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EXAMINING PERFORMANCE OF INDUSTRIALIZED BUILDING SYSTEM (IBS) IMPLEMENTATION BASED ON CONTRACTOR SATISFACTION ASSESSMENT

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ABSTRACT

Construction industry is a main contributor to the development of the country. It is vital to ensure the performance of this industry meeting the minimum standards and client requirements. Several studies mainly in developed countries such as Australia, Unites States, and United Kingdom have demonstrated that satisfaction level among the construction players is critical particularly in terms of project performance. Satisfaction on project performance is significant to the players as failure to meet their needs may lead to project delays, cost overruns, poor quality, disputes and conflicts. Nowadays, in Malaysia, construction players are encouraged to shift from the conventional method of construction to Industrialized Building System (IBS). This method is also known as prefabrication has an ability to minimize on-site works and increase the building quality in a controlled environment. However, the take up rate of IBS in developing countries is still low as compared to developed countries. This is due to lack of technical knowledge, negative perceptions and unsatisfactory on its implementation among the contractors. A subjective performance measurement by measuring contractor satisfaction may help to improve their satisfaction level by providing a better understanding on the benefits of IBS. A broad range of satisfaction factors, as perceived by researchers and practitioners, was identified through comprehensive literatures. A questionnaire survey was carried out to examine the relative significance satisfaction factors for contractors in IBS implementation. The analysis showed that there are 36 factors have significant impacts in improving their performance in IBS implementation. Additionally, all significant factors have a correlation with eight performances of a contractor namely 1) cost performance, 2) time performance, 3) product performance, 4) design performance, 5) safety performance, 6) profitability, 7) business performance and 8) relationship performance. Further research will develop a systematic framework based on findings from this paper. It is expected that the framework can serve as a guide to develop appropriate guidelines that will aid the owners to make decisions in selecting appropriate contractors which able to complete proposed IBS project.

Keywords: satisfaction, contractors, industrialized building system, assessment, performance.

INTRODUCTION

As a developing country, Malaysia is depending on construction industry to provide employment opportunities and enhancing its economic development. However, there are several problems that need to overcome to improve the industry productivity. Previous researcher highlighted that this industry has a poor record for project success in terms of cost, quality, safety and time completion. The level of satisfaction among the stakeholders on the final products is low. Al-Tmeemy, Abdul-Rahman, and Harun (2011) stated that participant satisfaction is crucial in determining the successful of construction project. According to Doloi *et al*. (2012), participant satisfaction is describe as the level of happiness for each stakeholder for the construction projects. Any obstacles or problems occurred such as poor workmanship, slow decisions made by clients and conflict among project's team member will contribute to low satisfaction and project failures. Therefore, it is vital to improve satisfaction among project's participants. This will ensure performance of team member is at the optimum level and consequently will guarantee the successful project completion.

For building construction, conventional on site methods have long been criticized for their high risk to human health and safety, low quality and cause significant damages to the environment (Jaillon and Poon, 2008). Malaysia is facing these problems together with a shortage of construction labour as the main issue. Statistics show that 69% of the 800,000 registered workers are foreign (CIDB 2008). Majorities of these foreign workers are unskilled and normally involved in the activities that require labour intensive. The dependency on unskilled foreign workers promotes economic and social problems (Abdul Kadir, Lee, Jaafar, Sapuan, and Ali, 2006). A solution to overcome these problems is to transform the construction industry into the new state of art - Industrialised Building System (IBS). The IBS concept

could reduce the number of workers involved, speed construction activity, ensure workmanships meeting the quality standards, reduce overall cost and increase level of stakeholders' satisfaction. (Blismas, Pendlebury, Gibb, and Pasquire, 2005; Kamar, Alshawi, and Hamid, 2009; Riduan Yunus, Masrom, Abdullah, and Mustakim, 2014). In addition, the most advantageous solutions to reduce construction waste are based on IBS (Jaillon and Poon, 2008). As such, the Malaysian Government has laid out a comprehensive national IBS Road Map for the construction industry players to adopt in the industrialization programme of the construction industry (CIDB 2003).

