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EXTERNAL FACTORS INFLUENCING ON INDUSTRIAL BUILDING SYSTEM (IBS) IN MALAYSIA

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ABSTRACT

For the adoption of suitable strategies by any organization or individual, there is the need to understand the organizations' or individual's current status and position in relations to the external environment. A PEST (Political, Economic, Social and Technological) analysis is an environmental scanning division of strategic management. It can be used as a basis for future planning and strategic management. The application of PEST analysis helps a business to understand different macro-environmental factors that they need to take into consideration when determining the decline or growth of a particular market. In this study, PEST analysis has been conducted in order to investigate the important factors that are influencing the Industrial Building System (IBS) implementation in Malaysia. This analysis has been conducted to evaluate how attractive the IBS in Malaysia is and the factors that can help its development and improvement. Therefore, at first the PEST factors introduce the Political, Economic, Social and Technological factors. Then, the PEST factors which affect the implementation of the Industrial Building System (IBS) in Malaysia are addressed through the review of past research and interviews with experts. In the next step, the identified factors will be ranked and prioritized as a result of applying the average ranking method. The classified factors in this study can be used in future studies to provide development strategies for IBS improvement according to its current position.

Key Words: Industrial building system (IBS), PEST (Political, Economic, Social and Technological), Construction Industry, Malaysia.

INTRODUCTION

Strategic management involves a set of decisions and actions which are applied by managers to enhance the performance of the organization or system in their external environments Houben *et al.* (1999). In the process of strategic management, there are currently some commonly accepted tools and concepts that can help strategists to generate practicable alternatives, evaluate those alternatives, and choose a specific course of action Dincer (2004). While the internal environment

can not affect the organization as much as the external environment is associated with the importance of external factors, the efficient appropriate techniques are used to analyze external the environment of organization. PEST analysis is a part of the external analysis which gives an overview of the different macro-environmental factors that the organization or system has to take into consideration. It is a useful strategic tool for understanding market growth or decline, business position, potential and direction for operations. Therefore in this study, a PEST analysis has been conducted in order to investigate the important factors that are influence the Industrial Building System (IBS) implementation in Malaysia.

PEST ANALYSIS

Understanding the environment which a system is running in is important in the determination of development and implementation strategies. The identification of external opportunities and threats can affect the success of any system. The external environment variables that affect the performance of a system consist of: Political, Economical, Social and Technological factors. It is from the initial letters of these factors that PEST analysis comes about. PEST analysis is a part of a comprehensive analysis that deals with the effects of the external environment on the system. By the evaluation of a system with this analysis, its performance can be examined against other options with regard to the external environment. PEST analysis is a scan of the external macro-environment in which an organization exists. It is a useful tool for understanding the political, economic, socio-cultural and technological environment that an organization operates in. It can be used for evaluating market growth or decline, and as such the position, potential and direction for a business.

Government behaves out of the hands of a business and as a result businesses will need to understand how political changes can directly affect them. During a PEST analysis, **political factors** looks at political effects such as: government support, regulations and standards, employment laws, transportation policy, environmental regulations and tax policy. **Economic factors** affecting a business will be analyzed in order to plan for the future. Performing the economic factors analysis will help a business to determine and estimate the cost of capital, operations and transportation. In addition, economic factors also include economic growth, home market situation, diesel and fuel prices etc. **Social factors** are related to society aspects such as population growth, employment rate, professionalism, training and education and the various attitudes that people have towards their careers. Safety, health, living standard and the consumer's need and the potential market size for an organization's goods and services are examples of social factors which an organization is faced with. **Technological factors** keep on changing everyday. There are developments in the techniques used, materials used and various other such aspects of the business. These influences the barriers to entry make or buy decisions and investment in innovation, such as automation, investment incentives and the rate of technological change. A few

of such developments are standardization, high quality and better product, innovation in method and products.

