UNIVERSITI PUTRA MALAYSIA

RISK ANALYSIS OF HOUSING PROJECTS IN MALAYSIA USING AN INDUSTRIALISED BUILDING SYSTEM

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By

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Chairman: **Salihudin Hassim, Ir.**

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The use of industrialised building system (IBS) has attracted many countries like Singapore, Sweden, Germany, and Japan. This system can replace the conventional building system that uses labour intensive force. However, although this system has been used since 1964, its acceptance in Malaysia among constructors is not satisfactory due to its failure in managing the construction system risks. Therefore in order to address this issue, this study has identified risks faced by developers in housing projects that use industrialised building system. The study also identifies highly risked construction stages, determines risk allocation for sources of risk, and proposes a computer program for the risk management. The techniques to identify risks being used in this study are through analysis of past research publications like journal, conference and discussion with parties involves in construction industry. Data is compiled through questionnaires that are distributed and collected from housing developers. The data is then analysed using statistical techniques like Chi-Square Test and Pearson Correlation Coefficient. It is found that there are twenty eight sources of risk that contribute to six types of risk in construction project. The top five sources of risk are inexperienced contractor in IBS project, complexity in

design, contractor performance failure, inappropriate estimate of construction cost, and variety of design. Based on four stages of construction which are the initial stage, tendering stage, procurement stage and implementing stage; initial stage contributes to the highest risk in industrialized building system. The problem of quality, poor productivity, defective materials, labour disputes and loss or delay due to resources availability are on contractors' shoulder. The building owners are responsible on variation of work, sales and marketing, and deficiencies in specification and drawing. The result of this study reveals that there is no relation between types of industrialized building system being used and types of risk. Three categories of risk which are financial risk, construction risk and design risk are interrelated with each other. A tentative risk register tool produced in this study is based on computer application. It may help developers to identify sources of risk, evaluate and manage the identified risks as part of decision making. In conclusion, it is hoped that this study could help developers in making risk management planning besides improving decision making and achieving project objectives.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan ijazah Master Sains Pengurusan Projek

ANALISIS RISIKO DI DALAM PROJEK PERUMAHAN MENGGUNAKAN SISTEM PEMBINAAN BERINDUSTRI DI MALAYSIA

Oleh

SAIFUL AZRI BIN ABU HASAN SAZALLI

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Penggunaan sistem bangunan berindustri telah menarik minat banyak negara untuk mengaplikasikannya dalam pembinaan perumahan seperti Singapura, Sweden, Jerman, dan Jepun. Sistem bangunan ini boleh menggantikan sistem bangunan konvensional yang mana berorientasikan buruh. Bagaimanapun sejak projek pertama yang menggunakan sistem bangunan ini pada tahun 1964 sehingga kini, penerimaan sistem bangunan ini di Malaysia di kalangan pihak pembina adalah tidak memuaskan disebabkan oleh kegagalan mengenalpasti risiko-risiko sistem bangunan berindustri. Untuk menangani isu ini, kajian ini akan mengenalpasti risiko-risiko yang dihadapi oleh pihak pemaju di dalam projek perumahan yang menggunakan sistem bangunan berindustri, mengenalpsti peringkat-peringkat pembinaan yang berisiko tinggi, memperuntukkan punca-punca risiko kepada pihak-pihak terlibat dalam projek dan seterusnya mencadangkan satu pengurusan risiko bagi projek sistem bangunan berindustri berdasarkan komputer. Teknik-teknik mengenalpasti risiko yang digunakan ialah melalui analisis kajian-kajian lepas seperti jurnal, persidangan dan perbincangan dengan pihak yang terlibat dalam industri pembinaan dan data-data ini dikumpulkan melalui borang soal selidik yang diedarkan kepada pemaju perumahan.

