INDUSTRIALISED BUILDING SYSTEM (IBS) ADOPTION IN IRAN, PERCEPTION OF USERS AND INDUSTRY PARTICIPANTS

BY

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ABSTRACT

The Iran government has brought the Industrialized Building System (IBS) to the interest of all professionals in the construction industry. Due to certain barriers, the actual project of the IBS implementation could not be achieved. One of the factors recognized is the lack of customer gratification with IBS houses. This research aims at (i) finding out the factors pertaining to customer gratification of IBS houses and (ii) to determine IBS adoption factors for Iranian construction industry. The research objectives are to improve customer gratification with IBS houses and to develop strategies for IBS adoption in the Iranian construction industry. This research uses a mixed-method methodology. The research was conducted in three (3) phases of data collection. The respondents were divided into two (2) groups i.e. the IBS house occupiers and the construction industry participants. The quantitative method was based on a self-administered questionnaire survey. Data were obtained from eighty-two (82) IBS house occupiers to determine customer gratification in the first phase. Data from twenty-five (25) valid respondents from construction participants were also obtained to determine the IBS adoption factors in the second part of the first phase survey. Focus group discussion was adopted under qualitative method for the second and third phase of the research. From the overall analysis of customer gratification level, it was found that 70.7% respondents were satisfied, and 4.9% were very satisfied. Overall gratification level of IBS construction participants shows that the majority of the respondents are satisfied, and 4% of the respondents are very satisfied. List of strategies on how to improve customer gratification on IBS house progress and strategies on how to improve the IBS adoption in the Iran construction industry were developed. IBS house occupiers gratification was analysed using expressive analysis from the quantitative study. To determine IBS adoption factors, a statistical analysis was conducted to prove the reliability of the instruments used. Findings of the study exposed nine (9) customer gratification factors related to IBS house construction as well as nine (9) factors were identified as the critical factors in IBS adoption in the final phase of the research.

ملخص البحث

الحكومة الايرانية في محاولة عممت استخدام نظام البيوت الصناعية على جميع المتخصصين في البناء والتشييد لجلب نظرهم وانتفاعهم بنظام تشييد البيوت الصناعية المسمى(IBS). ونظرا لبعض الحواجز يبعد اعتماد هذا النظام في التشييد والبناء الايراني. أحد العوامل المعترف بها هو عدم وجود رضا العملاء مع المنازل IBS. يهدف هذا البحث إلى معرفة العوامل المتعلقة برضا العملاء من المنازل IBS، وتحديد عوامل اعتماد نظام IBS للتشييد والبناء الصناعي الإيراني. أهداف البحث هي تحسين رضا العملاء مع المنازل IBS و وضع استراتيجيات لاعتماد IBS في البناء والتشييد الإيراني. استخدم هذا البحث منهجية مختلط الطريقة. وقد أجريت عملية البحث في ثلاثة مراحل. تم جمع البيانات من مجموعتين: أي المحتلين والمستخدمين لمنازل IBS وأصحاب المصلحة في البناء والتشييد الصناعي. ويستند الأسلوب الكمي لجمع البيانات على الاستبيان الذاتي. وقد تم الحصول على البيانات من اثنين وثمانين (82) من مستخدمي البيوت الصناعية IBS لتحديد رضا العملاء في الجزء الأول من المرحلة الأول من البحث. كما تم جمع البيانات من(25) عينة صالحة من أصحاب المصلحة في البناء والتشييد الصناعي أيضا لغرض تحديد عوامل اعتماد IBS في الجزء الثاني من المرحلة الأولى للاستبيان. بعد تحليل شامل لمستوى رضا العملاء، فقد وجد أن 70.7٪ من المشاركين في البحث الحالي راضون و 4.9٪ كانوا راضين جدا. كما يدل مستوى الرضا العام من أصحاب المصلحة في نوع البناء IBSأن غالبية المستطلعين راضون و 4٪ من المستطلعين على مستوى عال من الرضا مع هذا النوع من البناء. وقد وضعت قائمة من الاستراتيجيات لتطور كيفية تحسين رضا العملاء من المنازل الصناعية IBS والاستراتيجيات حول كيفية تحسين اعتماد IBS في البناء والتشييد المنازل الصناعية في إيران لدى أصحاب المشاريع في البناء والتشييد. تم تحليل البيانات المكتسبة من مستخدمي المنازل الصناعية IBS لمعرفة مدى الرضا باستخدام "التحليل البياني" في الدراسة الكمية للبحث الحالي. لتحديد عوامل اعتماد IBS أجري التحليل الإحصائي لإثبات قابلية الاعتماد على الأدوات المستخدمة لجمع البيانات وصحتها. نتائج الدراسة كشفت عن تسعة عوامل رضا لدى العملاء المتعلقة ببناء المنازل IBS فضلا عن أن هذه العوامل التسع كانت حاسمة ومهمة لدى أصحاب المصالح في التشييد والبناء الصناعي في اعتماد النظام IBS في المرحلة الأخيرة من البحث.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Science in Building Services Engineering.