In Malaysia, the main factor for the delayed completion of construction projects is due to poor performance by the contractors (Sambasivan and Soon, 2007). In most cases, the contractors' satisfaction in project implementation is neglected. Masrom *et al*. (2013) stated that it is vital to investigate the contractors satisfaction in order to ensure their performance is at the optimum level. Their motivation and cooperation should be investigated to allow them working in a conducive working environment. Poor contractor satisfaction hindered a performance-enhancing environment and degrading the quality of project outcomes.

In this context, there is a need for better understanding of the satisfaction measurement for contractors to enhance the productivity for IBS implementation. A conceptual model needs to be developed to provide a systematic assessment and help the stakeholders understanding the significant factors which related to contractor satisfaction.

In this stage, the relationship between good satisfaction among contractors and their quality of work is vital to provide a fundamental platform for stakeholders to communicate effectively. This fundamental exploration will enlighten stakeholders on importance of understanding the basic of motivation and cooperation to work together effectively.

Next, this research will be continued to formulate an integrated model of contractor satisfaction that provides a systematic measurement for the IBS implementation with clear relationship on dependent (DV) and independent (IV) variables to ensure the successful of IBS implementation.

LITERATURE REVIEW

The characteristics of IBS have potentials to enhance contractors' performance for delivering high-quality buildings with a lower cost in an acceptable completion time. Prefabrication, offsite production, standardized components, modular coordination and mass production able to reduce labour usage, waste generation and improve the quality of constructed buildings. However, proper planning and strategies are required in dealing with this innovative technique to prevent unnecessary additional cost, unpleasant community disturbance and decrement of environment performance. These problems will reduce the level of satisfaction of construction participants. Early engagements among the participants provide an opportunity for them to understand their responsibilities and have a clear picture on the project objectives. The project objectives should be cleared at the early stages to ensure all participants understand their responsibilities. In addition, Yunus and Yang (2014) stated that the integration among the participants is important to ensure the successful of IBS projects. An effective collaboration on the key attributes and evaluation of successful factors can help the projects meet the project objectives as well as increase participant's satisfactions.

A systematic measurement of performance is important to help projects' owner in assessing the contractor's ability and their interest in completing the projects assigned. In addition, the assessment will help to determine areas of improvement and measure the participants' perception of product or outcome. According to Xiong *et al*. (2014), the motivation and cooperation among the participants can be improved by enhancing their satisfaction level. It will increase the efficiency of communication at the project and management level. At the same time, any problems that occur in the construction activity can be easily resolved.

There are two dimensions in assessing satisfaction performance, namely 1) objective measures and 2) subjective measures (Chan and Chan, 2004). The objective approach can be measured quantitatively which uses mathematical formula and calculate the value. The examples of objective measurements are determination of construction time, time variation, cost involves and accident rate. On the other hand, the subjective approach needs qualitative measurement which based on subjective opinions and the personal judgment of the participants, such as the quality and functionality of the buildings. According to Xiong *et al*. (2014), a combination of objective and subjective measures is vital to improve project performance, especially for large and complex projects. However, most of the existing tools and models are focusing on objective measures. This scenario will hinder the participants to get their expected satisfaction and reduce long-term profitability, such as repeat business and high-maintenance cost.

Ahmed and Kangari (1995) developed a client-satisfaction model based on the multiple-regression analysis between the mean scores and two independent variables. The variables were grouped into 1) client's type and 2) client-satisfaction factors. In the client's type group, the variables were transportation, food, chemical and paper, utility and miscellaneous. In the client-satisfaction factors, the variables were time, client orientation, communication, cost, response to complaints and quality. These factors have been identified from their study as the major factors that influence client satisfaction of contractor performance.

Soetanto and Proverbs (2002) suggested that satisfaction and performance are related as performance outcomes. By adopting Oliver's model, performance is

categorized as an input and level of satisfaction aor dissatisfaction is categorized as output. The model also purports that psychological processing or a 'black box' exists that requires rational consideration in making decisions.

