INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

Vol 14, Issue 9, (2024) E-ISSN: 2222-6990

Development of Conceptual Framework Influencing the Success of Collaboration among Organisation in Managing BIM Construction Project Based on Client Perspectives

Raja Nor Husna Raja Mohd Noor[1], Aina Sazrina Mohd Johari[2], Juzailah Nur Yunus[3] , Nor Izzah Zainuddin[4] and Mohd Rafe Abdul Majid[5]

[1,2,3,5]Civil Engineering Studies, College of Engineering, Universiti Teknologi MARA Cawangan Pulau Pinang, Permatang Pauh Campus, 13500 Pulau Pinang, Malaysia, [4]School of Civil Engineering, College of Engineering, Universiti Teknologi MARA, 40450 Shah Alam, Malaysia

To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v14-i9/22794 DOI:10.6007/IJARBSS/v14-i9/22794

Published Date: 06 September 2024

Abstract

Collaboration is one of the most significant advantages of BIM as a process and platform in general, functioning as the best Building Information Modelling (BIM) solution enables the sharing of relevant and real information with various groups of individuals, such as designers, managers, and all of stakeholders. There is a dispute in handling BIM collaboration which makes it difficult for the client organization to manage their project. In addition, as client perspectives especially there is no specific procedure or reference that can be used as a guideline in implementing BIM collaboration. Therefore, there is a need to develop conceptual framework influencing the success of collaboration among organisation in managing BIM project based on client perspectives. This research study focused on three objectives which (i) to identify the current existing practices on the collaboration among organisation in the BIM projects based on client perspective to enhance the BIM collaboration in the building and infrastructure projects organisation; (ii) to investigate the factor influencing the success of collaboration among organisation in BIM projects based on client perspectives and (iii) to develop conceptual framework influencing the success of collaboration among organisation in managing BIM project based on client perspectives. Methodology for this research study is systematic literature review (SLR) and questionnaire survey were involved 30 respondents that have an experience in BIM construction projects. The data from the questionnaire survey was processed and analyzed using the ranking analysis via mean and standard deviation in order to rank the factor for both objectives. Finally, based on the consolidated of findings, a conceptual framework for collaboration

among organisation in BIM construction projects based on client perspectives can be develop. The conceptual framework can describe the relationship between the variables under study and can be initial database as guidelines to the client organisation and other construction players where can enhancing BIM collaboration in construction projects.
Keywords: Building Information Modelling (BIM), Collaboration And Conceptual Framework

Introduction

According to CIDB (2016), Building Information Modelling (BIM) in Malaysia is defined as a modeling technology and related set of processes for producing, communicating, analyzing, and using digital information models throughout the life-cycle of a construction project. BIM is well known in the construction industry either Malaysia or overseas in order to improve the quality of work. According to Sinoh et al., (2020), BIM is a disruptive technology and becomes necessary in the architecture and engineering sectors, particularly in Malaysia in 2020. BIM applications in construction projects provide numerous benefits to construction stakeholders, including improved communication among stakeholders and speedier design decisions (Cho et al., 2011).

However, BIM collaboration in Malaysia has shown gradual movement. This is supported by the CIDB (2017) data, which shows that in peninsular Malaysia, Sabah, and Sarawak, only 17 percent of projects use BIM. Despite the industry's awareness and willingness to take initiative, where the CIDB has been organizing a series of BIM awareness programs, such as BIM Day and National wide BIM Road Tour, awareness programs have been a part of CIDB initiatives for increasing awareness and understanding of the construction industry since 2014 (CIDB, 2017), the percentage of BIM implementation remains low where it effects the collaboration among the organisations. To enhance the BIM implementation in Malaysia, CIDB and PWD had introduce several guidelines in terms of awareness, readiness, and execution plan as reference for the organization to fully adopted BIM effectively, however there is no existed conceptual framework influencing the success of collaboration among organisation in managing BIM project based on client perspectives to enhance the BIM implementation in Malaysia construction projects (CIDB, 2020 and PWD, 2014). Thus, this research is important to achieve these objectives which are: (i) to identify the current existing practices on the collaboration among organisation in the BIM construction projects based on client perspectives; (ii) to investigate the factor influencing the success of collaboration among organisation in BIM construction projects based on client perspectives; and (iii) to establish conceptual framework for collaboration among organisation in BIM construction projects based on client perspectives.

Literature Review

In this research, a systematic search was conducted using the Scopus search engine to identify articles related to current existing practices on the collaboration among organisation and factor influencing the success of collaboration among organisation in BIM construction projects based on client perspectives internationally and within Malaysia. Scopus was selected due to its accuracy and broad coverage of different research areas including management, business and engineering (Sinoh et al., 2020; Noor et al., 2021a). The search was limited to articles and review papers published in academic journals after 2011 untill 2023. Through the general keyword title “Building Information Modelling”, this search

returned 2041 references. Subsequently, two stages of screening processes were conducted to remove duplicate and unrelated articles.

In the first screening process, the full search code was TITLE-ABS-KEY (("building information model*" AND "collaboration") AND ("BIM" AND "organisation" AND ("BIM" AND "current exiting") AND ("BIM" AND "organisation" AND "factor influencing to success")) AND PUBYEAR > 2011 AND (LIMIT-TO (LANGUAGE , "English")) was used to select relevant articles. There were 1222 articles which were removed and 919 remained. Finally, the second screening process involved the reviewing of the "full text reading" specifically focusing on the factor influencing the success of collaboration among organisation in BIM construction projects based on client perspectives. A total of 889 articles were carefully removed and the remaining 30 articles were selected for a further process.

