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Research paper

Factors Affecting Quality Management of Construction Project Using Industrialized Building System: a Review

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Abstract

Quality management is essential to improve success in project implementation by using Industrialized Building System (IBS). The development of construction industry in Malaysia is encountering a relocation from ordinary techniques to a more efficient and automated strategy which is by utilizing IBS.There are a few issues in overseeing IBS construction projects which prompt low qualities such as hiring non-expertize in construction, using low quality of materials and problem with management. Therefore, this paper aim is to determine the various success factors affecting the quality management of construction project that using IBS and ranked the success factors. Found that 87 factors from review papers and two most significant factors affecting quality management in IBS are high ranked which is appointment of high experience technical team, using high quality components and materials with overall percentage 2.48% and 1.86%. However, some of the factors are repeatedly listed due to high affecting to quality.

Keywords: *Industrialised Building System, Quality, Success Factors, Construction, Management*

1. Introduction

Industrialized building system (IBS) is characterized as a construction method in which elements are fabricated in a controlled environment on site or off site, transported, located and assembled into a structure with unimportant additional site work [1]–[4]. Author [5] defined IBS is a building component that produces either at factory or on site with a detailing of standard shapes and measurements. The components will be transported to the construction site to be checked with specific standards. Next, author [6] defined IBS as a construction framework that is built using pre-fabricated components. The assembling of the components is proficiently done by utilizing machine, formworks and other distinctive sorts of mechanical hardware. Lastly, author [7] defined IBS as a planned collecting and development process with all around organized relationship for profitable management, preparation and control over assets used, activities and results supported by the used of highly developed components.

The implementation utilize IBS in construction industry is one of strategy to achieve a better level of quality and efficiency. Based on paper [8], IBS has classified into five categories of system:

1. Precast concrete framed buildings
2. Formwork
3. Steel framing
4. Prefabricated timber framing
5. Blockwork

2. Research Background

Construction industry is a standout amongst the most essential to country because it helps growth in economy. Industrialized building system is an advanced technology in construction that can help to speed up the construction. However, this technology is not as popular then as it gets the perception that the building using IBS resulting on poor of quality, lack of durability and less used in construction compared to conventional method. In the worldwide era these days, production of Industrialized Building System is broadly utilized in international. Therefore, comprehension and implementation of product are essential to deliver in good high quality products [9].

Likely in Malaysia, the IBS was begun executing in construction since the 1960s. In 1964, the Malaysian government propelled a venture to put under a magnifying glass the viability of the IBS. This is to check its potential as framework that could be conveyed as another option to the conventional system which as of now had a strong a dependable balance in Malaysia [10], [11]. The IBS ended up being a success in development. Notwithstanding the way that it was effective in speed up the development of housing ventures. In perspective of different reference materials acknowledged by experts in the development and experts, it has a couple of various methods for defining the IBS [12].

These are transported, positioned and assembled into a structure with the minimum of extra site work. The parts of the IBS are materials that are conveyed from production lines where quality control isn't endangered on. This in like manner limits activities at the site of construction. Example of building segments of IBS such as wall panels, slab floors, beams and staircases [14].

The IBS method can help to decrease wastage of assets be-sides giving great quality outcomes to consumers [15]. The construction method of this type is an industrial process in which building components are designed, transported to the construction site and finally erected according to plans. It in some cases includes relating programming which is an essential in making helpful situations for industrial development [16].

The aim and objective for this paper is to review and create platform to highlight success factors that can influence the IBS and general construction in term of quality management and

determine the top success factors based on the past studies for the benefit of researcher and construction industry player.

Numerous reviewers highlight and study on issues that will give negative perception towards construction by utilizing IBS. There is not much study on reviewing and focusing to improve quality success factor. Rahman and Omar observed that the implementation IBS from point of view construction people, when at site several issued relating to manufacturing the components of IBS at factory, transportation the elements from factory to the construction site, and technical issues during assembly the component [17]. The most common issues experienced are improper assembly of the parts that typically included the beam-to-column and column-to-base connections. These issues arise because of the way that the gatherings engaged with the development disparage the imperative of exactness in setting out the arrangement and levelling of the bases. Fundamentally, exact levelling and arrangement of the bases are the two most essential aspects for the successful rapid erection of pre-cast concrete components

Most of the contractors that involved in the installation of IBS suffered from poor productivity. This is due to the transportation the elements of IBS, thus affecting productivity of the project. Additionally, there is no particular direction was given by experts in making preparing obligatory for the IBS contractors, making some of them favor spur of the perfunctory action instead of making proactive action towards improving their skills. There is no specific framework for evaluating preparing, inspiration effectiveness and effect completed [18].

