Success Factors and Barries in the Implementation of Load-Bearing Masonry System: The Case Study of Construction Firms in Malaysia

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***Abstract*— This study addresses the success factor and barriers in the implementation of load-bearing masonry (LBM) system. The case study is conducted through an interview to explore the situation of success factors and the barriers of implementation LBM system between the construction companies in Malaysia. The finding indicates the success factors for implementation of the LBM system in the construction companies are: organizational resources, usefulness, less maintenance, reduce construction time and cost, and these factors are consistent with the previous literature finding. Furthermore, the barriers of the implementing LBM system are due to lack of knowledge among the industry players and logistics issue. Thus, these success factors should be considered for the other companies that are interested to use the LBM system in their future projects. Additionally, to encourage policy makers into considering these factors in future action plans to enhance the adoption of LBM systems in the construction industry.**

Keywords*—Load-bearing masonry system, Success factors, barriers, Malaysian construction firms*

1. Introduction

In reaction to the dynamic business environment, technology has become the main component in enhancing a firm's performance to gain a competitive edge in the industry. The used of the technology in construction is respectable despite it the housing demand [1]. Load bearing masonry (LBM) system is an alternative method of construction technology due its advantages: reduction of construction costs, reduction of construction time and also because of its durability, aesthetics and flexibility [2] compared to the conventional RC frame system.

This system started to be used in the early civilizations and with the comprehensive research and development this system is now widely used in the developed countries. Western countries like the United States and European countries, particularly used this system for housing and building.

In Malaysia, this system had been improved and was gazetted under the Uniform Building By-Laws in 1987 but the use of this system is still uncommon as compared to its extensive widely used overseas. In additional, many of the organizations have struggled in adoption of this system in their construction projects. According to a study by [11], the adopting of the LBM system did not reach the desired level, but the awareness of this system among the industry players has gone higher. Therefore, this paper explores the issues relating to success factors and the barriers of implementing LBM system in the construction projects.

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Specifically, this study contributes to practitioner and academic areas. For the practitioner, the construction industry still faces a low rate of implementation of the technology in construction projects. In-depth understanding of the success factors and barriers of the companies that uses this system in their projects would improve the usage of the technology in the construction industry and as well as serve as a guide for potential adoption in the future.

For the academic area, study of load bearing masonry (LBM) system is still limited in terms of management studies as compared to technical studies such as structural design and material testing. Thus, it contributes to the knowledge about the LBM system in various areas.

2. Load-bearing masonry (LBM) system

Load bearing masonry (LBM) system is the oldest method in construction field. This system was designed to carry the imposed load such as snow, wind and also live and dead load [10]. The system comprises of the arrangement of the material such as bricks or blocks that are bonded and jointed with mortar. Commonly, there are six types of the LBM system:

i Plain Masonry or unreinforced Masonry
ii Reinforced Masonry
iii Pre-stresses Masonry
iv Confined Masonry
v Interlocking Bricks System
vi Prefabricated Brick Masonry

In the early of civilization, the LBM system was designed based on graphical method or simple calculation: the Monadnock Building in Chicago was built in the year 1891- a good example of this masonry structure [4].

Nowadays, this technology is based on engineering design and it gives several advantages such as economical, reduce time of construction, flexibility, durability [2] and earthquake resistance compared with the conventional RC frame system. In additionally, it is a potential solution to current problems of materials and labor shortages and also delay in completion of construction projects [13].

3. Research Method

The objective of this study is to identify the success factors and the barriers of the companies that implemented this system. In this study, the industry players that use LBM system was selected as respondents, so that the study reveals determinant from various perspectives. The contractor, consultant and developer firms are selected based on their experiences for load bearing masonry (LBM) system.

The case study has been appropriate for this research since address the nature of situation happening to be same as experienced in the current situation [12]. In this regards, three cases of the successful LBM system adopted were selected for the study and they are:

i. Company A

Company A is located near the state of Kedah and it is classified as a class F contractor. The company has fifteen (15) years of experiences in carrying out housing project and eight (8) years of experiences in implementing of LBM system. To reach the objectives, the interviewee selected is a managerial level employee who is responsible for the housing activities and very knowledgeable with the LBM system. As a result, a managerial level employee with eight years of experiences in LBM system was interviewed.

ii. Company B

Company B is an engineering consulting firm with twenty (20) years of experiences in designing LBM system. The interviewee also is of a managerial level who is responsible for the company activities and has an experiences of more than fifteen (15) years in designing LBM system.

iii. Company C

Company C is developer firm with eighteen (18) years of experiences in providing affordable houses and more than five (5) years of experiences in implementing LBM system in their projects. In additional, the participant is also of managerial level who is responsible for the technical field and has experience in the housing projects that used LBM system.

4. Data Collection

A semi-structured interview was the technique used for data collection. This technique was suitable for this study due to the flexibility it offers and its ability to go deep into a particular topic such factors that influence the usage of the technology in the organization. [3] has defined a semi-structured interview that refers to current circumstances in which the interviewer has a general series of questions and sometime the interviewer will have the tendency to ask further questions in response to what is seen as significant replies.

The interviews conducted face to face in order to minimize the interviewer bias (error) such as voice inflection, discrepancies in wording and interpretation. The interviews are conducted at different place which are at the location of participant's firms and at different times. On the average, the interviews were approximately 50 minutes duration and were tape recorded and transcribed for the analysis.