Based on the synthesize of previous literatures (i.e., Araiyici et al., 2011; Qian et al., 2012; Haron et al., 2013: Noor et al., 2021b), identified four components (i.e., people, management, government enforcement and technology), which were used as references to determine the related attributes for current existing practices and factor influencing the success of collaboration among organisation in BIM construction projects based on client perspectives. Therefore, through the content analysis approach recommended by Merriam (2009), 20 attributes associated with current existing practices on the collaboration among organisation in the BIM construction projects BIM were identified, while 20 attributes related to factor influencing the success of collaboration among organisation in BIM construction projects based on client perspectives were determined as shown in Table 1 and Table 2, respectively.

Current existing collaboration among organisation in BIM construction projects based on client perspectives, can be measured by observing the level of performance of task that had been for a task being implemented. According to the previous study (i.e., Alreshidi et al., 2017, Noor et al.,2021a, Noor et al.,2022), the level of collaboration still in the minimum level, and this shown a lack of level of collaboration among organisation to fully implement BIM in their projects. Therefore, the current existing practices for collaboration among organisation in BIM construction projects can be categorize into 4 components which are government enforcement, people, management and technology. Therefore, the summarization of attributes for current practices for collaboration among organisation in BIM construction projects has been highlighted in Table 1.

According to Alreshidi et al. (2017), the main important domain highlighted in the technology domain contribute to the current existing practices for collaboration is the lack of expertise as requirement or needs among organisation members in BIM collaboration. One of the applications of BIM, as demonstrated in prior research, is the potential replacement of human-to-human communication with human-to-computer communication through the use of models. This allows for more streamlined and efficient information sharing among different entities involved in traditional building processes (Liu et al., 2017). Furthermore, the current existing practices is the poor of software interaction in continuous exchanging model data (Liu et al., 2017), due to insufficient of internet facilities to access the software (Garcia et al., 2021). With the insufficient of knowledge improper of technical support for BIM collaboration such as software and hardware towards handling BIM it might be hard to involving the BIM collaborations (Garcia et al., 2021).

The main important domain contribute to the current existing of BIM collaboration based on clients perspective is management, where include cost maintenance, management leadership and collaboration strategies. Every management must obtain the necessary BIM software while keeping the total cost in mind. The decision-making process regarding BIM software

takes into account various direct and indirect expenses, including license updates, hardware upgrades, initial software acquisition, installation, and training costs. This must be balanced by stakeholders that benefit economically from the use of BIM in terms of increased productivity like improved cost, quality, and time (Patel, 2021). Next, the current existing practices is the lack of management leadership that able to improve the BIM collaboration. According to Alreshidi (2017), competent leadership is important factor that able to improve the BIM collaboration among project team. Furthermore, there is a lack of training of employers in handling the software due to lack support in terms of financial, psychology and technical. According to Oraee et al. (2019), a lack of BIM training and education leads to a mismatch in understanding among team members, which creates a barrier to collaboration in construction projects.

For people component, the main domain contribute to the current existing influencing collaboration in managing BIM project are awareness, people behaviour and skilled manpower. The lack of awareness related to utilisation of BIM software in the project collaboration is due to the slow acceptance and implementation of BIM in project such as difficulty to trust the new technology, reluctance to learn new BIM skills and BIM-based tools (Matthews et al., 2018). Next attributes is difficulties in the employment of skilled BIM manpower. According to Dainty et al. (2017) and Matthews et al. (2018), a lack of necessary skills is a significant barrier to inefficient cooperation on BIM-enabled projects. To successfully utilise new technologies, the required talent must be appropriately built and consistently improved. Due to the extensive usage of interdisciplinary cooperation in construction projects, BIM has provided an effective platform for collaborative activities, requiring participants to have the appropriate competences to work on BIM-enabled projects (Mignone et al. 2016). Project team often face challenges due to a lack of previous collaboration and expertise in BIM implementation due to lack of trust and consfidence. Contractors, in particular, may hesitate to acquire BIM models from designers due to concerns about the accuracy of the design models, uncertainties regarding ownership or copyright, and the additional time required for model analysis. To effectively implement the relatively new concept of BIM, individuals from different parties need to engage in more formal meetings and informal discussions, allowing them to familiarize themselves with the principles of BIM. This subjective process is necessary for all stakeholders involved, as highlighted by Liu (2017). The roles played by the government are vital factors that shape the readiness of organizations. Their policies, regulations, support, and collaborative efforts all contribute to fostering a favorable environment for organizations to improve their readiness levels and effectively navigate the challenges and opportunities of their respective sectors. The domains involves for this aspect are legal policy and government enforcement. The main challenges faced by project team is a lack of adequate national BIM guidelines and standard and lack of government support to influence organisation collaboration. Government support is crucial in fostering an environment that encourages and facilitates collaboration among organizations. It can involve providing financial incentives, creating collaborative platforms or networks, establishing favorable policies, and offering guidance and expertise (Zhang, 2020). Lin (2020) stated that corporate high-level support for BIM adoption has the potential to positively influence employees' perceptions of its usefulness and ease of usage.

However, according to previous studies (i.e., Saka et al., 2020 and etc) mentioned that there are several factor influencing the collaboration among organisation in BIM construction projects based on client perspectives where can be classify into four main component: (1)

technology; (2) management; (3) people and (4) government enforcement, as stated in Table 2.

