stage. What was noted was that longer exposure to BIM raised the level of insight/knowledge of the design stage implementation process, further asserting what Pruskova & Kaiser (2019) maintained to be an important aspect in knowledge generation for example such as experience. Interviews were held via online and telephone calls. The summary of the respondents' backgrounds is described in Table 2.

Table 2: Overview of the respondent's background

Respondent	Age & Gender	Location of ACP	Position held in ACP	Year of experience working in ACP	Year of experience working with BIM	Certification from a Professional Body
Respondent 1	40 (Male)	Kuala Lumpur	Director	15	12	Professional Technologist MBOT /LAM
Respondent 2	40 (Male)	Selangor	Director	16	20	LAM / Autodesk USA
Respondent 3	32 (Male)	Kuala Lumpur	Head of BIM / Architect	10	6	Professional Technologist MBOT/LAM
Respondent 4	39 (Male)	Kuala	Director	13	6	Autodesk

Respondent 5	34 (Male)	Kuala Lumpur Selangor	Principal	10	6	LAM
Respondent 6	36 (Male)	Kuala Lumpur	BIM Architect	10	4	LAM
Respondent 7	37 (Male)	Kuala Lumpur Selangor	Principal	11	9	LAM / Autodesk USA
Respondent8	38 (Male)	Kuala Lumpur	BIM Coordinator	18	10	Autodesk

4. Findings and Results

Findings on Guideline No. 1: Technology Perspective
Interviews with the experts indicated that existing hardware in those ACPs that cannot run BIM software must first be seen to upgraded to result in minimum investment costs for new equipment and tools. Software costs were thought to be the least serious consideration. Everything must be done fast to look into BIM promotion in Malaysia. Marketing and promotion of BIM must be supported by an in-depth cost-benefit analysis. BIM is expensive at first when compared with AutoCAD, but the productivity returns make it worthwhile.

Findings on Guideline No. 2: People's Perspective
The expert panel was unanimous in agreeing that creating awareness among design consultants within the construction industry is highly important. This can be achieved through various training and education programs to inform construction professionals regarding the benefits of BIM. This thesis submits that the people-oriented achievement of BIM objectives is more complicated than that from a technical standpoint. Therefore, top management in the ACPs is required to invest in BIM-oriented education and training programs.

Findings on Guideline No. 3: Process Perspective
According to experts in the panel, various possible methods would assure a successful BIM adoption by ACPs:

- Familiarizing ACPs with BIM flexibility and familiarity.
- Boosting BIM references among stakeholders of a project, such as clients, consultants, and contractors, so that information can be shared, communicated, and reused throughout BIM projects consistently.
- Establishing the efficiency of a plan for BIM establishment, presenting a BIM guideline to allow ACPs to examine all the relevant criteria.

The process of transitioning to a new technology, such as BIM requires a strategic approach. One way to guarantee widespread adoption among these key players is with government enforcement of BIM regulations. Government support is needed to strengthen BIM as a main driver of construction projects in the early stage of the execution process.

Experts say that instead of considering investment in buying new equipment and tools, the main component would improve the present hardware installed in ACPs that cannot run BIM software. The software costs were, all in all, the least important. However, introduce all possible means to speed up the adoption of BIM within this country. Effective marketing and promotion of BIM will need full-scale cost-benefit analyses supporting them. Although BIM is incredibly price-consumptive in initial investment compared to AutoCAD, its long-term effectiveness and productivity benefits justify its worth.

5. Conclusion and Recommendations

Thus, the above guideline was framed to improve the application of BIM from the SD and DD phases of construction. It includes maturity concepts, elaborated in this section. The guideline for BIM implementation for ACP was formed based on this concept and then adopted into the industry. A structured and systematic approach was necessarily imbibed in the development of the guideline to facilitate the success of BIM implementation within the stages of SD and DD of the project. It begins with BIM awareness and ends with sustaining BIM implementation strategies for such phases for other buildings, being three parts and a roadmap for Architectural Consultancy Practices, and it remains friendly to input use, particularly for the newcomer in construction who needs guidance. The guideline considers the ACP the appropriate timing in which BIM should

be utilized in the SD and DD phases. It provides information for architectural consulting firms that have implemented BIM but want to take it further. For the newcomer in the construction industry, it is a guideline that can assist with BIM during the SD and DD phases of a project. From what has been found, ACP found this guideline easy to understand.

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