

UNIVERSITI PUTRA MALAYSIA

IMPORTANT CRITERIA FOR INDUSTRIALIZED BUILDING SYSTEMS FROM THE PRESPECTIVES OF MAJOR PROJECT PARTCIPANTS

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Master of Science

IMPORTANT CRITERIA FOR INDUSTRIALIZED BUILDING SYSTEMS FROM THE PRESPECTIVES OF MAJOR PROJECT PARTCIPANTS

By

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September 2002

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The revolution in the building industry has resulted in many new building systems

being introduced. Consequently, the principal project participants are often faced

with decision involving the selection of an appropriate building system. Hence, the

research presented in the study focuses on the importance of criteria in selecting the

most appropriate building system. It also presents a proposed evaluation model that

serves as a guideline for professionals in the industry to perform an initial feasibility

study on the selection of industrialized building system.

ii

Based on the literature search, the relevant criteria were grouped into six categories:

Project Objectives Criteria, Project Characteristics Criteria, Project Constraint

Criteria, Technical Oriented Criteria, Performance Oriented Criteria, and Resources

Oriented Criteria. The importances of these criteria were identified through a mailed

questionnaire, which was employed as the research methodology.

From the importance or priorities of criteria obtained from the questionnaire survey, the relationship of criteria among principal project participants was analyzed. It has found that the criteria among Clients, Architects, and Engineers are strongly correlated, except the criteria of Contractor. In addition, it has also been found that the criteria among principal project participants are independent from methods of construction, methods of construction and types of project.

The proposed evaluation model is set up based on the Analytical Hierarchy Procedure, which enables to set up complex problems involving attributes, subattributes, sub-subattributes, and so on, in an orderly, structured manner. Beside organizing the tangible and intangible decision criteria in a systematic manner, it also provides a structured yet relatively simple solution to the decision-making problems related to selection of an appropriate building system for implementation.

As a result of the research, there will be documented sources of information for the selection of an appropriate building system. Moreover, the selection of an appropriate building system can be performed in a systematic and effective method.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai

memenuhi keperluan untuk ijazah Master Sains

KRITERIA PENTING UNTUK SISTEM BINAAN BERINDUSTRI DARIPADA PEKSPEKTIF PROFESSIONAL UTAMA PROJEK

Oleh

LIM JEE GIN

September 2002

Pengerusi: Profesor Madya Ir. Dr. Mohd Razali Abdul Kadir

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Revolusi dalam industri pembangunan telah mengakibatkan banyak sistem binaan

berindustri diperkenalkan. Akibatnya, pemaju, akitek dan jurutera perunding

sentiasa menghadapi masalah untuk memilih suatu sistem binaan berindustri yang

paling bersesuaian. Dengan demikian, penyelidikan ini telah dijalankan untuk

memberi perhatian kepada kepentingan kriteria dalam pemilihan suatu sistem binaan

berindustri yang paling bersesuaian. Selain itu, penyelidikan ini juga mencadangkan

suatu model penilaian yang dapat digunakan sebagai panduan oleh profesional

dalam industri pembangunan ini untuk melakukan penyelidikan kemungkinan

dilaksanakan bagi sistem binaan berindustri berkenaan.

iv

Berdasarkan kajian literatur yang dijalankan, kriteria yang berkenaan telah digolongkan kepada enam kumpulan, iaitu Kriteria Objektif Projek, Kriteria Sifat Projek, Kriteria Rintangan Projek, Kriteria Teknikal, Kriteria Prestasi, and Kriteria Sumber Projek. Kepentingan kriteria berkenaan ditentukan melalui sistem soal selidik pengiriman.

Berdasarkan kepentingan kriteria pemilihan berkenaan, hubungan kriteria pemilihan di antara profesional utama projek telah dianalisis. Adalah didapati bahawa kriteria pemilihan di antara Pemaju, Akitek dan Jurutera Perunding mempunyai hubungan yang linear kecuali kriteria pemilihan bagi Kontraktor. Selain itu, didapati juga kriteria di antara semua profesional utama projek adalah bebas daripada kaedah binaan, sistem kontrak dan jenis projek.