Technology is one of the factor influencing the success of collaboration among organisation in managing BIM construction project based on client perspectives. The attributes that involve in this aspect is provide the training for the existing employees either internal or external activities that manage from company so that employees can improving their skill (Alreshidi, 2017). Yan & Kah (2018) also mentioned that technology is one of the factor influencing in BIM collaboration among organisation in Malaysia. The next factor influencing is keeping on update the software to keep the data safely (Zaini et al., 2020). Zhang et al., (2020) stated that provide the sufficient of internet facilities to easy access the software one of the factor influencing success in BIM collaborations. The next factor influencing is provide the professional technical personnel to guide handling the software (Muthusamy, 2020). It has been discovered that senior management backing inside the business, personal subjective will, and technical standards all influence whether designers wish to embrace BIM. Meanwhile, high-quality staff, effective management and leadership, information availability, and the project's complexity will all have an impact on the seamless deployment of BIM. The last factor influencing is enhancing and performing the proper of technical support for BIM collaboration (Liu et al., 2021). According to Zaini et al. (2020), the successful implementation of BIM collaboration depends on how effectively a company aligns BIM technology with its work processes. Familiarity with new software or hardware and instead necessitates a fundamental transformation in the design process are importance influence to assist project team collaborate together, as emphasized by Eastman et al. (2019).

Management is one of the factor influencing the success of collaboration among organisation in managing BIM project based on client perspectives. Employ the competent staff to operate BIM software for improving the BIM collaboration is one of the factor influencing the success of collaboration (Patel et al., 2011). Having competent staff would easier for project team collaborate to mange BIM in doing their respective tasks. This competent staff can also help in management leadership where the skills available make it easier for management to move to complete BIM collaboration projects. Other attributes that influence the project team collaboration where strategies and policies (Zaini et al., 2020), where it able to increase the organisational readiness towards BIM collaboration (Tam et al., 2021). Therefore, the summarization of factor influencing the collaboration among organisation in BIM construction projects based on client perspectives has been highlighted in Table 2.

Table 1

Summarazation of Current Existing Practices on the Collaboration among Organisation in the BIM Construction Projects Based on Client Perspectives

Current Existing Practices on the Collaboration among Organisation in Building Information Modeling (BIM) Projects based on Client Perspectives	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**R11**	**R12**	**R13**	**R14**	**R15**	**R16**	**Total Hits**
Technology																	

Lack of expertise of requirement among organisation members in BIM collaboration in projects	/		/			/		/	/					/			6
Poor of software interaction in continuous exchanging model data		/	/	/			/			/		/				/	7
Insufficient of internet facilities to access the software	/	/	/	/	/		/		/						/		8
Shortage of knowledge on handling the technology (software) in BIM collaborations projects		/	/			/		/			/			/			6
The improper of technical support for BIM collaboration (e.g: software and hardware)	/		/		/			/			/						5
Current Existing Practices on the Collaboration among Organisation in Building Information Modeling (BIM) Projects based on Client Perspectives	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**R11**	**R12**	**R13**	**R14**	**R15**	**R16**	**Total Hits**
Management																	
High cost of maintenance and technical support issue	/	/		/			/				/						5
Lack of management leadership that able to improve the BIM collaboration		/	/			/		/	/			/		/	/		8
Lack of training of employers in handling the software	/	/			/				/								4
The improper of BIM collaboration strategies and process		/		/	/			/		/	/					/	7
Poor of organisational readiness in BIM collaborations project		/		/			/						/				4

Table 1
Summarization of Current Existing Practices on the Collaboration among Organisation in the Bim Construction Projects Based on Client Perspectives (continue)

Current Existing Practices on the Collaboration among Organisation in Building Information	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**R11**	**R12**	**R13**	**R14**	**R15**	**R16**	**Total Hits**

Modeling (BIM) Projects based on Client Perspectives																	
People																	
Lack of awareness related to utilisation of BIM software in the project collaboration	/		/	/		/	/		/								6
Difficulties in the employment of skilled BIM manpower		/	/	/		/	/				/	/					7
Lack of trust and confidence among the employer or constructions players	/		/			/							/			/	5
Lack of motivation among BIM professional (behaviour)	/	/	/	/	/	/		/		/		/			/		10
Lack of understanding on roles and duties to operate and implement BIM collaboration		/	/		/	/		/	/					/			7
Current Existing Practices on the Collaboration among Organisation in Building Information Modeling (BIM) Projects based on Client Perspectives	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**R11**	**R12**	**R13**	**R14**	**R15**	**R16**	**Total Hits**
Government Enforcement																	
Lack of adequate national BIM guidelines and standard		/			/	/		/				/					5
Lack of government support to influence organisations in BIM collaboration		/			/	/						/	/		/		6
Lack of initiative to encourage organisations in	/	/	/		/			/		/			/			/	8

BIM collaborations															
High cost of BIM software implementation	/		/		/				/			/		/	6
Improper documentation and training support	/		/	/		/									4

R1: (Muhammad et al., 2013), R2: (Wang et al., 2010), R3: (Esraa et al., 2022), R4: (Badiru et al., 2015), R5: (Al-Ashmori et al., 2019), R6: (Tallgren et al., 2019), R7: (Latiffi et al., 2013), R8: (Volk et al., 2013), R9: (Oraee et al., 2018), R10: (Shang et al., 2014), R11: (Hosseini et al., 2018), R12: (Yan et al., 2017), R13: (Cao et al., 2017), R14: (Aizul et al., 2016), R15: (Patel et al., 2012), R16: (Zaini et al., 2019)

Table 2

Summarization of the Factor Influencing the Success of Collaboration among Organisation in Building Information Modeling (BIM) Projects Based on Client Perspectives