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Norwina Mohd Nawawi
Supervisor

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Science in Building Services Engineering.

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DECLARATION PAGE

I hereby declare that this dissertation is the results of my own investigation, except where otherwise stated. I also declare that is has not been previously or concurrently submitted as a whole for my other degree at IIUM or other institutions.

Mohammad Sharif Ashrafi

Signature…… Date……..

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

The Iranian construction industry has been experiencing an evolution since 2005 and is thought to grow 6.86% yearly by 2007. The United Nation's (UN) sanctions foreign investments in Iran, however, have not reduced its business prospects. The report had predicted the growth of the industry in 2012 to a value of $13.10 billion with an average growth of 4.40% over the 2008-2012 period. The need to provide housing to its burgeoning population had urged the country's infrastructure to reach the first global standards through strengthening in the medium term with BMI foretells the industry to be valued at $ 26.40 billion by 2012 (Samari et al., 2012).

In reference to Malaysia's housing industry, the Industrialized Building System (IBS) was initiated in 1964 by the Housing and Local Government upon learning the success of several European countries. The importance of IBS method in the European countries includes the provision of the good quality control production and valuable mass manufacture. The government of Malaysia had carried out two IBS guide projects in 1966. They were the construction of 40 stories of Tunku Abdul Rahman Flats located in Kuala Lumpur and the Rifle Range Road Flats located in Penang (Majid et al, 2010).

Industrialised building systems (IBS) is also practice in several countries such as United Kingdom, Japan, Germany, Singapore and Sweden as an alternative to the conventional building system (Hassim et al., 2009).

After the Second World War, the plan of industrialised building system (IBS) has received much concentration in the overwhelmed countries such as Germany, Italy,

the United Kingdom, and Japan. Though Malaysia did not experience the impact of war, the need to supply its population with reasonable and quality houses has prompted Malaysia government to encourage the use of IBS as an option to conventional building system (Thanoom,2003).

1.2 WHAT IS IBS

1.2.1 IBS Definition

IBS is a construction method of which the apparatuses are artificial, and the building parts are made in an organised environment (off site). At the same time, these parts are transported, sited and accumulated into a structure without extra works on the site ((CIDB), 2003).

IBS is the process that components of the building are pre-planned, prearranged and fabricated, transported to the site. The arrangement includes stability combination of software and hard ware section. The software part includes system design, which is a tedious progression of studying the necessity of the end user, market investigation and the progress of standardised element (Junid, 1986).

IBS is an incorporated manufacturing and construction progression system with a meticulously planned establishment for well-organized management, prepare and controlling over properties used, activities and consequences supported by the used of extremely established components (Lessing et al., 2005).

1.2.2 Types of Building System

According to Kadir et al., (2006) building system is classification into four main categories:

1. Conventional building system;
2. Cast in-situ formwork system – table or tunnel formwork;
3. Prefabricated system; and
4. Composite system.

Numbers 2, 3 and 4 building systems are addressed as IBS

1.3 ISSUES

1.3.1 Advantages

Typical advantages of using industrialised building system include cost savings, better durability and structural stability, better compliance with housing standards and building laws, better quality control, and better aesthetic and market value. Innovative housing systems are a shift from massive and weighty components to partial prefabrication and production of small-middle and lightweight components (Pan, 2007).

Iran construction industry suffers from a significant amount of unskilful labour. This condition mostly leads to high cost, high rate of human errors, and low quality of buildings. The IBS concept by transferring most of the construction activities from the site to factories can reduce the number of site workers. It not only reduces human costs but also increases productivity thus companies give attention to more on training to their limited labours and enhance their skills and efficiency (Samari et al, 2012).

