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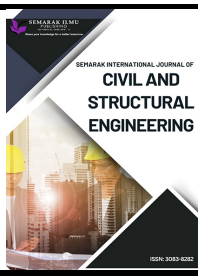

Strategies of Implementing Building Information Modeling (BIM) in Project Design Stage In Somalia

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ABSTRACT

Building Information Modelling (BIM) provides significant benefits to construction players. However, BIM in Somalia are still new and not implemented. This is due to lack of effective strategy in implementing BIM at project design stage. The aim of this project is to study the BIM barriers at the project design stage in Somalia's construction industry. The literature review was carried out to determine BIM implementation in project design stage and strategies that implemented in another country. The survey questionnaires were distributed to the construction field players within the city of Mogadishu based on the results of the interview with project teams. Results of this study revealed that the level of using BIM is still low, that only 1.3% of the construction players have knowledge about BIM. Further, the barriers for implementing the BIM that ranked based on the highest mean value of 4.022 to 3.196 are lack of competent staff to operate BIM software and lack of knowledge about BIM, respectively. The proposed strategies to enhance effective implementation BIM which ranked base on the highest mean value from 3.989 to 3.641 are government encourage and force to make all design in BIM formats and provide a grant scheme for BIM training. In conclusion, for successful widespread application of BIM in Somalia, a good push from the government alone is far from enough. All other construction industry players mentioned must assume their roles well in promoting the use of BIM in their construction projects.

1. Introduction

Construction industry is one of the contributors to the economy of Somalia. It has contributed a total worth of over 70% of the country's GDP to the Somalia gross domestic product in year 2011 to 2023 (Abdulrahman, 2019). According to Sarda and Dewalkar (2016), the uses of technology in the construction industry have increased the rate of Somalia economy. Nowadays, the implementation of BIM in project construction stage is seen as one of the effective ways to reduce construction problems. Even though BIM implementation gives positive effects to construction projects, most of

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the design team is facing difficulty to fully implement BIM. In addition to that, some were failed to obtain the benefits of using BIM (CREAM, 2019). According to Zakaria et al. (2020), some of the construction players are having difficulty to implement BIM as they do not know what, how, where, who and when to begin with BIM in construction projects especially in the Somalia construction industry. This matter happened due to several factors such as lack of knowledge on BIM, skill on BIM and the cost for BIM tools (Zakaria et al., 2019).

Therefore, this research will identify the barriers that hamper the implementation of BIM in project construction stage in Somalia. Low productivity of construction projects, low quality of end projects, project delay and construction cost overrun are the four main construction problems lead to construction project failure (Khosnava et al., 2012 and Haron, 2019). Most of the problems that were identified by Khosnava et al. (2012) and Haron (2022) occurred due to weakness in managing project construction phase. This shows that, project design stage is one of important element lead to the success of managing construction projects (Eastman et al., 2011; Memon et al., 2019). Therefore, many attempts were done by construction players especially by the design team (developer, architect, structural engineer, M&E engineer and contractor) to improve quality of project construction stage by implementing BIM (Forbes and Ahmed, 2020).

Moreover, the role of effective strategy to impalement BIM is important to answer all questions and enquiries from the construction players (developer, consultant and contractor), what can BIM produce and who are responsible towards the process (Building and Construction Authority (BCA), 2019). The strategy will help construction players to achieve all benefits of BIM implementation in construction project especially design stage in a right way. Since BIM implementation in project design stage could reduce construction problems during design stage, this research will have identified the barriers that hinder to implement BIM in project design stage in order to propose strategy that could enhance effective to implement BIM in project design stage. The strategy could assist design team in a proper way to implement BIM, so developer, contractor and consultant could gain all benefits of implementing BIM in design stage and increase efficiency in managing construction project lifecycle.

In addition, there are several examples of successful implementation of BIM in the stage of the project design. These projects include Birmingham City University in UK and the Freedom Tower in New York City, USA (Haron et al., 2022). Besides that, there are also some projects in Malaysia that implemented BIM have also been identified. These projects are Educity Sports Complex in Nusajaya, Johor and Ancasa Hotel in Pekan,Pahang and National Cancer Institute (NCI) of Malaysia in Putrajaya (Ahmad Latiffi et al., 2023). Other countries, such as the U.S.A and the UK have implemented BIM in their construction projects through the encouragement of their government (Li et al., 2017). The aim of this paper is to study the building information modeling (BIM) barriers in the construction in Somalia constriction industry. To achieve the aim of the following objectives have been used to determine the level of using BIM in project design stage in Somalia. 1. To identify the barriers of BIM implementation in project design Stage in Somalia. 2. To propose strategies that will enhance effective implementation BIM in project. 3. To empirically examine the partnership between the elements of the proposed relationship between the barriers and the strategies of BIM implementation.