Factor Influencing the Success of Collaboration among Organisation in Building Information Modeling (BIM) Projects based on Client Perspectives	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**R11**	**R12**	**R13**	**R14**	**Total Hits**
Technology															
Provides the training for the existing employees either in external or external activities that manage by organisation		/		/		/			/						4
Keep on update the software to keep safe the data		/	/						/	/				/	5
Provides the sufficient of internet facilities to easy access the software	/		/	/		/		/				/		/	7
Provide the professional technical personnel to guide handling the software				/		/									2
Enhance and performing the proper of technical support for BIM collaboration			/		/				/						3
Factor Influencing the Success of Collaboration among Organisation in Building Information Modeling (BIM)	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**R11**	**R12**	**R13**	**R14**	**Total Hits**

Projects based on Client Perspectives															
Management															
Compliance to incorporate BIM in construction projects with other construction players to cut the cost of maintenance and technical support issues	/			/		/	/				/			5	
Employ competent staff to operate the BIM software for improve the BIM collaboration	/	/	/						/		/		/	6	
Provides the employer to keeping updated about recent technology trends in the industry to handling the software	/			/			/				/		/	5	
Top management of the stakeholders need to defined the strategies and policies for BM collaboration	/		/	/		/		/				/		6	
Management set up a system for performance measurement that able help increasing the organisational readiness	/	/	/			/	/		/	/				7	

Table 2

Summarization of the Factor Influencing the Success of Collaboration among Organisation in Building Information Modeling (BIM) Projects Based on Client Perspectives (Continue)

Factor Influencing the Success of Collaboration among Organisation in Building Information Modeling (BIM) Projects based on Client Perspectives	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**R11**	**R12**	**R13**	**R14**	**Total Hits**
People															
Take action in undertaking BIM training and seminar to	/	/	/		/	/		/		/					7

increase the awareness about BIM software															
Improving the internet and power supply infrastructure to form skilled manpower	/	/		/		/				/				/	6
Openly sharing information to better understanding the expectations, actions and demonstrate desire to help enhance trust and confidence	/	/	/	/		/		/							6
Using interface/graphic interface easiness of the BIM software to utilize in the various types of projects to motivate BIM players	/	/	/	/	/	/			/				/		8
Establish integrated combination of mutual clarification and reminder of roles and duties	/	/				/						/	/		5
Factor Influencing the Success of Collaboration among Organisation in Building Information Modeling (BIM) Projects based on Client Perspectives	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**R11**	**R12**	**R13**	**R14**	**Total Hits**
Government Enforcement															
Enhance the cooperation between BIM experts, academia and researchers to educate and expose BIM to young generations	/	/		/			/	/	/	/	/	/			9
Government should provide the national BIM standard and guidelines to support the BIM collaboration		/		/	/		/	/	/	/		/			8
Encouragement from top management in the organisation to implement BIM (e.g: financial supports)	/		/	/	/	/	/							/	7
Government action by subsidizing the cost of BIM software and attending seminar	/	/	/			/								/	5

Provision of supportive documentation and training to the customers on the newly launched BIM software and latest techniques.	/	/	/	/	/	/	6

R1: (Garcia et al., 2021), R2: (Chen et al., 2017), R3: (Hafiz et al., 2019), R4: (Rizal et al., 2010), R5: (Liu et al., 2020), R6: (Saznizam et al., 2019), R7: (Muthusamy et al., 2020), R8: (Tam et al., 2021), R9: (Zhang et al., 2020), R10: (Alreshid et al., 2017), R11: (Wang et al., 2022), R12:(Patel et al., 2021), R13: (Sun et al., 2019), R14: (Liu et al., 2016)

Methodology

In the initial stage, a systematic literature review (SLR) was conducted to explore the attributes relating to current existing practices on the collaboration among organisation in the BIM construction projects based on client perspectives and factor influencing the success of collaboration among organisation in BIM construction projects based on client perspectives to implement BIM in the projects. Subsequently, the questionnaires survey was selected as the method of data collection involving 30 practitioners focusing on client among Klang Valley area. A pilot research was distributed among 5 numbers of academics at UiTM that have an expertise as professional engineer (Ir). The goal of performing the pilot research is to increase the quality of information in questionnaire and efficiency of the performed survey. According to Teijlingen (2014), one of the advantages of conducting a pilot study is to improve the main study's quality and efficiency and help researchers gain experience with the study approach. Due to research constraint in term of time research period, this research distributed questionnaire using Google Form and telephone interview. The responses from the respondents were sufficient and satisfying to present the case studies in Klang Valley. According to Noor et al. (2019), selection of case studies is appropriate to describe the detailed study of single groups or organisations and projects. The closed-ended questions had been designed comprising of two parts (i.e., respondent profiles and assessment of attributes that are related to current existing practices and factor influencing the success of collaboration among organisation in BIM construction projects based on client perspectives). This set of survey used the 5-point of Likert-type scale (1: not important to 5: highly important). The data collection were process through Statistical Package for the Social Science (SPSS) version 26.0. The ranking analysis was executed based on mean value and standard deviation as suggested by Sinoh et al. (2020) and Noor et al. (2018), to indicate the rank for the attributes related to the current existing practices and factor influencing the success of collaboration among organisation in BIM construction projects based on client perspectives.

Profile of Respondents

In overall, there was a good mixture of organisation of respondents specifically focus on clients from varies main designations (i.e., engineer, project manager, assistant manager, manager, project engineer and supervisor), whereby a majority of respondents (59 per cent) were engineers and project managers as practitioners who were directly involved in the management and operations in BIM project working practices (see Table 3). On average, the respondents had about more than 11 years of experience in the construction industry and there were 87 percent of respondents who had experienced the use of BIM during the working process. In overall, all of respondents were considered as experts due to the year of experience in average between 11-1 years in construction industry and in average 6 -10 years experience working in BIM projects.