IBS in Malaysia

With the growth of the demand of housing in Malaysia, the conventional construction method is unable to meet this demand as a consequence of the low speed of construction and higher cost (Agus, 1997; Taherkhani and Saleh, 2011). On the other hand, the IBS method known as the systematic construction procedure, provides a high quality of work, requires less workers and time needed to complete construction, and this is accepted as the only way to bridge the gap between demand and supply (Rollet, 1986; IEM, 2001). The IBS has undertaken to solve and improve the current construction method and scenario in Malaysia (Agus, 1997; Kamar *et al*., 2009; Mohamad *et al*., 2009). In spite of huge publicity campaign from the government the percentage of IBS implementation is lower than expected IBS Roadmap (2003). It is not as high as the government anticipated at this stage. Nevertheless, the effort to promote the usage of IBS as an alternative to conventional and labour-intensive construction methods has yet to make a headway (IBS Roadmap Review, 2007; Kamar *et al*., 2009). The clear understanding of the current status of IBSs will help to set the strategies to improve IBS implementation in Malaysia. However, the first step in any advance study on building systems and its technology should be initiated by knowing the status quo Badir *et al*. (2002). Therefore this paper presents the PEST analysis conducted to investigate the important factors that are influence the Industrial Building System (IBS) implementation in Malaysia.

METHODOLOGY

The goal of this study is the identification of external factors which influence IBS implementation in Malaysia, thus both the quantitative methods (questionnaires) and the qualitative method (semi-structured interviews) are used. The data is divided into two parts. The first part consists of handbooks (particularly government documents), a literature search, and papers focused on IBS and the construction industry in Malaysia, to review the IBS implementation in Malaysia and determine the main political, economical, social and technological factors affecting this building system. In the second part the information which was gathered from the first part is presented to five academic experts during the evaluation process by applying a semi-structured interview to finalize a list of factors. The respondents were asked to tell what factors they think are or are not significant in IBS implementation environment. In the next step, the study is continued by the questionnaire survey developed based on the information gathered in the previous interview session. Respondents were required to rate the existing external factors which are prioritized and classified as a questionnaire on the political, economical, social and technological (PEST) aspects. Various ranking methods were compared with each other (Corne and Knowles, 2007; Köppen and Yoshida, 2007; Kukkonen and Lampinen, 2007). According to Corne and Knowles (2007) and the

best results were obtained from a simple average ranking method. Kukkonen and Lampinen (2007) examined the average and minimum ranking methods. The average ranking (AR) method has been shown to be highly effective in providing sufficient selection Ishibuchi *et al.* (2008). According to the IBS Centre official site, the IBS supply chain was listed as consisting of manufacturers, contractors and consultants. Thirty IBS companies were randomly selected through an existing list including ten manufacturers, fifteen contractors and five consultants.

Questionnaires were sent to the management level of the companies. The respondents were asked to score how important each factor is based on its influence on the implementation of IBS in Malaysia. Respondents are required to respond on all information by stating their level of agreement based on five ordinal measures known as Likert Scale from one (1) to five (5) according to a specified level Mohamad *et al.* (2011). The last section in this questionnaire requires respondents to state their level of agreement on the factor affecting IBS implementation. According to the scale, the questionnaire rating follows the five-point scale described previously and converted into relative important indices for each factor. These indices are adopted from the Relative Index (RI) ranking technique based on Eq. 1 (Kometa *et al.*, 1994).

$$RI = \frac{n(1)\times 1 + n(2)\times 2 + n(3)\times 3 + n(4)\times 4 + n(5)\times 5}{N_{total}\times 5} \quad (1)$$

Where n(i) is the number of responses with scale, i (i=1,..., 5) and N is the total number of responses to each question. The maximum value for RI is 1, and the minimum is 0.2 accordingly. Totally, 23 questionnaires have been collected from respondents (12 contractors, 8 manufacturers and 3 consultants). As a final point, factors are ranked according to their Relative Index (RI).