The study will contribute to the pool of knowledge in various faces of academic and professional perspective. Academically, the study will generate a statistical data that is expected to contribute to developer, contractor, consultant (construction player) and the construction industry by identifying the barriers that hinder and slow to implement BIM in project design stage in Somalia and to identify level of BIM implementation in Somalia. The contractor is involved in this research because contractor is involved in managing project construction phase in design and build project (Chappell,

2020). Further, the proposed strategy could improve the implementation of BIM in Somalia that is beneficial to decrease construction waste in the construction industry.

Moreover, few studies have focused on testing relationship among the construction models in the construction industry context (Ahmed, 2020). In this regard, this paper promotes academic understanding by expanding knowledge of both the relationship barriers and strategies theory and practice. Therefore, the proposed model of the study contributes to existing theories on the construction management of relationships through empirical research of the association between its derived components — relationship strategies among relational barriers applied to the project team in selected construction sites Some of the strategies for the implementation of BIM in the United Kingdom are set out in Table 1

Table 1
The barriers and their strategies of the implementation of BIM at construction phase in UK (Sarhan and Fox, 2019)

Barriers	Strategies
Lack of understanding of the new model of network competition	Develop a new model of network competition Provide incentive by the government
Lack of staff training to achieve customers value	Constantly monitor and make the adjustments to customer value
Lack of communication and interaction to adopt BIM	Build a sense of trust and collaboration among the project team Adopt pull production system based on (Last planner system)
Expensive cost of adopting lean construction	Encourage contractors, consultants and clients to invest in lean construction
Lack of strategic leadership	Develop a strategic leadership style
Insufficient understanding of the BIM philosophy	Implementing processes that deliver true value for the customer

The research methodology has been decided based on the objectives of the study. Basically, this research needs opinions from the participants, for instance, the identified barriers of implementing BIM in Somalia design stage that are going to be rated by the participants and relate the real barriers of the current situation. Hence the participants need to understand and analyze each barrier prior to decide. This process attempts to get their opinion based on their experience, knowledge and attitude. Furthermore, the participants need to share their experience and knowledge to provide enough detail to find other possible barriers that may decrease the place of implementing BIM in Somalia construction stage. Which were not identified previously. In addition, the participants also need to relate the strategies that provided and provide their own valuable ideas to propose a strategy, which can be used as a guide to enhance effective the implementation BIM in Somalia. To increase the validity of the study, certain criterion had been set. The questionnaire was sent to 15 individuals who are connected to developer, consultant and contractor known as construction player. Participant were briefly explained the purpose of the research. Meantime, they were clearly informed that they are participating a pilot test. The answers were observed and compared each other. Two of 15 respondents have forwarded comments on the questionnaire. Respondent has stated that it will be better to use more technical terms and words in the questionnaire. Even though the point was taken in to the consideration, appropriateness to introduce more technical terms in to the questionnaire has been considered.