Table 3
Respondent's Background

Profile	Description	Percentage (%)
Designation	Engineer	46
	Project Manager	17
	Assistant Engineer	13
	Manager	10
	Project Engineer	7
	Supervisor	7
Experience in Construction Industry	More than 15 years	20
	11 – 15 years	47
	6 - 10 years	33
Experience in BIM Utilization	Yes	28
	No	72
Experience Working in BIM Project	11 – 15 years	13
	6 - 10 years	87

Ranking Analysis and Findings

This section presents the ranking of the attributes and components related to the current existing practices on the collaboration among organisation in the BIM construction projects based on client perspectives as indicated in Table 4. Ranking analysis assigns a number to each attribute to indicate its rank based on their mean and standard deviation values. Having ranked the attributes and component for current existing practices on the collaboration among organisation in the BIM construction projects based on client perspectives, the ranking analysis indicates that the highest mean values for component was "Technology" (mean value = 4.294) was given rank of 1, which comprised of the top three attributes. Technology domain comprise five attributes including "Lack of expertise of requirement among organisation members in BIM collaboration in projects" (mean value = 4.47), followed by "Shortage of knowledge on handling the technology (software) in BIM collaborations projects" (mean value = 4.40) and "Insufficient of internet facilities to access the software" (mean value = 4.37).

Meanwhile, "management" component was ranked as No. 2 which highlighted three important attributes for current existing practices on the collaboration among organisation in the BIM construction projects based on client perspectives. There were three attributes highlighted under "management" which include the "The improper of BIM collaboration strategies and process" (mean value = 4.50), and "Lack of training of employers in handling the software" (mean value = 4.27) and "High cost of maintenance and technical support issue" (mean value = 4.10) contribute to the "management domain".

In addition, component for "government enforcement" has been ranked as No. 3, whereby this component was underpinned with three main attributes. The first domain related to government enforcement is "High cost of BIM software implementation" (mean value = 4.50), followed with "Lack of initiative to encourage organisations in BIM collaborations" (mean value = 4.27). While, the third domain is "Lack of adequate national BIM guidelines and standard" with (mean value = 4.10) and "BIM implementation can be aided by sufficient organisational support " (mean value = 4.17), respectively.

Subsequently, the “people” component was ranked as No 4, with (mean value = 4.154). The mean value was showing that the "important" contributed to the current existing practices, in this study this component was considered as part of essentials and appropriate attributes that are able to describe the real current practices of on the collaboration among organisation in the BIM construction projects based on client perspectives. For “people” component, it comprised of there main domain attributes. The “Lack of motivation among BIM professional (behaviour)” with (mean value = 4.27) and followed with domain of “Difficulties in the employment of skilled BIM manpower” with (mean value = 4.17) and domain of “Lack of understanding on roles and duties to operate and implement BIM collaboration” with (mean value = 4.13) which describe the current existing practices on the collaboration among organisation in the BIM construction projects based on client perspectives as the findings suggest.

Table 4 Ranking Analysis Based on Mean and Standard Deviation of Current Existing Practices on the Collaboration among Organisation in the Building Information Modeling (BIM) Projects Based on Client Perspectives

Table 4
Ranking Analysis Based on Mean and Standard Deviation of Current Existing Practices on the Collaboration among Organisation in the Building Information Modeling (BIM) Projects Based on Client Perspectives (Continue)

The Current Existing Practices on the Collaboration among Organisation in the Building Information Modeling (BIM) Projects based on Client Perspectives	**Mean**	**Std. Deviation**	**Rank**	**Mean Overall**	**Std. Deviation Overall**	**Overall rank**
Technology						
Lack of expertise of requirement among organisation members in BIM collaboration in projects	4.47	0.571	1			
Shortage of knowledge on handling the technology (software) in BIM collaborations projects	4.40	0.498	2			
Insufficient of internet facilities to access the software	4.37	0.669	3	4.294	0.632	1
The improper of technical support for BIM collaboration (e.g: software and hardware)	4.30	0.596	4			
Poor of software interaction in continuous exchanging model data	3.93	0.828	5			

The Current Existing Practices on the Collaboration among Organisation in the Building Information Modeling (BIM) Projects based on Client Perspectives	Mean	Std. Deviation	Rank	Mean Overall	Std. Deviation Overall	Overall rank
Management						
The improper of BIM collaboration strategies and process	4.50	0.509	1	4.280	0.556	2
Lack of training of employers in handling the software	4.27	0.640	2			
High cost of maintenance and technical support issue	4.10	0.662	3			
Poor of organisational readiness in BIM collaborations project	4.07	0.583	4			
Lack of management leadership that able to improve the BIM collaboration	4.07	0.583	5			
Government Enforcement						
High cost of BIM software implementation	4.50	0.509	1	4.202	0.595	3
Lack of initiative to encourage organisations in BIM collaborations	4.27	0.640	2			
Lack of adequate national BIM guidelines and standard	4.10	0.662	3			
Lack of government support to influence organisations in BIM collaboration	4.07	0.583	4			
Improper documentation and training support	4.07	0.583	5			
People						
Lack of motivation among BIM professional (behaviour)	4.27	0.640	1	4.154	0.520	4
Difficulties in the employment of skilled BIM manpower	4.17	0.379	2			
Lack of understanding on roles and duties to operate and implement BIM collaboration	4.13	0.571	3			
Lack of trust and confidence among the employer or constructions players	4.10	0.403	4			
Lack of awareness related to utilisation of BIM software in the project collaboration	4.10	0.607	5			

Table 5 shows the results for factor influencing the success of collaboration among organisation in BIM projects based on client perspectives which comprised of four components (i.e. government enforcement, management, technology and people) that underpinned several essential vital components that drive the BIM implementation in the project organisation. The results in Table 5 highlighted that this component was influenced by four main criteria including "Government Enforcement" which ranked as No. 1 with mean 4.274, followed by three main domain "Management", "Technology" and "People" with overall mean of 4.166, 3.976 and 3.880 respectively. As described in the results, there were several top three attribute underpinned with "Government Enforcement" influencing organisation collaboration in managing BIM projects including "Enhance the cooperation between BIM experts, academia and researchers to educate and expose BIM to young generations" with (mean value = 4.57)," Government action by subsidizing the cost of BIM software and attending seminar" with (mean value = 4.37) and "Encouragement from top management in the organisation to implement BIM (e.g: financial supports) with (mean value = 4.27).