Based on the previous model, Masrom (2012) updated the contractors satisfaction model by considering three (3) main variables (Figure-1). The variables are 1) Tangible and Intangible Factors, 2) Organisation's Characteristics and Level of Satisfaction. Different size of contractors will require different factors in assessing the level of satisfaction for the contractor organization. In addition, the characteristics of the organization such as professional background, project type, client's type will have significant influences in determining the contractor's satisfaction.

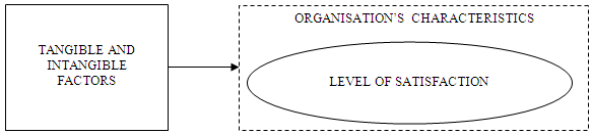

Figure-1. Contractors satisfaction model (M. A. N. Masrom, 2012).

RESEARCH METHODOLOGY

A questionnaire-based survey was used to identify the contributory factors of construction project situations to contractor satisfaction and their degree of influence in improving performance of IBS implementation. A pilot study was conducted before the actual survey to compile survey questions into useable formats to describe responses, comprehensiveness, and acceptability of the questionnaire.

The questionnaire consists of requests for general information concerning the respondents and specific questions in relation to the satisfaction dimensions and their contributory factors.

The first section of the questionnaire asks respondents to provide information concerning their current position, educational background and experience in the IBS implementation. The second section contains questions relating to a specific project which previously completed construction project using IBS. Based on the project selected, respondents are requested to indicate their satisfaction level for each of the seven satisfaction dimensions (cost minimization, time saving, quality improvement, risk reduction, workers' performance, green environment and business development) on a five-point Likert scale, where 1 refers to *extremely dissatisfied* and 5 refers to *extremely satisfied*. The third section concerns the 36 potential satisfaction factors for contractors. Likert scales are again used to identify the level of influence for each factor, from 1 ('very low' influence) to 5 ('very high' influence). The type of statistical test used in this research is non-parametric. The fourth section of the questionnaire encourages respondents to provide further comments or suggestions.

The questionnaire set was sent out to respondents with a covering letter clarifying the purpose of the study and an assurance of anonymity. A self-addressed stamped envelope also provided to help respondents return the complete questionnaire set. The samples of contractors were selected at random from professional database of the Malaysian Construction Industry Development Board (CIDB). A total of 150 copies of the questionnaire were distributed by post, online survey and face-to-face consultation. As a result, 54 questionnaires were returned and used in the analysis, representing a response rate of 36 per cent.

The responses were analysed using SPSS PASW Statistics 18.0 with several analysis methods to achieve the research objectives.

RESULTS

Cronbach's α was conducted to test the internal consistency of the scale. It is important to check either the ratings used in the questionnaire is appropriate or not. In this study, the Cronbach's α value is 0.985 which regarded as sufficient (Pallant, 2007). The result indicates that there is a strong internal consistency of the scale used in the study and suggests reliable data has been obtained.

Figure-2 shows respondents experiences in managing IBS projects. The IBS construction in Malaysia can be considered still new due to resistant of construction players to shift from conventional construction to this innovative technology. Therefore, it can be assumed input from respondents that have more than 1 year experiences is valuable and can help the researchers to understand the actual scenario in IBS projects. According to Lou and Kamar (2012), contractors should be given more exposures on the IBS implementation to improve their knowledge and interest in this technology. From the analysis, majority of respondents agreed that the implementation of IBS should be continued in Malaysia to catalyst the country's development.

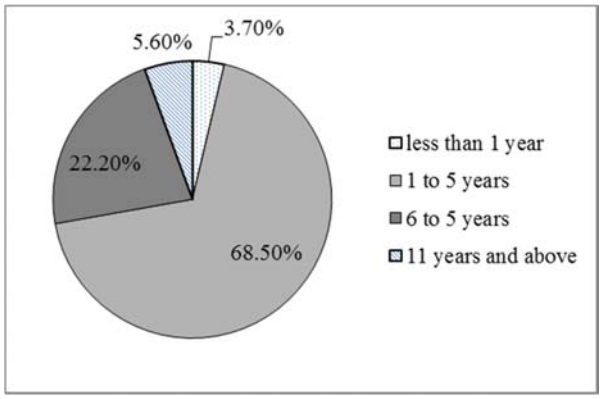

Figure-2. Respondents' experiences in IBS project.