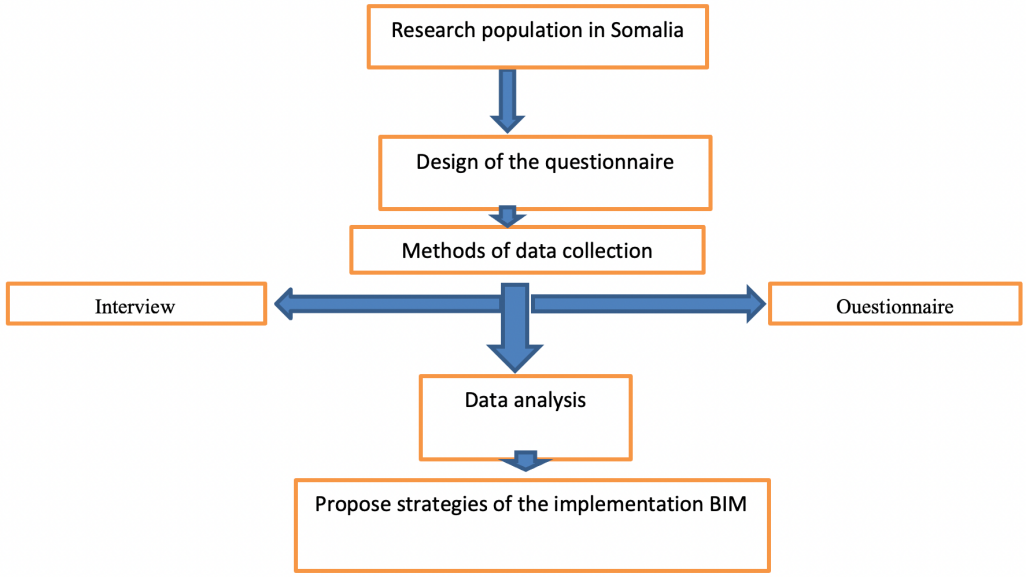

Fig.1. Flow chart

Fig. 3. Mogadishu city in Somalia (Google, 2021)

2.1 Semi structural interview with the project team

Semi-structured interview is conducted to get the understanding of the project teams at selected construction sites in Somalia about the factors that influence BIM in somalaia construction industry. 10 interviews were distributed among the contractors, developers and consultants of the selected construction companies The objective of this is to ensure a balanced distribution of the interviews

among the construction sites and, therefore, the responses from the participants. In addition, the selection criteria are based on the individuals who have knowledge and experience in private and government construction projects in Mogadishu (more than 7 years of the site experience) (Piaw, 2013; Braun et al., 2017). Ma et al. (2020) explained that the face-to-face interview provides accurate information about the interview. It is also very flexible and helps respondents to focus on and complete the interview (Li et al., 2017). Therefore, the face-to-face interview was chosen in this study as an interview method. It has been found that, feedback on the results of site manager in the building projects did not show a clear response regarding the implementation of BIM to reduce construction waste. Instead, the traditional method is applied for construction management due to their organizational culture, although they are aware of the importance of implementing BIM to increase profits (https://bimconstruct.com.my/). Organizational culture is considered a crucial factor in developing an innovative environment. Therefore, human factors such as people's behaviors and attitudes must be changed in order to make the right contribution to the collective culture of the organization (Arif et al., 2019). Notably, any firm needs a various set of cultural values, which still require a new competitive network method that depends on collaboration and coordination among companies. The expensive cost to adopt BIM software, lack of knowledge about BIM, and lack of competent staff to operate BIM are the common barriers that prevented BIM implementation in the building projects in Somalia based on several site engineers' responses (HM Government, 2022). lack of understanding of its concepts and insufficient training are significant obstacles to successful implementation of BIM. Notably, a minority of respondents considered that BIM is not adequate for the construction industry because of the demands from clients for quicker and cheaper projects. This is inconsistent with the principles of BIM to reduce construction waste in order to minimize the cost, time and add value to the client (CREAM, 2016). Therefore, without significant knowledge of BIM, various Mogadishu companies would resist sharing knowledge to accomplish customers values. On this basis, the best way to develop understanding of BIM in Somalia by investigating its core element and providing training to people in the construction industry to ensure continuous improvement through the implementation of BIM processes. the government encourages and stimulates the adoption of BIM in the design phase is a strategy that can increase the implementation BIM. On the basis of the respondent's point of view, the government must assume its responsibilities to encourage as well as stimulate various firms to create and innovate changes in the current culture of construction projects (Kim and Park, 2006; Fox and Sarhan, 2013). Therefore, the government could provide a new model of network guidelines for the use of BIM based on cooperation between different parties in terms of Clients, developers, consultants and contractors. In particular, having government support is crucial to developing a new network model.