Meanwhile, "Management" component was ranked as No. 2 which highlighted two important attributes to strengthen collaboration among organsiation. The first attribute is "Management set up a system for performance measurement that able help increasing the organisational readiness" with (mean value =4.40) and followed with "Provides the employer to keeping updated about recent technology trends in the industry to handling the software" with (mean value = 4.23).

In addition, component for "Technology" has been ranked as No. 3, whereby this component was underpinned with three main attributes. The first domain related to management is "Provides the sufficient of internet facilities to easy access the software" (mean value = 4.30), followed by two main attributes including "Provide the professional technical personnel to guide handling the software" (mean value = 4.17) and "Enhance and performing the proper of technical support for BIM collaboration" (mean value = 4.07) respectively.

Subsequently, the "people" component was ranked as No 4, where comprised three main attributes contribute to the success of collaboration in managing BIM projects. The first attribute highlighted "Take action in undertaking BIM training and seminar to increase the awareness about BIM software" as first attribute with (mean value = 4.17), followed with "Improving the internet and power supply infrastructure to form skilled manpower" and "Establish integrated combination of mutual clarification and reminder of roles and duties" with (mean value = 4.03) and (mean value = 4.00) respectively.

Table 5
Ranking Analysis Based on Mean and Standard Deviation of the Factor Influencing the Success of Collaboration among Organisation in Building Information Modeling (BIM) Projects based on Client Perspectives

The Factor Influencing the Success of Collaboration among Organisation in Building Information Modeling (BIM) Projects based on Client Perspectives	Mean	Std. Deviation	Rank	Mean Overall	Std. Deviation Overall	Overall rank
Government Enforcement						
Enhance the cooperation between BIM experts, academia and researchers to educate and expose BIM to young generations	4.57	0.504	1			
Government action by subsidizing the cost of BIM software and attending seminar	4.37	0.490	2			
Encouragement from top management in the organisation to implement BIM (e.g: financial supports)	4.27	0.450	3	4.274	0.480	1
Government should provide the national BIM standard and guidelines to support the BIM collaboration	4.23	0.504	4			
Provision of supportive documentation and training to the customers on the newly launched BIM software and latest techniques.	3.93	0.450	5			
Management						
Management set up a system for performance measurement that able help increasing the organisational readiness	4.40	0.498	1			
Provides the employer to keeping updated about recent technology trends in the industry to handling the software	4.23	0.626	2			
Employ competent staff to operate the BIM software for improve the BIM collaboration	4.17	0.379	3	4.166	0.490	2
Top management of the stakeholders need to defined the strategies and policies for BM collaboration	4.03	0.490	4			
Compliance to incorporate BIM in construction projects with other construction players to cut the cost of maintenance and technical support issues	4.00	0.455	5			

Table 5
Ranking Analysis Based on Mean and Standard Deviation of the Factor Influencing the Success of Collaboration among Organisation in Building Information Modeling (BIM) Projects Based on Client Perspectives (continue)

The Factor Influencing the Success of Collaboration among Organisation in Building Information Modeling (BIM) Projects based on Client Perspectives	Mean	Std. Deviation	Rank	Mean Overall	Std. Deviation Overall	Overall rank
Technology						
Provides the sufficient of internet facilities to easy access the software	4.30	0.535	1			
Provide the professional technical personnel to guide handling the software	4.17	0.531	2			
Enhance and performing the proper of technical support for BIM collaboration	4.07	0.450	3	3.976	0.581	3
Provides the training for the existing employees either in external or external activities that manage by organisation	3.97	0.890	4			
Keep on update the software to keep safe the data	3.37	0.809	5			
People						
Take action in undertaking BIM training and seminar to increase the awareness about BIM software	4.17	0.461	1			
Improving the internet and power supply infrastructure to form skilled manpower	4.03	0.490	2			
Establish integrated combination of mutual clarification and reminder of roles and duties	4.00	0.525	3	3.880	0.612	4
Openly sharing information to better understanding the expectations, actions and demonstrate desire to help enhance trust and confidence	3.93	0.640	4			
Using interface/graphic interface easiness of the BIM software to utilize in the various types of projects to motivate BIM players	3.27	0.944	5			

In overall, it could be concluded that all of 20 attributes related to current practices on organisation collaboration in managing BIM project and 20 attributes of influencing of success for organisation collaboration in managing BIM project has been consolidated in a form of conceptual framework as described in Figure 1. Towards implementing the success of BIM in the projects, the strengthen of organisation collaboration is a part of a necessity that needs to be particularly highlighted in order to ensure the level of collaboration and integration of

an organisation is in the optimum level to execute BIM comprehensively. The strength of success of an organisation collaboration is based on the four main components (i.e., people, management, government enforcement and technology), which are considered as intercorrelated in each other. For example, the people component is a central of component that specifically acts as the main domain to nurture the project team collaboration towards managing BIM projects. This component should be underpinned with the (i.e., management, government enforcement and technology) in order to provide the optimum level of organisations collaboration to successfully implement BIM for projects.