Model penilaian yang dicadangkan adalah berdasarkan Prosedur Hierarki Beranalisis, di mana kaedah ini mempunyai sifat keistimewaannya untuk mengatur masalah kompleks yang melibatkan atribut, subatribut, sub-subatribut, dan sebagainya dalam suatu struktur yang sistematik. Di samping pengaturan kriteria pemilihan secara sistematik, kaedah ini dapat memberi suatu penyelesaian yang mudah dalam pemilihan suatu sistem binaan berindustri yang paling bersesuaian.

Dengan siapnya penyelidikan ini, penyelidikan ini dapat memberi sumbangan ke arah sumber maklumat yang berguna dalam pemilihan sistem binaan berindustri. Tambahan pula, pemilihan sistem binaan berindustri yang paling bersesuaian dapat dilakukan dengan kaedah yang bersistematik dan berkesan.



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I certify that an Examination Committee met on 24th September 2002 to conduct the final examination of Lim Jee Gin on his Master of Science thesis entitled "Important Criteria for Industrialized Building Systems from the Perspectives of Major Project Participants" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby 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 concurrently submitted for any other degree at UPM or other institutions.

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TABLE OF CONTENTS

		Page
ABS ACH APP DEC TAH LIS	ABSTRAK ACKNOWLEDGEMENTS APPROVAL SHEETS DECLARATION FORM TABLE OF CONTENTS LIST OF TABLES LIST OF FIGURES CHAPTER	
CHA	APTER	
I	INTRODUCTION	
	Background	1
	Problem statements	2
	Objectives	6
	Justification	6
	Thesis Overview	8
	Closure	11
II	LITERATURE REVIEW	
	Introduction	12
	Definitions	12
	Industrialized Building Systems	13
	Conventional Building Method	14
	Hardware and Software	14
	Closed System and Open System Modular Construction	15
	Standardization	16
	Modular Co-ordination	16 17
	Selection Criteria of Industrialized Building Systems	17
	Criteria of Client	19
	Criteria of Consultant	23
	Criteria of Contractor	29
	Adoption of Selection Criteria from Pertinent	•
	Previous Research	31
	Summary of Decision Criteria	37
	Classification of Industrialized Building Systems	43
	Cast in-situ Construction Method	44
	Fully Prefabricated Construction Method	46
	Composite Construction Method	48



	Contracting Method	49
	Decision Making	64
	The Nature of Decision Analysis	64
	The Decision Making Process	66
	Sensitivity Analysis	71
	Model Building	72
	Importance and Terminology	72
	Objectives of Modeling	75
	Model Classification	77
	Model Specification	80
	Model Construction and Use	81
	Criterion Selection	82
	Model Validation	82
	Method of Evaluation	84
	Decision Analysis Techniques	85
	Closure	92
III	METHODOLOGY	
	Introduction	93
	Method of Data Collection	93
	Questionnaire design	95
	Pre-test of Questionnaire	98
	Sampling Design	99
	Variables	100
	Classifying Decision Criteria	101
	Data Analysis	104
	Closure	105
IV	DATA ANALYSIS AND DISCUSSION	
	Introduction	106
	Description of the Survey Response	107
	The Profile of Respondents	108
	Respondents' Qualification	108
	Academic Discipline	109
	Respondents' Current Position	110
	Experiences of the Respondents	111
	Company Profile	112
	Nature of Business	112
	Years of Operation	113
	Project Information	114
	Type of Project	115
	Method of Construction	116
	Contracting Method	117
	Importance of Decision Criteria	119
	Project Objective Criteria	120
	Project Characteristic Criteria	122
	Technical Oriented Criteria	124
	Performance Oriented Criteria	129



