Strategic Level Implementation: Development Criteria for IBS Formwork System Readiness Framework (IBS FOSREF) for Malaysian Construction Industry

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Abstract. The Industrialized Building System (IBS) was introduced by the Construction Industry Development Board (CIDB) are classified to precast concrete framing, panel and box systems, steel formwork systems, steel framing systems, prefabricated systems and block work system which is mainly components based systems and products (CIDB, 2007). According to Nawi (2011), the benefit of IBS formwork system implementation will lead to environmental friendly which reduce the harmful impact on the environment by better use of available resources and reuse of molds will affect less of waste materials. Since there is no theory about readiness factors of IBS formwork system in Malaysia, the stakeholders will not realize the significance of IBS formwork system. Most of the challenges factor in implementation of IBS formwork system is the attitude of Malaysian construction stakeholders which are un-readiness in facing of globalization era since it was already stated by IBS Roadmap (2003-2010). Hence, the goals of this research are to analyses the critical factors of driving or hindering the used of IBS formwork system in the Malaysian construction industry. A survey among 157 respondents which are construction personnel was employed for the study. The survey result shows that fifteen (15) identified factors for IBS formwork implementation are further ranked according to the average mean score perceived by construction personnel as follow: (F6: Government Initiative), (F12: Roles of Agencies), (F13: Procurement), (F7: Training), (F14: Incentives), (F15: Manufacturer Availability), (F11: Familiarity of IBS System), (F4: Qualified Technical Team), (F8: Cost & Financial), (F3: IBS Score Index), (F1: Project Trend), (F10: Compliance of Policy), (F5: IBS Scoring Manual), (F9: Promotion) and (F2: Contractor Involvement). Other than that, the development of IBS Formwork System Readiness Framework (IBS FOSREF) incorporated with Strategic Level Implementation Mc Kinsey 7s for Malaysian Construction Industry which are the main outcome for this research could facilitate the Malaysian construction stakeholders to ensure IBS formwork system implementation will be success.

1 Introduction

According to [8], IBS defined as prefabricated component and on-site installation involved with various construction process in utilizing product, technique, component, or building system. IBS offered valuable benefits such as minimizing wastage, reducing unskilled worker, enhanced the environmental, better quality control and increase construction site cleanliness besides time consuming in construction can be reduced and given more organised and safer construction site. It was agreed by [27], the IBS concept are involved with the component that are manufactured in a controlled environment either in the factory, or on or off-site, assembled and positioned into a structure with minimal additional site works. Other than that, several characteristics of IBS required to be accepted as part of IBS which are equally crucial to assure the achievement of the listed benefits. The process involved by taking the parts of the building that are repetitive and difficult to cast on-site due to standard designed off site, assembly and positioning all the parts on site and involved with time consuming and labour intensive. The utilization of innovative and clean mould technologies are the initiatives in IBS implementation especially in on-site casting activities [9]. According to [6], IBS implementation can be explained in eight stages and the chronology of of IBS implementation in Malaysia are as shown in table 1.

1.1 IBS Formwork System

According to [19], IBS formwork system, also known as steel formwork system are identify as Tunnel forms, beams and columns moulding forms, permanent steel formworks (metal decks). On the other hand, according to [7], formwork system in IBS considered as one of the low level or the least prefabricated IBS. The system generally involved in site casting and subject to structural quality control, high-quality finishes, and fast construction with less site labour and material requirement.

The IBS formwork using the material such as metal or steel, aluminium and plastic gained its popularity recently due to its flexibility of application in many projects, recyclable at many phase of construction and can be used in different types of design structure. The factor are giving a significance impact towards the importance of IBS formwork system applied in the Malaysian construction industry.