RESULT AND DISCUSSION

As it mentioned in the methodology, the external factors affecting IBS implementation in Malaysia is reviewed through literature and semi-structured interviews. The main political, economic, social and technological (PEST) factors determined are referring to the questionnaire and the following data on the results of respondents is expressed in accordance with the standings of the score of average index (table 1-4).

Political Factors

The political factors which affect IBS implementation can be presented in five main categories: transportation issues, government support, standards and regulations, taxation and inflation issues and research and development centres. Table 1 states the results of the respondents in terms of political factors that influence IBS implementation. The analysis based on the average index shows that: The highest average index for the political factors is the transportation average which has a score of 4.52. The construction cost includes the transportation cost of the IBS

components from the factory to the construction site. One of the IBS implementation needs is the transportation required to move IBS components. As an example, in the logistics and transportation industry in Malaysia, the maximum length that can be carried on a vehicle on the road is only 15 meters and the maximum effective prefabricated concrete span of the beams or slabs can reach up to 20 to 25 meters. Therefore the transportation system must be redesigned in such a way that it can be transported into the difficult conditions. As a result a suitable transportation system to transfer the IBS components from the manufacturing plant to the construction site is required.

Table- 1. Political Factors

Position	Political Factors		References	Average Index	Relative Index (RI)
1	Transportation	Require transportation to carry IBS components, loading carrying capacity through the transportation navy	(Chung, 2006; Hong, 2006)	4.52	0.904
2	Standards and Regulations	Require standards and new regulations, laws and cumbersome bureaucracy such as labor law, health and safety laws and waste disposal laws	(CIDB, 2010)	4.30	0.861
3	Government Support and Policy	Government policies and incentives, attitudes, support and research spend, execution of IBS Road Map	(Basri, 2008; CIDB, 2010)	4.30	0.861
4	Research & Development Centres	Establishing research and development centre for IBS, local research organizations and testing lab	(Chung, 2006; CIDB, 2010)	4.17	0.835
5	Taxation	Taxation changes specific to product/services	Interview	2.91	0.583

The second most important political factor is standard and regulation issues and has a score of 4.39.

The following are samples of factors which the IBS may face: required standards and new regulations, laws and cumbersome bureaucracy such as labour laws, health and safety laws and waste disposal laws. Government support and policies, research & Development Centres and taxation are the next political factors ranked by 4.30, 4.20 and 2.91 average indexes. The need to adopt an innovative method and component standardization is the main issue to do with the government in the Malaysian construction industry (Abd Shukor *et al*., 2011). The execution of the IBS Road Map can enable the construction industry in covering this issue. The government agencies in Malaysia can provide relevant consultation and create special funding to encourage reengineering and change management initiatives to suit the IBS process. Although, government can increase the allocation of research grants through its agencies and provide more incentive i.e.

establishing R&D development centres, and tax reduction to encourage more R&D contribution in construction industry, particularly on IBS.

Economical Factors

As it was demonstrate in Table 2, the respondents indicated that the high initial investment capital and transportation cost requirement of IBS got the highest economical average indexes with scores of 4.57 and 4.48. The initial capital cost of IBS is usually high and includes the cost of constructing the factory, casting beds and the support machinery. IBS requires a high working capital thus the IBS components can be expensive with regards to the investment of machineries to produce the components. The early stage of the training of workers to handle machinery is also costly and the training might cause the workers to hop to other companies as it is the normal culture in Malaysia. Changes in all these economical matters can influence IBS implementation trend in the country.