Authors from United Kingdom reviewing the paper that considering the three fundamental difficulties that the UK is at present encountering is lack of labor skills, a housing setback and sustainability targets, the utilization of offsite techniques for construction would conceivably enhance the present circumstance [19]. However, the consequences of this study have recommended that construction has numerous hindrances to overcome before it can be considered as a standard construction method, including costs, tending to lead times and the need to hold a level of adaptability for configuration changes. Further research may try to conduct interviews with an extensive variety of partners which could lead to reviewing new developing issues and patterns. Visiting entrenched construction fabricating factory in the UK would likewise comprehend the accessible offsite items and additionally examine the obstructions from the production team point of view.

All issues that been mentioned in previous research study give a bad perception towards using IBS in construction industry. Based on literature have recognized and gathered the perceptions into 4 noteworthy partners which are client/developer, contractor, designer and the end user which is buyers [20]. As example from paper [17] describe the reason that add to the negative perception towards IBS term is past disappointments and unattractive design. These structures are typically connected with low quality structures, spillages, abandoned projects, and upsetting building appearance. Due to the bad architectural design and plan, it gives a real impact and bad impression towards IBS. On the other hand, even the construction expertise is unverifiable with IBS innovation and relates IBS with potential post-development issues. To overcome the issues, various studies have been done to recognize the causes or factors and this study aims to review the success factors and determine the top success factors of quality management that can be implemented by using IBS in construction industry in order to achieve a successful project.

3. Theoretical Framework

To ensure critical success factor, competent and knowledgeable professionals in IBS are needed specific framework that more focusing on quality management that can help contractor, consultant and client to achieve certain level of satisfaction and client need in construction. Figure 3.1 depicts the theoretical frameworks of the study [21]. This theoretical framework is utilized to demonstrate the connection amongst preparing and inspiration with project execution. Figure 3.1 shown that the framework is a relationship between independent variable (IV) which is training and moderate variable (MV) is motivation with dependent variable (DV) is performance.

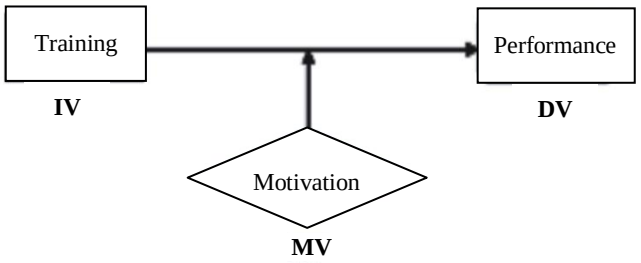

Fig. 1: The theoretical framework

4. Success Factors of Quality towards Construction Project

Quality has turned into an exceptionally prevalent subject lately because of applied changes in the construction industry. Quality has many definitions; it will depend on individual perception to define what quality are [22]. Quality is characterized as "conformance with necessities", construction project quality is the satisfaction of the proprietors needs per characterized extent of works inside the financial plan and indicated schedule to fulfil the proprietors or clients prerequisites [22] - [25]. Collins portrays that quality as the world's most established reported calling. Quality in it is most straightforward frame characterized as: 'meeting the client's desires,' or 'consistence with client's detail.' [31].

Better quality products can be created with the implementation of IBS as it utilizes great quality parts and included various of aptitude all through the procedure from beginning with assembling, installer, architects,engineer, contractual workers and others [26], [27], [30]. According to Ayodeji Oke paper, the study proved that the utilization of quality management system and the basic achievement success factors will increase the level of quality in most construction projects at Swaziland. Numerous success factors can be implementing to control the quality but the problem is how to execute the factors in the project [28]. According to [29] the absence of quality in construction project is caused by poor or non-appropriate workmanship, perilous structures, delays, cost invades and disputes in construction. The effect to contractor when had a low quality is they need to amend at own cost and the effect to country economy is reinvestment of assets to revise the low quality project [26].