2.2 Questionnaire

The knowledge and educational level of the respondents of the real scenario may vastly vary. As a result, 1000 questionnaires were sent to each of the relevant personnel from the 10 nearest construction companies. Notably, the number of respondents were less than 200 to run AMOS software using SEM (Kline, 2010; Xiong et al., 2015). Therefore, 232 project team members responded to the questionnaire. However, the participants for the pilot testing consist of General manager, project managers, Architectural coordinator, M&E coordinator, C&S coordinator and engineers. It has been noticed that the opinions of the respondents were considerably different. However, the information received through the questionnaire can be considered as satisfactory and adequate. Hence it has been realized that modifications are not necessary for the questionnaire. The sample must be contractor companies, Consultant and developer companies. The scope of work had

to consider the limitation and the constraints of the research, where large scale survey is practical. Therefore, quantitative research methodology will be ideal and most comfortable approach. However, the validity and the credibility of the results of the objectives can be only improved by precise statically analysis. Further, the applications of the result in the practical scenario needs to generalized up to a considerable extent. Furthermore, Statistically Package Social Science (SPSS) 24 and AMOS software will be used on this research to analysis the data.

2.2.1 Structural Equation Modelling

The measurement model is "the portion of the model that specifies how the observed variables depend on the unobserved, composite, or latent variables" (Arbuckle, 2005, p.89). In this sense, the measurement model aims to specify which items correspond to each latent variable. Accordingly, the measurement model in this research specifies the pattern by which each measure is loaded onto a particular variable (composite or latent variables) (Byrne, 1989). Each one of the constructs under consideration including relational bonds — barriers and strategies — which was separately analysed in a separate measurement model. If the results are not consistent with an a priori specified measurement model, then the measurement model should be prespecified, and reanalysed (Anderson and Gerbing, 1988; Bollen, 1989; Hair et al., 1995; Tabachnick and Fidell, 2001; Kline, 2005; Holmes-Smith, 2006). Thus, the measurement model in this stage has been evaluated in two steps. The first step assesses the unidimensionality for each factor, and the second step aims to assess the reliability and validity of each construct. These two steps are discussed below.

2.2.1.1 Assessing the Unidimensionality (Step 1)

First, this section covers the specification of the measurement model for each underlying construct with a discussion of the path diagram. Then, it describes the use of multi-item scales to measure each factor in the measurement model which assessed by describing the estimate (Factor loadings and Average Variance Extracted (AVE) that should be more than threshold 0.50 as well as Composed Reliability (CR) that should be more that 0.70). This is followed with a description of the procedures that were conducted to modify the measurement model.
In each measurement model, multiple items have been used to measure each factor (Anderson and Gerbing, 1982; Hair et al., 1995; Kline, 2005) to allow the most unambiguous assignment of meaning to the estimated constructs (Anderson and Gerbing, 1988). In this context, Kline (2005, p.172) maintains that, "if a standard CFA model with a single factor has at least three indicators, the model is identified. If a standard model with two or more factors has at least two indicators per factor, the model is identified." Consistent with this, Crosby et al. (1990) note that in measuring long-term relationships, it is unlikely that one item perfectly measures a construct.

3. Results

The reliability of the data was measured as per the procedure explained under methodology. The questionnaire covered the strategies. The result is varying from 0.788 to 0.802 From Table 2, which more than the Cronbach's Alpha index range. Further, 25 % of the range of Cronbach's Alpha coefficient result is 0.802 to 0.812, where the reliability of the data can be considered as good. In the meantime, the overall Cronbach's Alpha test result is average to 0.805. all the 11starategies are 73 consistence and reliable and considered as good since range of Cronbach's Alpha coefficient result is

0.856 to 0.877. the convergent validity was supported by all items being obviously significant (P<0.005) and loading on their specified factors.