Table -2. Economical Factors

Position	Economical Factors		References	Average Index	Relative Index (RI)
1	Capital Cost	Requires an initial investment capital	(Peng, 1986; Warszawski, 1999; Badir *et al.*, 2002; CIDB, 2003; Shaari and Ismail, 2003; Chung, 2006; Kamar *et al.*, 2009; CIB, 2010; CIDB, 2010)	4.57	0.913
2	Transportation Cost	Location of manufactures, increase of diesel and fuel prices and IBS components size	(Chung, 2006; Hong, 2006)	4.48	0.896
3	Construction and Operation Cost	Expensive IBS components, total construction costs (material and labour cost), cost of training unskilled and semi skilled labourers, suitable price of IBS for all construction class, etc	(Ismail, 2001; CIDB, 2003; Kamar *et al.*, 2009)	4.43	0.887
4	International and Domestic Market Trends	The competition by competitor to produce better quality at a cheaper price, improve domestic and local construction markets, export of IBS components for overseas application	(Chung, 2006; Marsono *et al.*, 2006)	4.04	0.809
5	Economic Growth	Economic and GDP Growth	Interview	3.65	0.730

The high cost also includes the transportation cost of the IBS components including handling from the factory to the construction site. Some of the factors that affect transportation cost are:

the far distance between the locations of manufacturers and construction site, the increase in diesel and fuel prices and IBS components size. Construction and operation cost are the next economical factors and are ranked by a 4.43 average index. As an example, rising material and labour cost causes the increase of the prices of IBS components and thus increases construction and operation costs. The continued competition between competitors to produce better quality at a cheaper price, the export of IBS components for overseas application, the improved domestic and local construction markets and the effect on economic growth affects international and domestic market trends and economic and GDP growth and are ranked as the next economical factors by the scores of 4.04 and 3.65.

Social Factors

Among the social factors, the factors which were suggested to have the highest scores are employment issues and professionalism, and training and education which have an average index of 4.57 and 4.52 (table 3). The IBS method requires a professional workforce to handle construction projects. Training and development of the workers are important to ensure that they are competent to joint the projects. The training includes the installation process according to the correct sequencing to ensure the stability of the structure itself and also on the technical side of the application. On the other hand, the labourers need to be trained in the application of the proper connection of bolts, nuts and welding. Since the workers required on the site are only the professional workers such as erectors, pre-caster and others, foreign unskilled workers will therefore be replaced with skilled indigenous workers (Chung, 2006).

Table- 3. Social Factors

Position	Social Factors		References	Average Index	Relative Index (RI)
1	Employment issues	Dependency of foreign labours, opportunities for country younger generations by decreasing foreign workers	(Warszawski, 1999; Badir *et al.*, 2002; Chung, 2006)	4.57	0.913
2	Professionalism, Training and Education	Require experienced and skill workers, increasing professional work force by training and development for workers, skill level of IBS section employees and workforces	(CIDB, 2003; Chung, 2006)	4.52	0.904
3	Knowledge and Awareness	Acceptance and perceived Image of the System, perception of using IBS methods, motivation and incentive for IBS application, resistance of change, attitudes to foreign and domestic products and components	(Junid, 1986; Esa and Nurudin, 1998; CIDB, 2003; Kamar *et al.*, 2009; Abd Shukor *et al.*,	4.17	0.835

			2011)		
4	Communication and Advertisement	Communication and advertisement to support awareness about IBS	(Chung, 2006; Kamar *et al.*, 2009)	3.78	0.757
5	Safety, Health and Living Standard	Level of safety in construction site and working platform, enhance value end users, change lifestyle standards and conditions	(CIDB, 2003; Chung, 2006)	3.57	0.713
6	Cultural and Social Aspects	local social condition and building tradition through the new design, attentions to local traditional and cultural aspects	(Hamzah *et al.*, 2010)	3.48	0.696