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Table. 1. Chronology of IBS development in Malaysia

EARLY CONSTRUCTION	• 5th Century: Gangga Negara, Kedah • 14th & 15th Century: Malay Architecture • 16th Century: Portuguese influence • 17th Century: Dutch influence 18th & 19th Century: British influence
INITIAL STAGE OF PREFABRICATION	• 1960: Successfully implemented in UK, Western and Eastern European • 1960: Introduced in Malaysia • 1963: Architect was sent to Europe to learn IBS • 1964: Architect was sent to France for IBS exposure
DEVELOPMENT IN 1964 – 1970	• 2nd Malaysian Plan 1960 – 1965: Built affordable house at Jalan Pekeliling • 1965: Jalan Rifle Range, Penang • 1964 – 1974: Edmonton, North London
DEVELOPMENT IN 1970s – 1980s	• 1978: Prefabrication technology (Penang Government launched) • 1980: 2800 units of living quarters at Lumut Naval Base • Late 60s and 70s: Introduced foreign systems
DEVELOPMENT IN 1980s – 1990s	• Early 80s – 90s: Usage of structural steel components • 1984: 36 storeys Dayabumi complex • 90s: Demand in precast concrete system • 1981 – 1993: Low Cost houses and high cost Bungalows in Selangor
DEVELOPMENT IN 1990s – 1998s	• 1994 – 1997: Hybrid IBS application • 1999: CIDB formed IBS Steering Committee
DEVELOPMENT IN 1998 – 2008	• Private companies adopted IBS • 2000: Coordination of dimensions and space • 2004: 50% of IBS in construction elements • Nov 2003: IBS Roadmap published • IBS agenda further boosted in 2004 – 2006 • 2006: Tax incentives and CIMP 2006 – 2015
2008 – CURRENT	• Oct 2008 – May 2010: IBS project awarded • 2009: Registration scheme for IBS • 2011: IBS Roadmap 2011 – 2015 2013: IBS Company Status (AIS)

The Construction Industry Development Board (CIDB) Malaysia in 2006 reported that, the implementation of IBS formwork was relatively lower as compared to the other components of IBS system due to several issues related to high initial capital investment for pre-casters in purchasing new machinery, mould, transferring a foreign technology as well as highly wages of skilled workers; were reflected to the lower application of this system. Furthermore, knowledge in IBS formwork technology among the Malaysian construction industry stakeholder are still lower and these has given a negative implication in creating an understanding, awareness and readiness to applied IBS formwork system.

The sustainable formwork system provides a better speed of construction, lower life-cycle costs, almost indestructible and reducing the additional site work [8]; [14]; [16]. On the other hand, the IBS formwork technology can reduce various problems which comes from construction industry.

As a sustainable element technology, IBS formwork helped fulfil the basic goal of construction; time, resources and quality [8]. Nevertheless, the expectation in application of IBS formwork in construction industries is still unexpected. Even full effort given by CIDB of Malaysia by actively promoting the use of IBS in construction, the application by the stakeholder are still lower and relatively below the target. The stakeholders need to align with the paradigm shift from conventional construction process into a lean construction method [5].

2 Problem Statements

The IBS formwork are well known as the best alternative in completing the construction project by reducing the used of conventional formwork which was exposed to the additional site work in nature as well as to the construction waste that finally affected the time, cost and safety [10]. Nevertheless, the production of IBS formwork seems not achieved enough when their application still not rapidly embracing [10]. In fact, the implementation of this system will facilitate the Malaysian stakeholders especially the contractor in a way to reduce any harmful effects to the environment by achieving the sustainable agenda. Currently, the take up of IBS formwork was below than the target of IBS used as stated in the IBS Roadmap 2003-2010 [5] and the participation of contractors to involved in the IBS project is currently poor [14]. With regards on that scenario, the identification of critical factor and difficulties through empirical study is vital in way to overcome the shortcomings. In general, a critical factor is defined as the factors which contribute the ineffective result and achievement towards successful of building construction with considering of time, quality and cost.

In respecting to this scenario, the study on identification of critical factor and its difficulties for applying IBS formwork; will assists the Malaysian government to overcome the shortcomings. This can provide an alternative a solution to enhanced the uses of IBS formwork in the Malaysian construction industry.

3 Research Methodology

For the first objective, to identify the critical factors that contribute to difficulties in adopting IBS formwork, literature review strategies being used for the data collection for in depth knowledge about IBS Formwork in Malaysia. The development of critical factor was confined to the literature published from 2003 onwards in academic journals and published proceedings. A thorough examination was carried out to develop in depth-understanding about which factors are likely to happen due to IBS formwork implementation.