Noor et al. (2021a) highlighted the success of BIM implementation in project level is influenced by the success of organisation collaboration in managing projects. Therefore, through this conceptualize framework, it could assist the BIM construction practitioners to enhance their understanding and awareness to fully prepare before executing BIM in the projects and also could act as a reference for best practices of BIM implementation in the working practice environment.

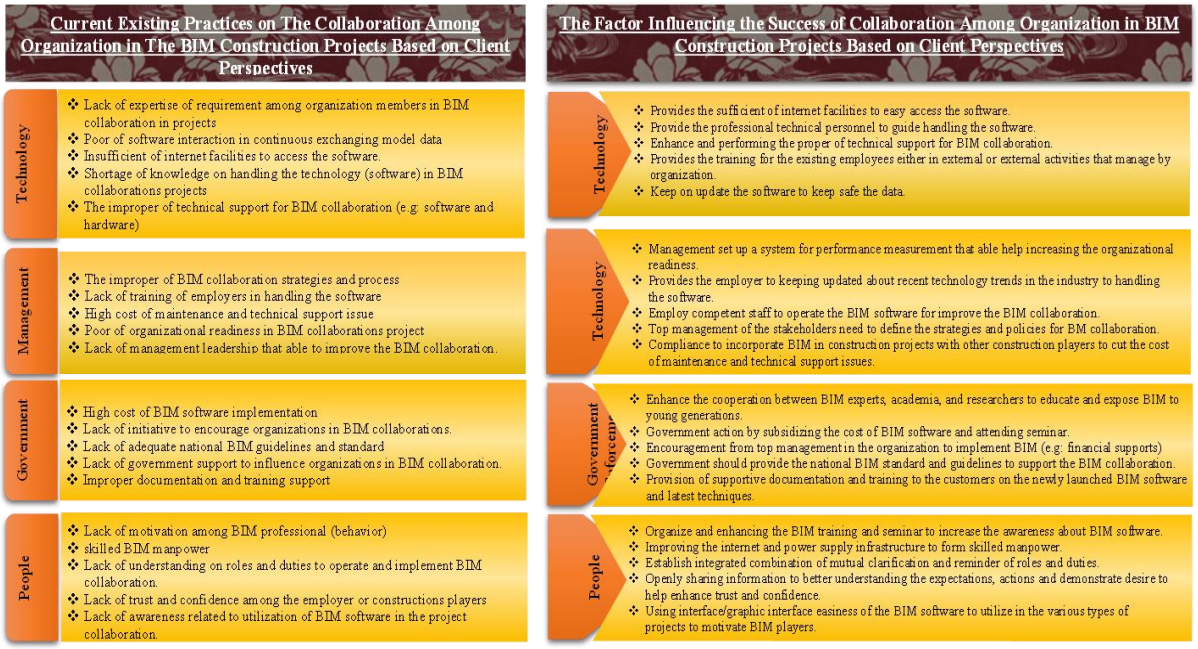

Figure 1. The Establishment Conceptual Framework For Collaboration Among Organisation in Building Information Modeling (Bim) Projects Based on Client Perspectives

Conclusion

This research study has provided an overview of the attributes related to the current existing and factor influencing the success of the collaboration among organistaion in managing BIM construction projects. Based on the questionnaire survey with response from BIM construction practitioners, this study assessed the importance of related attributes to prepare the readiness and reference for construction practitioners towards the success of BIM implementation in the projects. The findings identified 20 attributes of current practices and 20 attributes for factor influencing the success of collaboration among organisation in managing BIM projects which has been classified into four main components (i.e., people, management, government enforcement and technology) which has further been consolidated in the conceptualize framework (see Figure 1), that needs to be emphasized for organisation readiness and as reference in order to execute BIM in projects.

Furthermore, this study showed that practitioners' knowledge and experience at a variety of levels in construction environments can result in generating responses that are linked with real construction practices especially in managing BIM construction projects. Therefore, the proposed conceptualize framework could be applied for BIM construction practitioners as a point of reference to gain a better understanding in achieving the optimum level of readiness among BIM organisation towards the implementation of BIM comprehensively in projects. Consequently, this initiative could drive and cultivate the BIM practitioners towards achieving construction strategy 4.0 in changing the direction of working environment via advanced technology tool implementation especially in Malaysia context.

Acknowledgement
The author gratefully acknowledges the support from Universiti Teknologi MARA Cawangan Pulau Pinang, Malaysia. Special gratitude is also extended to the BIM construction practitioners, for their valuable input and commitment throughout the survey of case study.

Corresponding Author
Raja Nor Husna Raja Mohd Noor, Civil Engineering Studies, College of Engineering, Universiti Teknologi MARA Cawangan Pulau Pinang, Malaysia, Permatang Pauh Campus, 13500 Pulau Pinang, Malaysia. Email:rajanorhusna@uitm.edu.my

References

Alreshidi, E., Mourshed, M., & Rezgui, Y. (2017). Factors for Effective BIM Governance. Journal Of Building Engineering, 10, 89–101.

Arayici, Y, Egbu, C. O, & Coates, S. P. (2021). Building information modelling (BIM) implementation and remote construction projects: issues, challenges, and critiques. Journal of Information Technology in Construction, 17, 75-92.

CIDB. (2016). Building Information Modelling (BIM) Standard. Construction Industry Development Board, Malaysia.

CIDB (2017). Building Information Modelling (BIM) Report. Construction Industry Development Board, Malaysia, doi: https://www.cidb.gov.my/wp-content/uploads/2022/07/1217-MALAYSIA-BIM-REPORT-2016-min.pdf.