The ranking of satisfaction factors was carried out based on their mean values. In selecting the critical factors the cut-off mean value is 4.00, which represents "significant". Out of the 62 factors identified from literature review, only 37 were rated by the respondents as "significant" and "very significant" (mean ≥ 4.00). Standard deviations show how much variation exists from the mean evaluated in the analysis. Table-1 summarises the descriptive and inferential statistics for the "more" significant factors contributing to satisfaction factors in IBS construction. Standard deviations show uniformity with most below 1, thus representing data accuracy in this research.

Table-1. Significant satisfaction factors in IBS implementation for contractors.

ID	Satisfaction factor	Mean	Standard deviation	Rank
C22	Increase time of completion	4.46	0.63582	1
C21	Easier safety management	4.44	0.63444	2
C20	Buildability	4.44	0.66351	3
C10	Safe installation for IBS components	4.44	0.71814	4
C23	Effective plant management	4.41	0.59932	5
C5	Reduction cost for material disposal	4.41	0.65929	6
C7	Reduction cost for site clearing	4.39	0.71154	7
C37	Clean and organized site layout	4.37	0.62333	8
C44	Reduction in environmental pollution	4.35	0.78084	9
C31	Reduce the dependency on unskilled foreign labour	4.33	0.80094	10
C38	Minimize construction waste	4.32	0.61311	11
C26	Reduce accident on site	4.31	0.69565	12
C16	Higher product quality	4.28	0.59611	13
C6	Cost certainty	4.26	0.73164	14
C43	Dust reduction on site	4.24	0.72516	15
C24	Higher safety for workers during operations	4.22	0.88310	16
C19	Higher durability	4.21	0.68944	17
C41	Good environment and comfortable	4.20	0.68349	18
C36	Effective site layout improve productivity	4.20	0.71056	19
C35	Healthy working environment	4.20	0.78619	20
C13	Time certainty	4.19	0.64644	21

Table-1. (Continued).

ID	Satisfaction factor	Mean	Standard deviation	Rank
C15	Higher design quality	4.19	0.65212	22
C2	Reduction labour cost	4.15	0.73734	23
C33	Skills improvement	4.13	0.64563	24
C42	Material conservation	4.13	0.67422	25
C18	Reduce components and material damages	4.11	0.63444	26
C3	Material cost minimization	4.11	0.66351	27
C32	Improve workers' quality lifestyle	4.11	0.83929	28
C1	Acceptance of IBS implementation	4.09	0.65209	29
C39	Reuse components and materials	4.09	0.68041	30
C34	Less disturbance to public	4.09	0.78352	31
C55	Ease activities and smooth process	4.07	0.57796	32
C17	Higher quality for joint and installation	4.07	0.69640	33
C27	Minimum on-site space usage	4.06	0.65637	34
C56	Skilled workers for IBS installation	4.04	0.64319	35
C30	Faster delivery to construction site	4.02	0.65849	36

These 36 significant factors (Independent Variables - IV) were investigate their relationship with eight (8) performances (Dependent Variables - DV) which have been identified by Masrom, Skitmore, and Bridge (2013). The performances are 1) cost performance, 2) time performance, 3) product performance, 4) design performance, 5) safety performance, 6) profitability, 7) business performance and 8) relationship performance. Table-2 shows the relationship of significant satisfaction factors to type of contractors' performance using Spearman's rho analysis.