Another advantage of IBS is saving time (if there are suitable arrangement and operative organisation in its application), and cost saving (given an enough number of components to reduce the cost of investment equipment and earlier return in resources). Theoretically, it can be a transmission of an organisation, practical skills, and stringent quality control as well as advanced level in finishing that cannot be constructed by the conventional method of building (Nuzul Azam, 2012).

Most of the construction companies believe that minimum wastage is the most significant benefit of IBS in comparison to the conventional method where wasted material is indeed very substantial. The IBS method provides major parts of the building structure to be produced in the factories and transferred to the construction site. The method leads to less dumped materials in the site and clean work environment. IBS, therefore, provided opportunities for companies to reduce the raw material waste in their projects and save material costs as well. Most building projects are located in the cities. The use of IBS by construction companies will reduce environmental impacts and pollutions and thus can keep away from any conflicts with authorities or neighbours. Another perceived IBS benefit is more control on the products quality (Samari et al., 2012).

1.3.2 Disadvantages

In Iran, the lack of skill and knowledge of IBS is the major setback for the construction companies to implement the IBS method in their projects. IBS concept is a relatively a new construction method in Iran. Most architects, engineers and contractors in Iran do not have experience in the implementation as they did not have access to training courses. Other setback includes the higher cost that is mostly due to lack of expertise, technologies, standards and government incentives as well as very limited suppliers (Samari et al, 2012).

The other disadvantages could be:

- Transporting challenges
- less flexibility in terms of subsequent changes
- necessity of increased planning depth

- sensitivity for tolerances

1.4 PROBLEM STATEMENT

IBS concept is new in Iran. Despite its benefits, IBS usage in Iran is still low due to construction companies unwilling to use it. The lack of standards and building code in this construction method is another factor that contributes to IBS not attractive for construction companies. Although the level of implementation of IBS is extremely low in the Iranian construction industry, the awareness of the benefits of IBS is high among the professionals (Samari et al., 2012).

It can be seen cases, where house project built by IBS system contribute to delay in project, poor quality, and weak customer gratification (Kamar et al., 2007). This phenomenon brought the IBS system in to complications. As a result, the industry is unwilling to include IBS as an alternative building system. On the other hand, there are clients with full information and awareness on IBS benefits will confidently prearranged designers to design buildings according to IBS.

Samari et al., (2012) noted that professional and cultural issue are the other factors that contribute to the non-attractive use of IBS by construction companies in their project. Most companies are comfortable with the conventional method and found it easier for them to complete their projects that come from their experience. These construction companies are not comfortable nor are they assured that IBS could contribute them project success. Therefore, to encourage IBS among construction companies, it is critical to change their common perception on benefits of IBS as well as to give a critical review of rules and regulation by the government that will motivate their use.

However, due to dis-gratification and misconception of IBS by user-customers themselves, this research, therefore, consider the determination of customer's or user's gratification as imperative. This research, therefore, aims at defining the success issues in IBS adoption and to improve strategies on how to advance them in Iran.

1.5 RESEARCH QUESTION

From the background of the research study, and the problem statement, the research is to find the answers to the questions below:

i. What is the extent of customer gratification with IBS system in Iran?

ii. What are the barriers and success factors to IBS adoption in the Iran building industry?

iii. How to improve customer gratification in IBS system construction and level of IBS adoption in the construction industry?

1.6 OBJECTIVES OF THE STUDY

The following research objectives will answer the research questions:

i. To determine the customer gratification factors for IBS

ii. To define the achievement factors of IBS adoption in the building industry

iii. To improve the strategies to advance customer gratification with IBS system construction and level of IBS adoption in the building industry

1.7 AIM OF THE RESEARCH

The aim of this research is as follows:

(i) To define the achievement factors of IBS adoption in the building industry,

(ii) Define the strength, weakness, opportunities and threat in IBS, Determine the customer gratification factors for IBS, and

(iii) Find out strategies and techniques for the implementation of IBS.

The research aims to propose industrialised building system (IBS) as a better system rather than the conventional system in Iran to increase the quality of housing matching the lifestyles.