Data-data ini kemudiannya dianalisis menggunakan analisis statistik iaitu Chi-Square dan Pearson Correlation Coefficient. Didapati terdapat 28 punca risiko kepada 6 jenis risiko dalam projek pembinaan. 5 punca risiko kedudukan teratas adalah kekurangan pengalaman kontraktor dalam projek IBS, kerumitan rekabentuk, kegagalan perlaksanaan kontraktor, anggaran kos pembinaan yang tidak tepat dan rekabentuk yang pelbagai. Berdasarkan 4 peringkat pembinaan iaitu, peringkat permulaan, peringkat tawaran, peringkat perolehan dan peringkat perlaksanaan, peringkat permulaan merupakan peringkat berisiko tinggi di dalam projek sistem bangunan berindustri. Masalah kualiti, produktiviti lemah, kerosakan bahan binaan, pertelingkahan antara pekerja dan kerugian atau kelewatan perolehan sumber adalah dipertanggungjawab kepada kontraktor. Manakala pemilik dipertanggungjawabkan ke atas perubahan kerja, penjualan dan pemasaran, dan kekurangan dalam spesifikasi dan lukisan pembinaan. Kajian ini mendapati jenis-jenis sistem bangunan berindustri yang digunakan mempunyai perhubungan dengan jenis-jenis risiko. 3 kategori risiko dikenalpasti iaitu risiko kewangan, risiko pembinaan dan risiko rekabentuk mempunyai hubungan antara satu sama lain. Pendaftaran risiko yang dihasilkan berdasarkan aplikasi komputer dapat membantu pemaju untuk mengenalpasti punca-punca risiko, menilai dan menguruskannya sebagai sebahagian daripada proses membuat keputusan. Kesimpulannya melalui kajian ini diharap dapat membantu pemaju dalam membuat perancangan pengurusan risiko selain membantu membuat keputusan untuk mencapai objektif sesebuah projek pembinaan.

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Lastly, my thanks to all my close and special friends, Mr Ramli Kasin and Mr Wilson Suai and other lecturers for their advice and support. I am indebted to all of you.

I certify that an Examination Committee has met on 28 May 2008 to conduct the final examination of Saiful Azri Bin Abu Hasan Sazalli on his Master of Science thesis entitled "Risk Analysis of Housing Projects in Malaysia Using an Industrialised Building System" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Act 1981. The Committee recommends that the student be awarded the Master of Science.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master Science. The members of the Supervisory Committee were as follows:

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Date: 14 August 2008

DECLARATION

I declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, or is not concurrently, submitted for any other degree at Universiti Putra Malaysia or other institutions.

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SAIFUL AZRI BIN ABU HASAN SAZALLI

Date: 4 September 2008

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LIST OF ABBREVIATIONS

CIDB	Construction Industry Development Board
CRMS	Construction Risk Management System
IBS	Industrialised Building System
PRM	Project Risk Management
REHDA	Real Estate and Housing Developer's Association Malaysia
UK	United Kingdom

CHAPTER 1

INTRODUCTION

1.1 General

The construction industry is one of the most dynamic, risky, challenging and rewarding fields. It involves numerous uncertainties and is widely associated with high degree of risks due to the nature of construction business activities, processes, environment and organization (Kartam and Kartam, 2001). The complexities of projects, locations, types of contract, familiarity with the work and breakdown in communication are some of the significant contributors to risks in construction industry.

Risk has been defined in various ways. Porter (1981), Healy (1982), Barrie and Paulson (1992), and Perry and Hayes (1985) have expressed risk as an exposure to economic loss or gain arising from involvement in the construction process; Moavenzadeh and Rosow (1999) and Mason (1973) have regarded this as an exposure to loss only. Bufaied (1987) and Boothroyd and Emmett (1998) described risk in relation to construction project whose variation results in uncertainty in the final cost, duration and quality of the project. In order to emphasize the major objectives of survey on risk management action, risk has been defined as the probability of occurrence of some uncertain, unpredictable and even undesirable events that would change the prospects for the profitability of a given investment.

According to Ahmed, Ahmad and Saram (1999), failure to adequately deal with uncertain, unpredictable and undesirable event has shown to cause serious effects of risk that are summarized as:

- Failure to keep within cost estimate.
- Failure to achieve the required completion date.
- Failure to achieve the required quality and operational requirements.

In the 8th Malaysia Plan, the country continues to embark in developing an affordable and sustainable low and medium cost house. However, Malaysia is facing the risk of failure to accomplish the target of 600,000 to 800,000 unit of houses during this period because the conventional building system being practiced by the construction industry is unable to cope with the huge demand (Thanoon et al.(i), 2003). Hence, risk management consequently becomes an important mechanism to be adopted to ensure achievement of the planned objectives in committing to these great targets.

Instead of improving the efficiency of managing project risks, the Malaysian government has been promoting the application of new building system strategies for the implementation of building construction, in particular, the mechanism of industrialised building system (Thanoon et al.(ii), 2003; Trikha, 1999; Lian, 2002). The Malaysia government through CIDB encourages constructors to use industrialised building system in construction and to reduce the dependency on foreign labour, to increase productivity, quality and safety in the local construction industry, and also to minimize the risks in construction works (Shahrul, 2003).

1.2 Statement of the Problem

Risk is an abstract concept. It is difficult to define and in most cases it is impossible to measure with any precision. Risk is a situation where the actual outcome for a particular event or activity deviate from the forecast value. In construction, risks are related as a barrier in achieving the project goal which are cost within the budget, quality according to specification and time within the construction period.