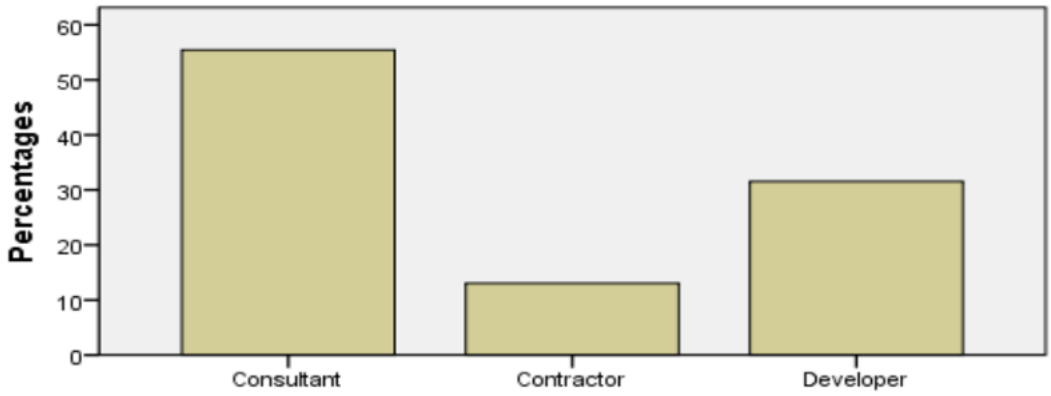

Fig. 2. The percentage of respondent's organization

Table 2
The percentage of respondent's organization

Descriptions	*Frequencies*	*Percentage (%)*
General Manager	*11*	*12*
Project Manager	*17*	*18.5*
C&S Coordinator	*7*	*7.6*
Architectural Coordinator	*8*	*8.7*
M&E Coordinator	*10*	*10.9*
Senior Engineering	*12*	*13*
Engineering	*167*	*29.3*
Total	*232*	*100*

From table 3 and table 4, it was observed that most of the strategies that could increase the pace of implementation of BIM in Somalia which the respondents generally agreed that the government should encourage and force to make all design in BIM formats (Mean =3.989) which, has a more significant role to speed up the enhance effective implementation BIM in Somalia. This indicates that in the Somalia, the government encourages and force is a must to implementing new approaches. Having a strong support from the government is vital and without the enforcement from the government in the implementation of BIM in Somalia, it will be slow or stagnant. Other countries like the United Kingdom (UK), Australia, Hong Kong and Singapore have implemented the use of BIM in their construction industry through their governments. In the UK for instance, the government is mandating BIM; Australia is supporting BIM, Singapore enforces the use of BIM as part of their policy

and terms of the contract and Hong Kong is assisting BIM (Succar, B., 2010; Zakaria et al., 2013; CREAM, 2019).

Other strategies that have more significant role to the government in order to increase the effective implementation BIM according to the respondent are Provide a grant scheme for BIM training (the second most important with Mean = 3.946) mobilizing Clients, contractor and consultant on the important of BIM (the third most important with Mean = 3.870) and the incentive is given by government such as a tax reduction (the fourth most important with Mean= 3.859) .The respondents believe that by having a grant scheme for training and by giving tax reduction, they can speed the effective of implementing BIM and this approach can also be used for those who are implementing BIM . This approach could attract the attention of the developer, contractor and consultant. The government through the municipality of Mogadishu could conduct conference about BIM and promote the benefits of BIM. This promotion could spark the curiosity about BIM among construction player in order to mobilize them on the benefit of BIM. By having a series awareness program to disseminate the knowledge of BIM, it can convey the benefits that can be gained by implementing BIM to the developer, contractor and consultant. The private sector could take part in this mobilizing because involvements from the private sector also play a significant role in speeding up the process of implementation of BIM in the construction. Additionally, the respondents also believe that local and private universities could play a major role in promoting BIM by providing curriculum or course related to BIM. This is why the introduction of BIM in university curriculum (fifth most important with Mean = 3.804) is one of the important strategies that could increase the effective of implementing BIM. Having a curriculum or course related to BIM could give the students an idea of what BIM is in the early stage and can produce students who are ready with a 3D parametric model. As we know, BIM technology Somalia is really new, therefore there are many opportunities for university researchers to conduct research related to BIM and they could collaborate with the industry to identifying the needs and the area for exploration.

Collaboration with local universities in research and development can be done through research grants, which are provided by the government such as Exploratory Research Grant or Science Fund. Moreover, one of the barriers that the organizations fail to realize the benefit of implementing new technology such as BIM is the lack of training provided by the organization for their staff, and the level and type of training should be based on the needs of the organization or individuals within an organization as it is shown in table 1. Hence, BIM training program for staff (sixth most important strategies with Mean =3.793) is one of the strategies that could increase the pace in implementing new technology like BIM. In addition, Some staff has low self-confidence especially related to implementing new technology such as BIM because the lack of knowledge, therefore Require/hire BIM specialist in company (eighth most important strategies with Mean = 3.750) could be one of the strategies to build up self-confidence in order to have a competent staff to operate BIM which is percent the requirement for staff to be BIM competent (seventh most important strategies with Mean = 3.751) to enhance effective implementation BIM in Somalia .