A descriptive technique was adopted to validate factors and sub factors of IBS formwork implementation. The questionnaire was conducted on a sample of drawn from a database of contractor listed in the Construction Industry Development Board (CIDB) Malaysia. The full-scale survey was constructed among B01 (Pre-Cast Concrete Contractor) and B19 (IBS Formwork System Contractor) which focusing on technical construction personnel. A total of 400 copies of the questionnaires were delivered to the potential respondents by email and online survey. However, only 157 copies and response of the questionnaire were received. The response rate was 39.25% and consistent with the norm of 20-30% for most questionnaire surveys distribute in the construction industry [11].

The second objective is to propose the best possible factors for IBS formwork system in Malaysian Construction Industry and thirdly, to develop a IBS Formwork System Readiness Framework (IBS FOSREF) for Malaysian Construction Industry. Finally, all the data gathered will be synchronized with effective strategic implementation Mc Kinsey 7s [17] as to ensure a significance implementation by policy maker. The data from the first, and second objective of the study is basically will be used for the development of the framework. For this paper, only third and fourth objective was discussed.

4 Finding and Discussion

According to study been done by [2], there are fifteen (15) numbers of importance factor found in his study which been develop by conceptual framework after 1st phase of research part which are identifying of critical factors through extensive literature review was completed. The fifteen (15) factors as follow:

Discussing on the survey result, from the perspective of construction industry stakeholders, the majority of respondents highlights in sequence that (F6: Government Initiative) is the main importance factor which could lead to enhancement of IBS formwork implementation.

Table. 2. Survey Result

Factor	Perception	Mean	Overall Ranking
F1	Project Trend	4.07	11
F2	Contractor Involvement	3.78	15
F3	IBS Score Index	4.11	10
F4	Qualified Technical Team	4.15	8
F5	IBS Manual	4.00	13
F6	Government Initiative	4.66	1
F7	Training	4.39	4
F8	Cost & Financial	4.11	9
F9	Promotion	3.96	14
F10	Compliance of Policy	4.04	12
F11	Familiarity of IBS System	4.17	7
F12	Roles of Agencies	4.46	2
F13	Procurement	4.42	3
F14	Incentives	4.39	5
F15	Manufacturer Availability	4.19	6

Rating	Rating Scale	Classification
1	very low or extremely ineffective	1.00≤ Average Index Score ≤, 1.50
2	low or ineffective	1.50≤ Average Index Score ≤, 2.50
3	medium or moderately ineffective	2.50≤ Average Index Score ≤, 3.50
4	high or very effective	3.50≤ Average Index Score ≤, 4.50
5	very high or extremely effective	4.50≤ Average Index Score ≤, 5.00

Sources: Mc Caffer, 1997

Fig 1. Rating Scales and Classification (Mc Caffer, 1997)

Then, it followed by (F12: Roles of Agencies), (F13: Procurement), (F7: Training), (F14: Incentives), (F15: Manufacturer Availability), (F11: Familiarity of IBS System), (F4: Qualified Technical Team), (F8: Cost & Financial), (F3: IBS Score Index), (F1: Project Trend), (F10: Compliance of Policy), (F5: IBS Scoring Manual), (F9: Promotion) and (F2: Contractor Involvement) [35]. With refer to the Figure 1, it can be summarized that the top five (5) ranking of IBS formwork which is F6, F12, F13, F7, F14 can be considered as some key importance criteria which classified as a 'Strategic Level Implementation' since the entire factor shows the government role and responsibility in a way to emphasize the utilization of IBS formwork. Since all the factors are linkages with policy makers responsibilities, a formulation of IBS FOSREF as stated by [2] at Figure 2 is believed to bring a significance impact to the IBS application in Malaysia context.