Risks always exist in any construction projects and often cause failure to achieve the objectives of project. Usually, risks exist from the early stage of the project development until the completion of the project. The types and levels of risk are different according to the stage of the development. All parties involved in construction project are exposed to the risks in the construction (Liebing, 2001; Cooper et al., 2005; Smith and Bohn, 1999).

The IBS is an industrialised building system in which almost all building components are mass produced either in factory or at site under strict quality control and minimal on site activities (Trikha, 1999). The industrialisation is essentially an organisational process – continuity of production implying a steady flow of demand; standardisation; integration of different stages of the whole production process; a high degree of organisation of work; mechanisation to replace human labour wherever possible; and research with organised experimentation integrated with production. It can speed up construction process with less labour on site and, if possible, at less cost and minimized effects of risk. With these advantages, a lot of

countries have chosen to use the IBS in their construction industries including the Malaysia government (Thanoon et al.(i), 2003).

However, since the first project of IBS in year 1964 till today, IBS in Malaysia is not well accepted by the construction parties despite numerous incentives and promotion especially to encourage housing developers to invest in IBS housing project (Ismail, 2001). One of the causes is the failure to adequately deal with risks in the IBS projects. Failures to keep within cost estimate in IBS projects are still common in Malaysia and it is one of the reason that limits the development of IBS (Lian, 2002). In fact, research done by Warszawski (1999) supports that there are risks in IBS such as technical risk and quality risk that cause aesthetic and functional faults, like cracks, blemishes, moisture penetration and poor thermal insulation in completed buildings. Hence, there is a need to have systematic identification, analysis and assessment of risk that may contribute significant success of projects (Barrie and Paulson, 1992).

The success of a project management exercise depends very much on an efficient and effective management of the risks involved (Ren, 1994). If risks are to be managed, those risks must first be identified However, attempts to consider every risk is doomed to failure: the time taken would be enormous, delaying the possibility of formulating managerial strategy until after the risk consequences had actually occurred, and the whole exercise is a waste of resources (Trikha, 1999). Thus, in practice, the primary aim is to identify the key, critical, important risks in the project so that they are analysed and appropriate responses are determined (Ahmed, Ahmad and Saram, 1999; Kangari, 1995).

Naturally, the objectives of construction projects differ among nations, and all nations and regions of the world may have their own characteristics (Kunishima and Shoji, 1996). Just as there are differences in ways of living, the value systems and the ways of thinking, there are also different ideas on management of construction risks. In other words, the managements of risks are greatly influenced by the uniqueness of the construction industry in a specific country. So far, little is known about risk and its management in the Malaysian construction industry especially in IBS project. This study assesses these issues.

This study presents the perceptions of Malaysian developers towards IBS risks in housing construction in Malaysia since there is no concrete study about it in the past. The result of this survey should further clarify the perception of developers regarding IBS in construction project and current circumstances in the industry. A thorough understanding of current trend may aid developers in risk management.

1.3 Research Questions

These are the research questions that need to be answered in this study:

1. What is the perception of developers involved in the IBS projects towards risk?
2. Which stages in IBS project are often encountered as critical risks?
3. What are the sources of risks in IBS projects?
4. What are the risks allocation between parties involved in IBS project?
5. What are the factors that are likely to influence the level of risk in IBS project?

6. How does risk management can take action against the risk in IBS project?

1.4 Significance of Study

Due to the current population growth and the increasing housing demand in Malaysia, construction system becomes a great subject to all practitioners in construction industry. An effective construction system that can mitigate risks determines the success of construction companies. In conjunction with this, a new building systems has been introduced to reduce cost, material saving, better quality control, shorter construction time and immunity to weather changes.

The industrialised building system is the method introduced for these purposes. This building system is a new method of construction that uses new modified materials and new technology. Studies show that it is effective in reducing men power demand, duration of construction, cost needed and mitigate risks in construction process (Thanoon et al.(ii), 2003; Lian, Hassim and Kadir, 2003). Nevertheless, the degree of the effectiveness of this system is being queried.

This research attempts to study and analyse the sources of risk in an industrialised building system in building construction in Malaysia since there is no concrete study about it in the past. Through this research, it will enable explicit decisions to be made to mitigate the potential effect of certain risks. On the contrary, it helps all main parties involved in IBS to make use of the full extent of other experience and knowledge by liberating them from the necessity of making simplifying assumptions

in order to produce deterministic plans and forecasts to enables decision makers to improve the quality of their judgement by providing more realistic information.