In addition, it is hard to guarantee that each person participating in the organization has the required technology and skill; therefore, the organization needs to have a development of BIM department within an organization to monitor the application of BIM in order to cater these barriers and to solve any barriers arise. This BIM department could disseminate their knowledge among the staff within an organization and this activity could spread the spirit of knowledge sharing among them. Therefore, the respondents believe that by the development of BIM department within an organization to monitor the application of BIM and having a technical support team (ninths most important strategies with Mean = 3.707) it can complement the training program provided by the organizations. It seen that the by providing free trial of BIM software the parentage of using it will

have increased especially with construction player that looking for new technology and solve the high cost of software at the same time government has a strong signification role in order to provide it, therefore, clients will be willing to pay extra for BIM implementation in design stage after they know about it is benefit and it is flexibility in designing

Table 2
Barriers of implementation LC in Mogadishu projects

Barriers of implementation LC in Klang Valley projects	Mean	SD
1. Lack of knowledge about BIM	4.54	0.82
2. Expensive software	4.33	0.81
3. Lack of training on BIM oftware	4.29	0.82
4. lacks features or flexibility to create a building model/drawing	3.8	0.81
5. Clients do not request or enforce BIM	3.7	0.85
6. Application of BIM will affect the current process practice	3.3	0.96
7. Legal or contract issue	3.2	0.91
8Lack of working procedures and standards	3.1	0.83
9. Lack of data of Return on Investment of BIM	3.0	0.99

Table 3
Strategies of implementation LC in Mogadishu projects

Strategies of implementation LC in Mogadishu projects	Mean	SD
1. Develop a new model of network competition	4.43	0.815
2. Build a sense of trust and collaboration among project team	4.29	0.812
3. Develop appropriate organization structure (pull production system in term of last planner system)	4.22	0.814
4. Implementing processes that deliver true value	3.90	0.816
5. Continuous monitoring and adjustment making in the building projects	3.69	0.816
6. Continuous improvement and optimisation in the building projects	3.30	0.910
7. Encourage clients and contractors to invest money to eliminate waste at every point possible	3.25	0.905
8. Contracts and legal issues of LC	3.24	0.820
9. Provide incentive by the government such as taxes	2.97	0.980

3.1 One Way ANOVA Test

The ANOVA analysis and whether there is a statistically significant difference between our group means. It is observed that the significance value is 0.006 (p = .006), which is below 0.05 and

there is a statistically significant difference in the mean of barriers and strategies. Therefore, we conclude that the strategies have a significant to effect on the barriers.