5. Data Analysis

The analysis of data was carried out through two steps which are; transcription of the interviews and frequency analysis approach. First step, the key characteristics identified from the cases are shown in quotations accordingly. To begin with, we defined the success factors and barriers related to LBM system implementation by unifying the viewpoints from all three companies. Then, the success factors and the barriers are addressed using the frequency analysis approach.

Each interview was transcribed and shortened. The frequency analysis was conducted to determine the success factors and the barriers.

6. Discussion of the Finding

Regarding the factors that influence the LBM system, questions were asked to gain an understanding of the factors that exist from the participant perspective of the interviewees. The factors that influence the usages of this system were explained as:
"*This method could reduce the construction time needed to complete a single housing unit, it takes about two to three months as compared to the conventional method (reinforced concrete frame) where the construction takes about six months to be completed*" (Company A).

"Based on previous projects the reduction of the time due to elimination of the formwork. The contractors aren't waiting for the strengthening of the concrete". *"The construction cost could be reduced up to 15 percent"* (Company B).

The construction cost could be reduced to about 15 to 20 percent of the total construction cost as the main materials used were blocks and this system uses a minimum number of reinforcements" (Company C).

Due to the reduction of time and cost it could be concluded that the LBM system is better than and more usefully compared to conventional method because it has the potential to increase the efficiency and performance of the works at construction sites.

Further, an additional factors were mentioned whereby; the method is easy as compared to the conventional one.

"The block units are easy to assemble on site and the worker became skillful easily". (Company A). *" This system is easily in practice at construction sites and required minimum supervision"* (Company B). *"Minimum workers and only required skills workers for laying units of block"* (Company C).

For a deeper understanding of the other factors present in the organizations, questions were asked about the resources of the company. The interviewees mentioned that the organization has sufficient software to design the masonry structure such as AutoCAD and 3D Home Architect and the statement were supported by:

"*The company uses AutoCAD and 3D Home Architect software to design the masonry structure and we have workers who are skilled with the software". Besides that our firm had a Project Manager with experience in the managing projects that use the load bearing masonry (LBM) system"* (Company A).

"*Our company has software in design detailing of LBM system and our staff have experience and knowledgeable in designing works"* (Company B). "*We have experienced technical staff in managing and supervising the projects that use LBM system"* (Company C).

Additionally, some other factors were present as the

products (houses) that used the load bearing masonry system required less maintenance as compared with the conventional method. These were supported by;

"Products (houses) made from our blocks required less maintenance (fewer cracks or other defect) and it consists thermal insulation" (Company A). *"The durability of the buildings achieved due to a reduction of the reaction process between reinforcement and concrete. LBM system required a minimum reinforcement compared with buildings built from conventional methods and it will extend the life of the buildings" (Company B). So far we have received minor complaints from the customer and less repairing works after building completion" (*Company C).

The interviewees were asked about the barriers in the implementation of this system in Malaysia and opinions were obtained:

"This system is not widely used in the Malaysia, it is because our builders are comfortable using the traditional methods (reinforced concrete frame) as compared to this system". Additionally, "one of the reasons is that, they are lack of knowledge in term of construction methods and supervision" (Company A).

"The main barriers for our firm is less demand from local developers in implementing the LBM system in their housing projects, it is due to lack of knowledge and less confidence in this method " (Company B). *"So far logistic issue is barriers for our projects. It is due to the location of the manufacturing is far from the construction site. It will increase the cost of logistics and the same time increase the construction cost". In additional, There is no local manufacturer for each state to produce a standard of bricks or blocks for LBM system" (*Company C).

7. Summary

The interviews of the cases were transcribed and summarized. The five factors that influence the adoption of LBM system were found. Besides that, the hurdle of the system in Malaysia is the industry players' lack of knowledge. In additional, from the analysis, the logistics issues also identified as potential barriers in implementing of LBM system.

Through the analysis, the findings were consistent with the information identified in the existing literature regarding the success factors in implementing of construction technology. The description of the factors mentioned by the interviewee is illustrated in Table 1.

Table 1. Summary of the Success Factors in Implementation of LBM system

Success Factors	**From Literature Finding**	**A**	**B**	**C**
Reduction of construction time	[4]	/		
Reduction of construction cost	[5],[6]		/	/
Organizational resources	[9]	/	/	/
Less maintenance	[5]	/	/	/
Usefulness	[7], [8]	/	/	/

8. Conclusion

This study aimed to define the success factors and the barriers of the LBM system implementing in a Malaysian construction industry. Using the interview approach to investigate the success factors for the LBM system implementation, the study results correspond with the previous studies regarding technology implementation. The determinant factors for the implementing in the cases of construction company categorised as: organizational resources, usefulness, low maintenance and construction time and cost reduction. Thus, the implications could be drawn from the findings, as these factors should be considered by other companies that are interested in implementing the LBM system in their projects. Therefore, policy makers should consider these factors in future action plans to enhance the adoption of LBM systems in the construction industry. The findings also indicated that the barriers in implementing LBM system are due to lack of knowledge among the industry players and logistics issue. Therefore, government agencies such as construction industry development board (CIDB) should be active in promoting and

encouraging the usage of this system among the industry players. Furthermore, there is a need for training places in enhancing the knowledge and skills among the industry players. For future, empirical studies should be developed to obtain statistical results by considering these success factors.

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