1.5 Objectives

In recognition of the importance of understanding the concept of risk in IBS project, this research aims to study the risk involved in development stages of IBS projects in Malaysia. The main objectives of the study can be listed as:

1. To identify and evaluate the sources of risk in IBS project.
2. To identify the stages in IBS project where critical risks are often encountered.
3. To determine the parties who contribute to risk in IBS project.
4. To propose a risk register database tool for IBS projects.

1.6 Hypotheses

The hypotheses that need to be tested in this study are as listed below:

1. Relationship between types of IBS and type of risk in IBS projects.
2. Relationships between types of risk in IBS projects.

1.7 Scope of Study

A building system classification done by Badir in year 1998 would be the baseline for identifying the IBS and types of IBS in this study. This classification is chosen as

it was done in Malaysia as it reviewed the availability of IBS in Malaysia. The scope of this study is described as below:

1. Housing developers registered with the Ministry of Housing and Local Government.
2. This study focuses on the risks which have relationship with process of housing development.
3. This study looks into four stages of project development which are initial stage, tendering stage, procurement stage and implementing stage.

1.8 Thesis Overview

This thesis consists of six chapters. A diagrammatic guide of the thesis is shown in Figure 1.1 and is briefly described as follows:

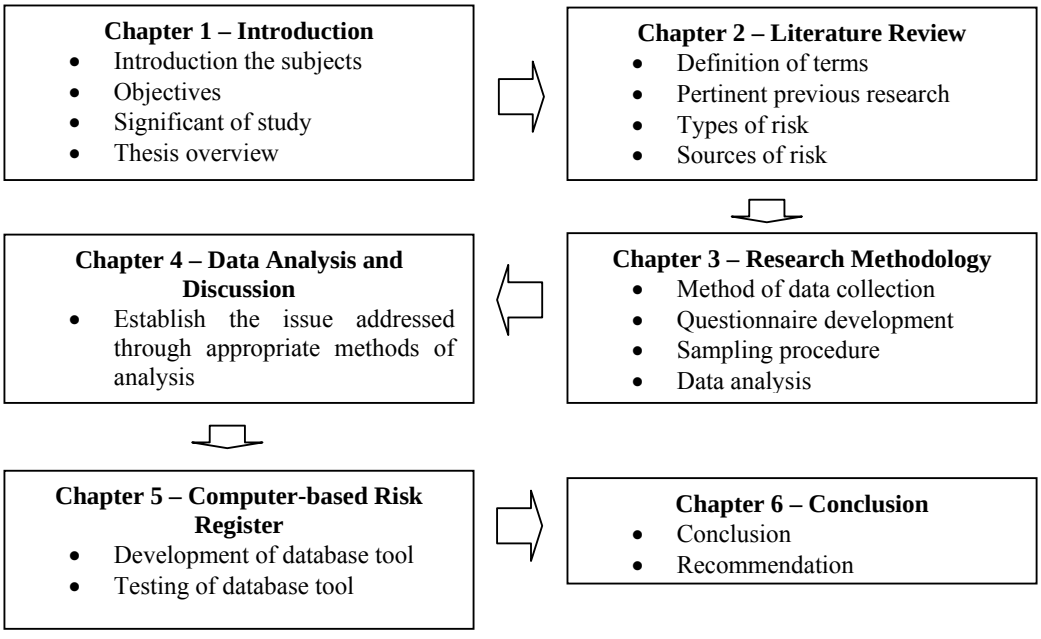

Figure 1.1. Structure of Thesis

Chapter one presents a general introduction to the subject and the problem statement. It also introduces the aims, objectives, significance of study and a brief summary on the structure of the thesis.

Chapter two is a literature review on related field of this study. Definitions of terms used in this study in related field, the industrialised building system, type of risk in IBS and sources of risk are also discussed.

Chapter three presents the methodology that is carried out to achieve the objective of this study. Questionnaire development and data collection are also presented together with the analytic methodology of data collected.

Chapter four presents the analysis and statistical tests to establish the finding from the survey. The results of the analysis are discussed and conclusions are drawn.

Chapter five presents the development of tentative risk register database tool for IBS projects based on the findings of this study. Actual practitioners are used to validate the risk register database tool developed.

Chapter six presents the summary and the conclusions of the findings of this study. Suggestion and recommendation for further development of research in this area are also presented.

1.9 Closure

This current chapter presents the problems statement, objectives of the study, significant of the study, scope and limitation and thesis overview. This is the background of the research study. The next chapter reviews and discusses the field of industrialized building system, risk and construction, types of risk and sources of risk.