The next social factor is knowledge and awareness which has an average index of 4.17. IBS is often misinterpreted and given a negative image due to its past failures and unattractive architecture Rahman and Omar (2006). These buildings are normally associated with pre-fabricated, mass construction methods, low quality buildings, leakages, abandoned projects, unpleasant architectural appearances and other drawbacks. Due to poor architectural design, IBS is not creating enough pull factors to encourage developers to adopt IBS Hamid *et al.* (2008). Changing the current perception is necessary to improve IBS adoption. Better customer perception will create better understanding and demand and will definitely encourage developers to push for IBS adoption. Increasing the society's knowledge and awareness can solve the problem of the negative perception of using IBS methods, consumer confidence and negative feeling on safety, lack of motivation and incentive for IBS application and can improve perceived image of construction. Therefore communication and advertisement got the next rank (score: 3.78) as the main tools to increase awareness among the society. Safety, health and living Standard, cultural and social aspects are the social factors that affect IBS implementation as shown in table 3.

Technological Factors

The average index of the technological factors is shown in table 4. According to respondents, time is the highest ranked factor and has averages of 4.61. IBS provides speedier construction period completion due to the introduction of components that replace on-site construction. And this is because the prefabricated components are designed in a controlled environment with a standard size then delivered on site. It requires less construction time because the casting of a precast element in a factory and foundation work at the site can occur simultaneously and the work at the site is only the erection of IBS components. This leads to earlier occupation of the building. Consequently, the successful delivery of a project could be achieved. IBS adoption can minimize the building process, therefore, enabling faster completion of the construction of projects (Badir *et al.*, 2002; CIDB, 2003; Chung, 2006; Kamar *et al.*, 2009; Abd Shukor *et al.*, 2011). The second most important technological factor is standardization and quality and has a 4.52 score. The IBS method enables quality improvement through the construction standardization.

The quality is controlled through the processes of controlled pre-fabrication and simplified installations that has maintained and ensured the better finishes and quality of work in the construction industry. That's why IBS components have higher quality and better finishes. This is also due to the careful selection of materials, use of advanced technology, better and strict quality assurance control, since production in the factory is under a sheltered environment (Badir *et al*., 2002; CIDB, 2003; Kamar *et al*., 2009). The respondents agreed that IBS components are easy to be installed, constructed and renovated by a score of 4.48. The building components are prefabricated in the factory and delivered on site, to be erected and installed. This process converts the building system to a manufacturing system. Subsequently all components are produced detailed and in standard size, leading to easy installation and providing the ability to renovate components.

Table- 4. Technological Factors

Position	Technological Factors		References	Average Index	Relative Index (RI)
1	Time	Construction time and speed of work	(Trikha, 1999; Badir *et al*., 2002; CIDB, 2003; Shaari and Ismail, 2003; Chung, 2006; Kamar *et al*., 2009; Abd Shukor *et al*., 2011)	4.61	0.922
2	Standardization and Quality	Standardization of manufacturing process and construction, quality of materials and better finishes	(Peng, 1986; Warszawski, 1999; Badir *et al*., 2002; CIDB, 2003; Shaari and Ismail, 2003; Haron *et al*., 2005; Chung, 2006; Lessing, 2006; Marsono *et al*., 2006; Kamar *et al*., 2009; CIB, 2010; CIDB, 2010)	4.52	0.904
3	Construction Easiness	Easy installation, construction and renovation, machineries for the installation process	(CIDB, 2003; Chung, 2006)	4.48	0.896
4	Structural Limitation	Structural limitation, joint and connection system, sizing of the building components	(Chung, 2006; IBS Steering Committee, 2006; CIDB, 2010)	4.39	0.878
5	Optimized use of Material	Optimized use of material and reduce material wastage	(Esa and Nurudin, 1998; CIDB, 2003; Chung, 2006; Lessing, 2006; Kamar *et al*., 2009)	4.39	0.878

6	Environmental friendly	Environmental friendly, cleaner and neater environment and construction site	(Ismail, 2001; CIDB, 2003; Chung, 2006; Lessing, 2006; Kamar *et al*., 2009; CIB, 2010)	4.35	0.870
7	Flexibility with different environment and climate	Less affected operation by the weather conditions	(Ismail, 2001; CIDB, 2003; Chung, 2006; Kamar *et al*., 2009; CIB, 2010)	4.30	0.861