1.8 RESEARCH METHODOLOGY

The research is categorised into three (3) basic types which are quantitative, qualitative and mixed methods. Smith et al., (1979) clarified that, quantitative research engagements the investigational, the traditional, the positivist, or the pragmatist method to investigate into an acknowledged problem. But, the quantitative research is founded as testing a principle, highlights and reproducibility. Fraenkel & Wallen (2003) argued that the goalmouth of quantitative methods is to define whether the extrapolative simplifications of a model hold correct. Therefore, quantitative research is more apprehensive with matters of how much, how well, or to whom that particular issue addressed.

Kerlinger & Lee (2000) clarified that qualitative research is reasonable in nature and that researchers create extrapolations based on direct clarifications with the principal goal to define reason and outcome. Fraenkel & Wallen (2003) explain that qualitative research is classified as either expressive or investigational research. The perseverance of expressive research is to become more acquainted with occurrences, to gain new vision, and to express a more particular research problem or proposition. On the other hand, investigational research is to test reason and affect connections among variables. In an expressive research, investigators do not control directly over

independent variables because their appearances have already happened or they are characteristically not manipulable.

The methodology of this research is a mixed method; quantitative and qualitative and using previous studies through literature review. The research process is formulated based on three (3) different phases of data collection.

1.8.1 Research Design

The research process of this study was formulated based on three (3) different phases based on the research questions of this research (refer Figure 1.1). The first phase comprises two (2) parts. In Part 1, the factors for customer gratification for IBS system were determined through a literature review and preliminary study. In Part 2 the factors for success and barriers to IBS adoption in the building industry were also resolute through a literature review and preliminary study. In the both factors collecting is through quantitative study using a "self-administered questionnaire investigation".

In the second phase, both customer gratification factors from Part 1 as well as the IBS adoption factors from Part 2 are individually set as the requirements or “What’s”. Through "qualitative study" or "focus group discussion", the data collection method was investigated and surveyed to define the approaches to achieve both supplies. The third phase of the research procedure combined the customer gratification approaches and the IBS adoption approaches determined from the second phase. The objective for combining both approaches was to determine which administrations are invented to performance in order to implement complete IBS adoption in the Iran building industry.

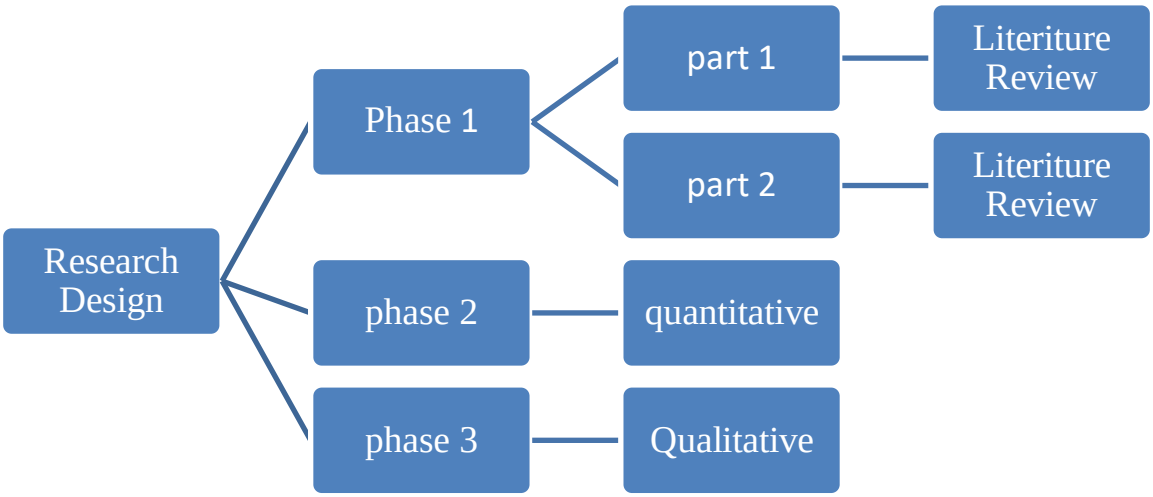

Figure 1.1: Research design adopted in this thesis

1.9 SUMMARY

IBS concept is new in Iran. The level of IBS usage is also low as the construction companies are not willing to use it. The lack of standards and building codes in the use of IBS is another factor that makes IBS unattractive to Iran construction companies. Although the awareness of the benefits of IBS among the professionals is high, the level of implementation of IBS is still extremely low in the Iranian construction industry. Among the obstacles that hinder construction firms to step in are the lack of expertise; lack of new technologies; lack of government incentives as well as low completion using this method. The managerial and cultural issue are among other factors that stop companies from IBS usage in their project. These companies are comfortable with the traditional or conventional method of construction to complete their projects. With the widespread negative perception on IBS, these companies are not able to accept IBS as another option that can contribute to project success. To promote IBS among

construction companies, it is therefore critical to change their common perception on IBS usefulness prior undertaking other actions. Another urgent need is to review rules and regulation by the Iranian Government to stimulate usage of IBS among the construction companies (Samari et al, 2012).