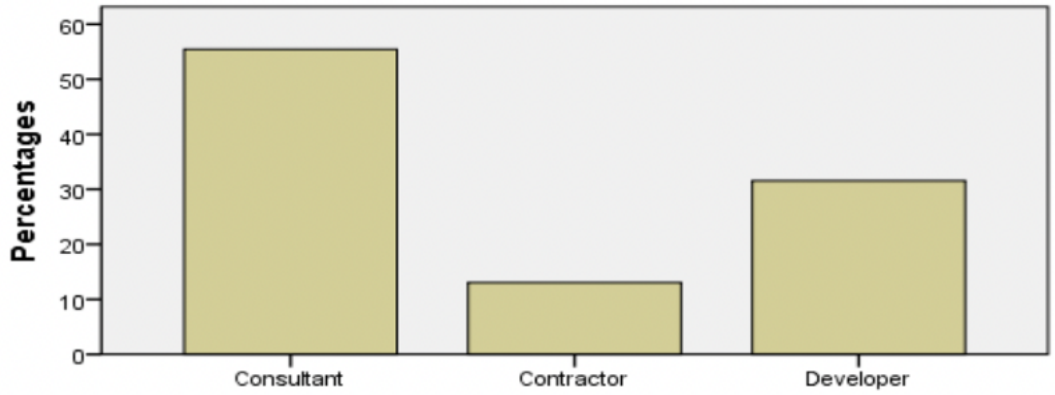

Fig .3. The One-Way ANOVA Test Result of Barriers and Strategies Means

3.2 A framework for strategies of the implementation BIM

Besides, it is noted that the average factor loading (AVE) of the barriers and strategies were significant. the average factor loadings AVE>0.5. As highlighted in the methodology through the discussion of the evaluation on the fit of the model to accept or reject the models based on SEM, particularly on the parsimonious fit indices. The chi-square (x2 /df) would be used in this study as an indicator of overall fit for accepting or rejecting the model in conjunction with other measures (Ajaya and Oyedele, 2018; Garza-Reyes et at., 2018; Mafimisebi et al., 2018). Furthermore, based on absolute fit indices to accept or reject the model, chi-square (x2) is considered the most essential measure to accept or reject the model (Durdyev et al. 2018; Mafimisebi et al., 2018). In particular, other measures have been verified through the implementation of CFA for barriers, as well as strategies for the implementation BIM, and have been considered appropriate. The decision would be supported if the chi-square values are (x2) or p-value = ***p<0.005, **p<0.01, *P<0.05. However, if p-value > 0.05, the decision could not be accepted (Ajaya and Oyedele, 2018; Durdyev et al. 2018; Mafimisebi et al., 2018). Notably, all barriers and their strategies have been adopted in the development of the framework (Ajaya and Oyedele, 2018; Garza-Reyes et at., 2018).

The test results of the hypothetical model by considering that the barriers are adpoted together to verify their adequacy are stated as follows. The barrier1, barrier2, barrier3, barrier5, barrier6, barrier 7, barrier8 and barrier 9 hypotheses were statistically significant and in the hypothetical direction. These hypotheses were all significant with standard errors (0.026, 0.015, 0.029, 0.021, 0.007 and 0.02 respectively) because they were within the acceptable range ***p< 0.005. Therefore, these hypotheses were supported. The indices for good-of-fit show that this model fits the data adequately. Therefore, it could be justified that all strategies were statistically significant for all barriers, with the exception of barrier4, barrier6 and barrier7 with the values of factors loading H1, H2, H3, H4, H5, H6, H7, H8, H9 (0,32, 0.8, 0.79, 0.53, 0.68, 0.05, 0.68, 0.55 and 0.7, respectively) as shown in figure 4.