Table-2. Correlation analysis between satisfaction factor and performance of contractors

Correlations									
		Cost	**Time**	**Product**	**Design**	**Safety**	**Profitability**	**Business**	**Relationship**
Spearman's rho	C1	x	x			x	x	xx	xx
	C2	x	x	xx	x		xx	xx	xx
	C3		x	xx	xx		xx	xx	xx
	C5	xx		x			xx		xx
	C6	xx	x	xx	x		xx	xx	xx
	C7	xx		x	x	xx	xx		
	C10	xx		xx	x			x	
	C13		x	xx			xx		x
	C15		x	xx	xx		x	xx	xx
	C16	x	xx	xx			xx		
	C17	x		xx	xx		xx	xx	
	C18			xx	xx	x		x	
	C19	x		xx				x	
	C20	xx	xx	xx		xx	xx	xx	x
	C21		xx			xx			x
	C22		xx		x	xx	x	x	x
	C23	x	xx			x	xx	xx	xx
	C24	x	xx	xx	x	x	x	xx	
	C26	xx				x			
	C27		xx	xx	xx	x	x	xx	x

Table-2. (Continued).

Correlations									
		Cost	**Time**	**Product**	**Design**	**Safety**	**Profitability**	**Business**	**Relationship**
Spearman's rho	**C30**		**x**	**xx**	**xx**		**x**	**xx**	
	C31	x	x			x	xx		
	C32	x	xx	xx	x		x		
	C33		xx		x		xx		xx
	C34		xx				x	xx	x
	C35	x		x		x	x		
	C36	x		x					x
	C37	xx	xx			xx			
	C38	xx	xx			x	xx		
	C39	xx				xx	xx	x	xx
	C41	xx					xx	x	xx
	C42	x	x				xx	x	xx
	C43	xx	x			x	x		x
	C44	xx	x			xx	x		x
	C55	x		xx			xx		
	C56	x	xx	x	xx		x	xx	x

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

FINDINGS AND DISCUSSIONS

This study investigates the critical factors in determining contractor satisfaction and its relationship with dependent variables (performances). The factors is including for both tangible (such as time completion, cost certainty and cost reduction) and intangible factors (such as worker's quality lifestyle, disturbance to public and skills improvement). Profitability, time and cost are the major performances which related for most of the significant factors. It shows that the traditional project management objectives (time, cost and quality) are still the most important criteria in making any decision related to construction projects. Profitability is the benefits in term of financial that gained by the contractors in implementing IBS construction. Masrom *et al*. (2013) highlighted that profitability is corresponds with the quality of project brief, appropriateness of procurement system used, and the other participants' satisfaction with the project. It is a driving force to adopt new technology in transforming conventional construction method (Horman, Riley, Pulaski, and Leyenberger, 2004). The analysis of the profits should be measured by including the life cycle of the projects. Therefore, IBS construction has a high potential to be adopted by the contractors in Malaysia.

The relationship investigation shows that 'Reduction in environmental pollution (C44) have a correlation with cost, time, profitability, business and relationship performance. Having a clear understanding on the environmental regulations and requirement by the local authorities will enables the contractor to deliver the project with less rework. This scenario could reduce additional cost and time to complete the project. The good image in preserving environment may also boost up the contractors' business and their relationship with the other stakeholders. This will increase the profits of the company for the long term.

Interestingly, safety performance not only benefits the contractors in term of social but also has a potential to minimize the overall construction cost. The analysis shows that the safety performance has a correlation with 'Reduction cost for site clearing - C7'. IBS components were produced offsite and can immediately install as a structural elements once delivered to the construction site. The numbers of debris or waste is also very small. This will reduce additional cost for unnecessary works such as site clearing and storage for construction materials.

CONCLUSIONS

Contractors are the major stakeholders in ensuring the successful of IBS implementation in Malaysia. To fully adopt IBS in the construction industry, common understanding on significant satisfaction factors for contractors are necessary. The correlation between these factors and performance of contractors is vital to provide a systematic platform in measuring the contractor satisfaction. This paper has identified significant factors in assessing contractor satisfaction and its relationship with eight performances in IBS implementation. These 36 factors are highly correlated with cost, time, product, design, safety, profitability, business and relationship performance. Further research will develop a systematic

framework based on findings from this paper. It is expected that the framework can serve as a guide to develop appropriate guidelines that will aid the owners to make decisions in selecting appropriate contractors which able to complete proposed IBS project.

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