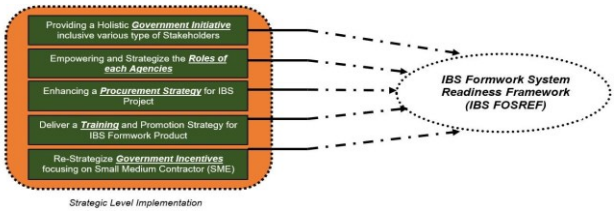

Fig 2. IBS Formwork System Readiness Framework (IBS FOSREF) for Malaysian Construction Industry

In order to ensure a successful implementation of IBS FOSREF by the government, it is recommended that the

entire factors should be adapt with Effective Strategic Implementation, McKinsey 7-S model [17] which integrates strategy, structure, systems, staff, skills, style, and shared values and stated that interconnections among these 7 variables could facilitate a government to step ahead in bringing an IBS agenda.

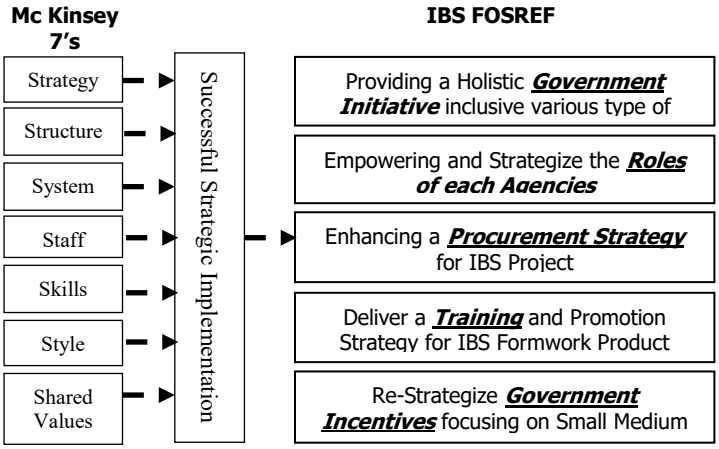

Fig 3. Strategic Implementation Models with Mc Kinsey 7's and IBS Formwork System Readiness Framework (IBS FOSREF) for Malaysian Construction Industry

The relationship between Mc Kinsey 7's [17] and IBS FOSREF can be categorized under several variables such as:

Strategy: As to strengthen the strategy of IBS formwork system, the type of procurement route and strategy that allowed adopters / stakeholders to be involve at the beginning such as during design and build.
Structure: The government shall allow a two way communication between IBS stakeholders and roles of each government agencies through a round table discussion as strengthening a current implementation of IBS.
System: It is pointed out that information technology (IT) is a vital an reliable tools to improve tendering, planning, monitoring, distribution, logistic and cost comparison processes by establishing integration, accurate and effective data dealing with project documents in IBS project. The aim of IT implementation is to enable joint up information management between government and IBS stakeholders to boost IBS implementation in Malaysia.
Staff: Training can be considered as integral part of an organisation learning and change. The primary rational for training between IBS workforce is to addressing skill deficiencies and to adapt employee's qualification to job requirement.
Skills: Indeed, it is imperative that an IBS stakeholder requires new skills and knowledge appropriately employed IBS workforce capable in installing IBS components.
Styles: A new approach and style of command in IBS formwork system can increase flexibility and versatility preferred by IBS practitioner due to its low setup cost compared to conventional system. A key strategy for IBS Stakeholders are the ability to get volume and knowledge to manage the design, manufacturing and construction under 'one-roof' by moving from the contractor roles towards becoming a total provider solution to client. The SME's contractor can attempt to own the pre fabrication technology by devising a special relationship with one or more pre-fabrication sub-contractor such as project based joint ventures, vertical integration or even internalisation. Meaning that, the IBS SME's must change their roles from existing contracting into IBS system integrator.
Shared Values: The pre-requisite depends to a large extent on the establishment of strategy, meeting of human capability and capacity and finally improve on the processes. The Government through their agencies shall give full support to all the IBS stakeholders in align with the business strategy, vision and mission of the national agenda with the desire to adopt IBS agenda.

5 Conclusions

In a nutshell, in a way to assure the Readiness among Malaysian Construction Stakeholders regarding the implementation of IBS Formwork, these five (5) factors should be in place and strategized by the government at 'Strategic Level' by adopting Mc Kinsey's 7s and IBS FOSREF. Thus, the roles of government agencies have play some significance roles to contribute a successful IBS Formwork implementation in Malaysia.

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