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The Iranian construction industry had been experiencing a turnaround since 2005. The industry is thought to grow 6.86% year-on-year (y-o-y) in 2007. Despite the United Nation's (UN) sanctions on Iran, foreign investments in the country have not reduced but contemplating well on its business potential. Construction industry displays a significant growth potential for the country. The report predicts the potential of the sector to be valued at $13.10bn in 2008, as it registers an average growth of 4.40% over 2008-2012. Urged by its necessity to enhance its infrastructure to reach the global standards and the need to provide housing to its expanding population, the construction industry of Iran will go on strengthening in the medium term. The BMI had foretold the industry to be valued at $ 26.40billion by 2012 (Samari et al., 2012).

As explained in Chapter 1, the Industrialized Building System (IBS) was initiated in Malaysia in 1964 by the Housing and Local Government after making references to the success of several European countries. The IBS consequence method in the European countries has provided excellent quality control production and efficient mass production. The Malaysian government then carried out two IBS preliminary projects in 1966. The first IBS project was 40 stories of Tunku Abdul Rahman Flats located in Kuala Lumpur and the second IBS construction project was the Rifle Range Road Flats located in Penang with 3699 units of flat and 66 shop lots along the Rifle Range Road (Majid et al., 2010).

Industrialised building systems (IBS) is practice in several countries such as United Kingdom, Japan, Germany, Singapore and Sweden. According to Hassim et al., (2009), this system can replace the conventional building system .

Thanoom (2003) stated that the idea of industrialised building system (IBS) had received much attention in the war-torn countries after the Second World War as a mean to speed mass construction. Although Malaysia did not suffer from the impact of war, the need to supply the people with affordable and quality houses had urged the government of Malaysia to promote the use of IBS as an alternative to the conventional building system. The objective of this research is to, therefore, to document both the success and the bad experiences of Malaysia as well as other countries, for the adoption of IBS for Iran.

2.2 WHAT IS IBS

2.2.1 IBS Definition

To date, it cannot be seen one frequently recognised or approved definition of IBS. Kamar et al, (2007) defined IBS as a construction system which apparatuses are factory-made in a factory, on the site or out of the site, placed and accumulated into structure with less extra site work.

CIDB (2003), defines IBS as a construction performance, of which apparatuses are manufactured in an organised situation (on or off site). At the same time, the parts are transported, positioned and assembled into a structure without too much extra site works.

As a prefabricated system, IBS is the process that components of building, need to be fully considered, prearranged, fabricated and transported to the site. This arrangement includes stability combination of software and hardware section. The

software part includes system design, which is difficult progression of studying the necessity of the end user, market investigation and the progress of standardise element (Junid, 1986).

IBS is an incorporated manufacturing and construction progression with carefully planned establishment for well-organized management, prepare and controlling over properties used, activities and consequences supported by the used of extremely established components (Lessing et al, 2005).

2.2.2 Types of Building System

According to Kadir et al., (2006) these are the four (4) main categories in the building system classification:

1. Conventional building system;
2. Cast in-situ formwork system – table or tunnel formwork;
3. Prefabricated system; and
4. Composite system.

The last three building systems i.e. (2), (3) and (4) are IBS.

According to Kadir et al. (2006), the conventional building system is divided into two (2) major components. The first component is the structural system. The structural system includes cast-in-situ column-beam-slab frames. The frames are constructed through four operations, namely, (1) erection of timber formwork and scaffolding, (2) erection of steel bar,(3) pouring of fresh concrete into the formwork and (4) dismantling of formwork and scaffolding. According to Kadir et al., (2006), these operations are labour intensive, tedious and require a lot of on-site coordination. In IBS construction after structural frame, the non-structural infill material consists of brick and plaster is the second component being erected.