Based on the previous studies, the researchers mainly studied about critical success factors of industrialised building by reviewing literature studies for success factors that influence quality execution is list in the Table 1 below.

Table 1: Success factors affecting quality in construction

Factors	Authors	F	%
Appointment of high experience and skills technical team	[28], [40], [41], [43]	4	2.48
Using high quality components and materials	[36], [42], [44]	3	1.86
Use proper and modern construction equipment	[28], [42], [44]	3	1.86
Allocation of adequate project duration	[28], [42], [44]	3	1.86
Conformance with construction drawings and specification	[28], [41], [38]	3	1.86
Employee involvement	[38], [41], [40]	3	1.86
Availability of resources	[39], [37], [41]	3	1.86

Project environment	[41], [37], [42]	3	1.86
Strict quality assurance control	[21], [35]	2	1.24
Good working collaboration between all parties	[17], [32]	2	1.24
Use suitable construction methods to suit specific project	[28], [44]	2	1.24
Proper structured site management and supervision	[28], [41]	2	1.24
Proper and up-to-date project planning and scheduling	[28], [40]	2	1.24
Improper planning	[28], [40]	2	1.24
Ensure up to date technology utilization	[28], [42]	2	1.24
Proper project feasibility study	[28], [42]	2	1.24
Organizational skills	[41], [42]	2	1.24
supplier's quality management	[37], [28]	2	1.24
Uniqueness of the project	[41], [37]	2	1.24
Develop set of design standards and norms applicable at the national level	[43], [39]	2	1.24
Checking IBS components before construction by using BIM	[43], [40]	2	1.24
Knowledge and training	[40], [42]	2	1.24
Site layout is clean	[42], [44]	2	1.24
Implement quality control and assurance system	[42], [44]	2	1.24
Socio-economic environment	[42], [44]	2	1.24
Stability of Political environment	[42], [44]	2	1.24
Using cost control system	[42], [44]	2	1.24
Implementing a safety program	[42], [44]	2	1.24
Cooperation between Supervision and contractor's staff	[42], [44]	2	1.24
Understanding of contract administration by Supervision	[42], [44]	2	1.24
Skill and experience of Supervision staff	[42], [44]	2	1.24
Skill and experience of Contractor's staff	[42], [44]	2	1.24
Using integrated project execution system	[42], [44]	2	1.24
Testing for final products only	[42], [44]	2	1.24
Clear procedure for accepting performed activities	[42], [44]	2	1.24
Preparing and using shop drawings	[42], [44]	2	1.24
Completeness and consistency of design documents	[42], [44]	2	1.24
Drawings are prepared in full details	[42], [44]	2	1.24
Conformance to codes and standards	[42], [44]	2	1.24
Adherence to specifications	[42], [44]	2	1.24
Bill of quantity is detailed and accurate	[42], [44]	2	1.24
Cooperation between parties involved in contract	[42], [44]	2	1.24
Pervious successful relations between parties	[42], [44]	2	1.24
A written contract with clear conditions	[42], [44]	2	1.24
Using a standard contract	[42], [44]	2	1.24
Types of awarding system	[42], [44]	2	1.24
Using a comprehensive material management system	[42], [44]	2	1.24
Cooperation between contractor and material suppliers	[42], [44]	2	1.24
Using storage and handling system	[42], [44]	2	1.24
Construction materials monopoly	[42], [44]	2	1.24
Labor management system	[42], [44]	2	1.24
Using labor with high experience	[42], [44]	2	1.24
Using motivation system	[42], [44]	2	1.24
Training courses for labor Income level and wages of labor	[42], [44]	2	1.24
Equipment management system	[42], [44]	2	1.24
Measurement of equipment productivity	[42], [44]	2	1.24
Good utilization of equipment	[42], [44]	2	1.24
Equipment maintenance	[42], [44]	2	1.24
Company's procedures of selecting subcontractors	[42], [44]	2	1.24
High cooperation between subcontractors and general contractor	[42], [44]	2	1.24
Using a system to evaluate subcontractors performance	[42], [44]	2	1.24
Good and fair subcontract conditions	[42], [44]	2	1.24
Site layout is large	[42], [44]	2	1.24
Site layout is organized well	[42], [44]	2	1.24
Site layout has storage areas for materials	[42], [44]	2	1.24
Use of advance technology	[21]	1	0.62
Comprehensible structure of process planning and control	[33]	1	0.62
Provide kpis to measure quality improvements	[34]	1	0.62
Adaptable for future needs of the owners through renovation or extension works.	[36]	1	0.62
Clear information and communication channel	[28]	1	0.62
Proper coordination between the construction team	[28]	1	0.62
Experienced contractors	[28]	1	0.62
Adequate planning and organizing	[28]	1	0.62
Have complete and suitable design at the right time	[28]	1	0.62
Income level and wages of labor	[44]	1	0.62
Ensure proper material procurement	[28]	1	0.62
Having frequent progress meeting	[28]	1	0.62
Changes / variations during the project	[40]	1	0.62
Decrease number of variation order	[28]	1	0.62
Interpretation of customer's expectations	[38]	1	0.62
Commitment to management	[40]	1	0.62