CIDB (2020). Legal & Contractual Requirement for Construction 4.0 in Malaysian Construction Industry.doi: https://mybim.cidb.gov.my/download/bim-legal-contractual-requirements/?wpdmdl=15742&refresh=6620b90e50ca71713420558

Dainty, A. R., Bagilhole, B. M., & Neale, R. H. (2017). Communication and Cultural Influences in Construction Project Teams: An Investigation into the Effects f National Culture on the Prevalence of Conflict Issues among Project Team Members. *Construction Management And Economics, 35(5)*, 270-284.

Eastman, C. M., Teicholz, P., Sacks, R., & Liston, K. (2019). BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, And Contractors. John Wiley & Sons.

Garcia, A., & Murguia, D. (2021). A Scenario-Based Model for the Study of Collaboration in Construction. *Proc. 29th Annual Conference Of The International Group For Lean Construction (IGLC)*.

Haron, A. T. (2013) Organisational Readiness to Implement Building Information Modelling: A Framework for Design Consultants in Malaysia. University of Salford Manchester, Salford, M5 4WT, U.

Lin, H. (2020). Examining BIM Adoption in Construction Projects: Role of Perceived Usefulness, Perceived Ease of Use, and Organizational Support. *Journal Of Civil Engineering And Management, 26(7),* 629-642.

Liu, Y., Van Nederveen, S., & Hertogh, M. (2017). Understanding Effects Of BIM on Collaborative Design and Construction: An Empirical Study in China. *International Journal Of Project Management*, *35*(4), 686–698.

Matthews, J., Love, P., & Easterbrook, D. (2018). Skills and Competencies for Effective BIM Implementation across Project Lifecycle. *Automation in Construction, 92,* 312-326.

Mignone, P., Messner, J. I., & Fischer, M. (2016). Evolution of Interorganizational Relationships in BIM-Enabled Projects. *Journal of Construction Engineering and Management, 142(7),* 04016024.

Noor, R. N. H. R. M., Endut, I.R, Ridzuan, A.R.M., Dahalan, N.H, Yunus, J.N. & Tutur, N. (2018), Major Challenges to Improve The Performance of Construction Waste Management Process: A Case Study in Klang Valley, AIP Conference Proceedings 2020,020054, vol 2020, doi: https://doi.org/10.1063/1.5062680.

Noor, R.N.H.R.M, Ibrahim, C.K.I.C, & Belayutham, S. (2021a). The Nexus of Key Attributes Influencing The Social Collaboration Among BIM Actors: A Review of Construction Literature, International Journal of Construction Management, doi: 10.1080/15623599.2021.1946902.

Noor, R. N. H. R. M., Che Ibrahim, C.K.I., Belayutham, S., (2021b). Making Sense of Multi-Actor Social Collaboration in Building Information Modelling Level 2 Projects: Case Study in Malaysia, Construction Economics and Buildings. Vol 21, No.4, http://dx.doi.org/10.5130/AJCEB.v21i4.7829.

Noor, R. N. H. R. M, Roslan, F. N., & Yunus, J. N. (2022). Conceptualization of Readiness for BIM Implementation Practice Among Construction Organisations: Pulau Pinang Case Study. AIP Conference Proceedings. 2532 (1), 1-14. doi: https://doi.org/10.1063/5.0113005.

Merriam, S.B. (2009). Qualitative Research A Guide to Design and Implementation, Revised and Expanded From Qualitative Research and Case Study Applications in Education, John Wiley & Sons.

Muthusamy, K., & Chew, L. (2020). Critical Success Factors for the Implementation of Building Information Modeling (BIM) among Construction Industry Development Board (CIDB) G7 Contractors In The Klang Valley, Malaysia. *2020 IEEE European Technology And Engineering Management Summit (E-Tems)*.

Patel, R. B., Shah, S., & Shah, P. (2021). Building Information Modeling: A Review of Practices and Opportunities. *Journal of Construction Engineering and Management, 147(5)*, 04021016.

Public Work Department (PWD)(2014). BIM Piawaian BIM JKR, https://www.jkr.gov.my/sites/default/files/documents/Piawaian%20Building%20Information%20Modeling%20%28BIM%29%20JKR.pdf

Saka, M. P., Birgonul, M. T., & Topal, N. (2020). Barriers to Building Information Modeling (BIM) Implementation in Turkey. *Journal of Management in Engineering, 36(4)*, 04020025.

Sinoh, S. S., Othman, F., & Ibrahim, Z. (2020). Critical Success Factors for BIM Implementation: A Malaysian Case Study. Engineering, Construction and Architectural Management, 27(9), 2737–2765.

Tam, C. M., Ong, L. H., & Tsui, W. M. (2021). Factors Affecting the Adoption of Building Information Modeling (BIM) in Construction Projects. *Journal of Civil Engineering and Management, 27(4),* 257-266.

Qian, A. (2012). Benefits and ROI of BIM for Multi-Disciplinary Project Management. National University of Singapore. doi: http://www.icoste.org/wp-content/uploads/2011/08/Benefits-and-ROI-of-BIM-for-Multi-Disciplinary-Project-Management.pdf.

Yan, C., & Kah, S. (2018). Implementation of Building Information Modeling (BIM) in Malaysia's Construction Industry. *International Journal of Construction Engineering And Management, 7(1),* 12-20.

Zaini, N., Ahmad Zaini, A., Tamjehi, S. D., Razali, A. W., & Gui, H. C. (2020). Implementation of Building Information Modeling (BIM) in Sarawak Construction Industry: A Review. *IOP Conference Series: Earth and Environmental Science*, *498*(1), 012091.

Zhang, R., Tang, Y., Wang, L., & Wang, Z. (2020). Factors Influencing BIM Adoption for Construction Enterprises in China. *Advances in Civil Engineering*, *2020*, 1–15.