Structural limitation and joints problems are the next technological factors of IBS by a score of 4.39. In spite of many IBS component advantages, they are faced with some structural limitation. A poor connection system may cause problems to site work such that the connections cannot be joined properly due to poor construction details that lead to issues of comfort and safety. Water leakage is often the major problem in buildings constructed using IBS. This problem is more obvious in Malaysia where there is heavy rain throughout the year. Eventually, this invites many serviceability problems such as leakage. Rain water can easily seep inside the building through the joints between the walls and steel beams. Dampness leads to corrosion to the lighting system and the steel beam.

The next technological-environmental factors in IBS implementation are: the optimized use of material, environmental friendliness, flexibility with different environment and climate and are ranked by the average index 4.39, 4.35 and 4.30. The use of IBS can greatly reduce the usage of conventional timber and therefore the environment will be preserved. Moreover, the utilization of machines during the production of IBS components leads to a higher degree of precision and accuracy in the production and consequently reduces material wastage. The optimized and controlled use of material, less site materials and minimal construction wastage that come with the usage of the standardized components and less in-site works by IBS application provides a cleaner site due to lesser construction waste and savings in material cost. In addition, because of faster project completion, construction operations are less affected by the weather. The weather has a lesser effect on construction operations because the fabrication of IBS components is done in a factory and the components are only erected at the site. In other words, construction operation is not affected by adverse weather conditions because prefabricated components are done in a factory controlled environment (Ismail, 2001; CIDB, 2003; Kamar *et al*., 2009). Site accessibility and management, maintenance, innovation and new technology, productivity and flexibility are some of the technological factors which affect IBS implementation.

As it was mentioned earlier, this paper introduces the PEST factors as well as the political, economical, social and technological factors. Then, the PEST factors which affect the implementation of the Industrial Building System (IBS) in Malaysia is addressed in the past research and interviews with experts. In the next step, identified factors ranked through IBS

supply chain sectors by applying the average ranking method. Classified factors in this study can be used in future studies to know the exact position of IBS in Malaysia and provide development strategies for IBS improvement with respect to its current situation.

CONCLUSION

As mentioned above, the PEST factors which affect the implementation of the Industrial Building System (IBS) in Malaysia was ranked and prioritized as a result of applying the average ranking method. Also, the main political, economical, social and technological (PEST) factors are determined. With regards to the political objectives, transportation, regulations and governmental supports achieved higher ranks. Thus, the transportation system should be improved and regulated especially in the case of IBS comportments. On the other hand, to decrease any failure and to optimize the development of the pre-cast industry, new standards should be developed by adding localized factors to its technical regulations. Moreover, governmental support should be localized and precisely directed to prevent the loss of capital and improving social welfares. On the subject of economical factors, it requires high initial investment capital, transportation cost and construction and operation cost to improve IBS implementation. However, the cost of transportation should be amended by improving the regulation of transportation in the political objectives. The construction cost would be generally decreased by using a typical design and avoiding any further design changes in constructions. Furthermore, this system speeds up the construction period which helps decrease the effect of inflation on the cost of projects.

Social factors are the factors least concerned with the current system, needs powerful support with regards to employment issues, professionalism, training and education and the awareness of IBS. The employment issue should be elaborated to decrease the need of foreign workers and align with the employing of local workers. There is the need to improve the knowledge of the local workers by utilizing the R&D centres. Technological objectives are covered mainly by time, standardization and quality, and the ease of construction. However, IBS terminology inherently improves the ease and time of projects. Furthermore, standardization and quality could be improved by using typical designs and improved designs of building's comportments which are qualified by R&D centres and approved by the government based on the new regulations. The classified factors in this study can be used in future studies to provide development strategies for IBS improvement with respect to its current position.

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