Focus on the customer / client	[41]	1	0.62
Continuous improvement	[41]	1	0.62
Interpretation of the expectations of the buyer / customer	[41]	1	0.62
Quality policy	[41]	1	0.62
Implementation of relationship between time and cost	[41]	1	0.62
Proper detailed design for connecting points between core components	[43]	1	0.62
	TOTAL =	161	100

*F = Frequency, *% = Percentage

Based from reviewing from the literature review, number of critical success factors for construction has been listed above in Table 1. Due to limitation of the studies in IBS construction, this paper also includes the success factors affecting the quality from general construction that can be used as references for any construction project in the future including for IBS construction.
According to Table 1, about 87 factors are extracted from the literature reviews. The method used for reviewing the critical success factors is by using frequency analysis. Based on the percentage calculated using frequency analysis, there are two main top success factors that affecting the quality management in IBS construction and the description of success factors are given in the following sections.

4.1. Appointment of High Experience Technical Team

Reviewing from paper [28], [40], [41], [43] points out that the lacking knowledge and experienced from technical team for establishment IBS components can result in low quality. Past studies demonstrate that numerous quality issues emerge for IBS projects are because of the absence of design guidelines, along these technical issues, some specialized issues can undoubtedly be settled by discussion and meeting among team with having high skills and experience. Skill and experienced of staff is among the main factors influencing quality. Review paper [28] is from Swazilland noticed that high experience and capabilities of work force engaged with a construction project will help to execute their project objectives professionally prompting better execution of quality, time, cost, efficiency and safety of the project. Another review paper from China, discuss about more imperative factor in adding to the quality of a project since it requires experience to assess the effect on IBS projects [43]. Due to lacking of involvement for IBS components can result in poor buildability as well as in adjusting of redesign. Furthermore, absence of experienced team frequently prompts poor on site planning and coordination for tending to nearby issues, thus will affect the end quality products.

4.2. Using High Quality Components and Materials

This factor is considered as success factors in construction project with percentage of frequency of 1.86%. According to [36], [42], [44] high quality of materials resulted in better outcome which is will give higher strength to the construction. Better materials selection and using high mechanized technology give an advantage while using IBS. Many researchers mentioned when using poor quality of raw materials will affect the production on site. Paper [42] from Gaza, discussed using the good material will give a better quality of the project.

5. Conclusion

The problems encountered were the reason of this study being conducted. However, there is still lack in awareness of the factors that will affect quality by using IBS. Based on the factors by reviewing, the top success factors that keep mentioning is appointment of high experience technical team and using high quality components and materials. With the finding from this paper, hopefully it can create platform for other researchers to focus and highlight more on factors that discuss directly about quality management of construction using IBS. This will help and give benefits to other researcher and construction industry player such as contractors, consultant and client for referring to achieve a satisfaction level on quality for future construction.

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