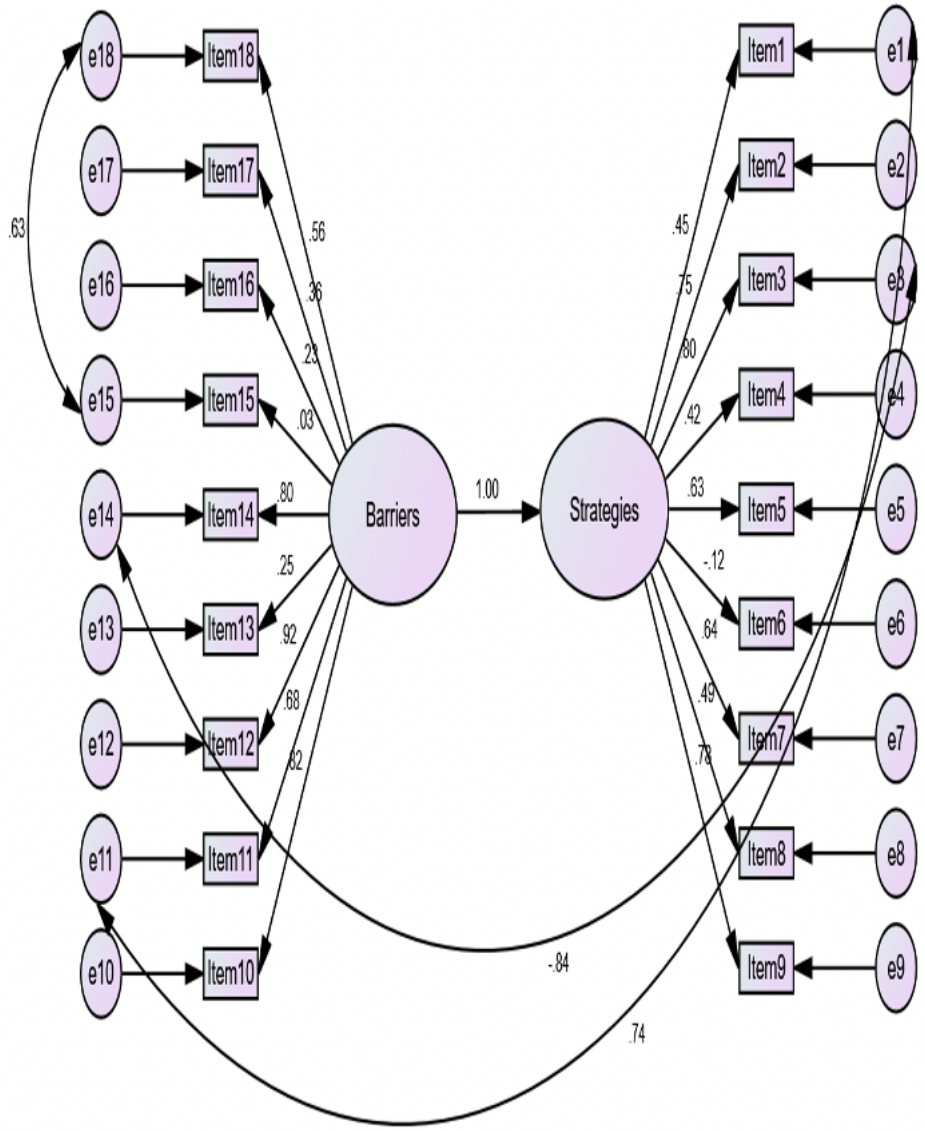

Fig. 4. barriers and strategies relationship of adopting BIM (Adapted from Ahmed and Wong 2020)

Table 4
P-value for Strategies of implementing BIM in Mogadishu projects
BIM strategy

Standard Error (S.E.)	t-value	P-value	Decision			
Strategies	<--	Barrier1	0.026	4.632	***	Supported
Strategies	<--	Barrier2	0.015	2.907	0.004	Supported
Strategies	<--	Barrier3	0.029	4.798	***	Supported
Strategies	<--	Barrier4	0.021	4.619	0.809	Supported
Strategies	<--	Barrier5	0.016	-0.242	***	Supported

Strategies	<--	Barrier6	0.007	-3.071	0.329	Supported
Strategies	<--	Barrier7	0.008	1.662	0.096	Supported
Strategies	<--	Barrier8	0.02	-4.523	***	Supported
Strategies	<--	Barrier9	0.015	0.976	0.002	Supported

4. Conclusions

The aims of this research objectives were achieved through the main finding of the study. The first objective, to determine the level of BIM in project design stage in Somalia has been achieved through the level of percentage using BIM in Somalia project design stage. The low percentages of 41.3% have a knowledge on the BIM at several construction companies whereas 58.7% of the responded do not. The first objective is achieved based on the mean value of the barriers listed in the questionnaires. A number of barriers that contributes to this situation are identified and ranked base on the means value from 4.022 to 3.196 as follows: 1. Lack of competent staff to operate BIM software 2. Lack of knowledge about BIM 3. Lack of training on BIM software. 4. Lack of data of Return on Investment of BIM 5. Clients do not request or enforce BIM 6. Reluctance from Client, Contractor or Consultant to implement BIM 7. Existing CAD system fulfills our need to design and draft 8. Lack of working procedures and standards 9. Never required by other team members 10. BIM does not reduce the time used on drafting compared with the current drawing approach 11. Legal or contract issue 12. Application of BIM will affect the current process practice 13. Application of BIM will affect the current productivity 14. BIM lacks features or flexibility to create a building model/drawing 15. Expensive software the third objective, to propose strategies that will enhance effective implementation of BIM in project design stage in Somalia, has been identified based on the ANOVA one-way test significant value of 0.006 to the barriers. Thus, the strategies proposed could enhance the effectiveness of implementation BIM in Somalia project design stage. The strategies are ranked base on the mean value from 3.989 to 3.641 as follows: 1. Government encourage and force to make all design in BIM formats. 2. Provide a grant scheme for BIM training. 3. Mobilizing Clients, Contractor and consultant on the important of BIM. 4. Incentive given by government such as a tax reduction. 90 5. Introduction of BIM in university curriculum. 6. BIM training program for staff. 7. Requirement for staff to be BIM competent. 8. Require/hire BIM specialist in company. 9. Development of BIM department within an organization to monitor the application of BIM. 10. Clients willing to pay extra for BIM implementation. 11. Provision a free trial of BIM software. Finally, the proposed model empirically examined the association between its derived components-relationship of barriers to the strategies applied to project team members. Therefore, this contributes to the theoretical and practical knowledge by providing evidence for the first time on the relationship between barriers and strategies. Besides, the study of lean construction could lead to a better understand on the development of framework of strategies, which would be useful for both academicians and practitioners

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