	Project Constraint Criteria	134
	Resources Oriented Criteria	136
	Correlation of Decision Criteria	143
	Correlation of Decision Criteria with regards to	
	Procurement Methods	144
	Correlation of Decision Criteria with regards to	
	Construction Methods	145
	Correlation of Decision Criteria with regards to	
	Project Types	146
	Closure	148
V	EVALUATION MODEL	
	Introduction	149
	The Analytical Hierarchy Process	149
	Setting Up of the Decision Criteria	151
	Pair wise Comparison	156
	The Recommended Scale of Relative Importance	158
	Synthesis of Priorities	159
	Local Priorities	159
	Consistency of Local Priorities	162
	The Principle of Synthesis	164
	An Illustration of AHP Method	164
	Pair wise Comparison	166
	Synthesis of Priorities	168
	Closure	172
VI	CONCLUSION AND RECOMMENDATION	
	Conclusions	173
	Correlation of Decision Criteria	173
	Correlation of Decision Criteria with regard to	175
	Contracting Methods	174
	Correlation of Decision Criteria with regard to	1/1
	Construction Methods	174
	Correlation of Decision Criteria with regard to	177
	Construction Methods	174
	Recommendation	175
REF	ERENCES	176
APP	PENDICES	
	Appendix A: Questionnaire	180
VITAE		188



...

LIST OF TABLES

Table		Page
2.1	Summary of Client's Criteria	22
2.2	Summary of Consultant's Criteria	26
2.3	Summary of Contractor's Criteria	30
2.4	Summary of Criteria	34
2.5	Summary of Decision Criteria	37
2.6	Modeling: A Managerial Classification	79
3.1	The Response Rate	100
3.2	Classification of Decision Criteria	102
4.1	Type of Analysis	107
4.2	Highest Academic Qualification	108
4.3	Academic Discipline	109
4.4	Respondent's Current Position	110
4.5	Mean Value of Respondents' Experiences	111
4.6	Distribution of Nature of Business	113
4.7	Mean Value of Years of Operation	114
4.8	Types of Project	115
4.9	Method of Construction	117
4.10	Contracting Method vs Building System	119
4.11	Priority Rankings of Project Objectives Criteria	120
4.12	Priority Rankings of Project Characteristics Criteria	122
4.13	Priority Rankings of Technical Oriented Criteria	124
4.14	Priority Rankings of Performance Oriented Criteria	129
4.15	Priority Rankings of Project Constraint Criteria	134
4.16	Priority Rankings of Resources Oriented Criteria	137
4.17	Correlation between Principal Project Participants	143
4.18	Correlation between Contracting Methods	144
4.19	Correlation between Construction Methods	146
4.20	Correlation between Project Types	147
5.1	The Recommended Scale of Relative Importance	159
5.2	Pair Wise Comparison Matrix – Level 2	167
5.3	Pair Wise Comparison Matrix – Level 3	168
5.4	Pair Wise Comparison Matrix for Level 3	
	- Solution and Consistency	169
5.5	Pair Wise Comparison Matrix for Level 4	
	- Solution and Consistency	170
5.6	Composite Priorities of Building Systems	171



LIST OF FIGURES

Figure		Page
1.1	Thesis Overview	10
2.1	Badir-Razali Building System Classification of	
	Fully Prefabricated Construction Method	47
2.2	The Decision Making Process	67
2.3	The Analysis Process	69
3.1	Guideline for Data Collection	94
3.2	Structure of the Questionnaire	97
5.1	Decision Hierarchy	152
5.2	Decomposition of the Problem into a Hierarchy	165



CHAPTER I

INTRODUCTION

Background

The revolution in the building technology causes many new improvements and methods being introduced to the construction industry over the past decade, which results in various types of industrialised building systems. This is due to rapid increase in world population, economics demands, facilities and others, especially in developed countries. Inefficiency of a building system can contribute to idle time, waste of money and low quality of products. Therefore, the success in the implementation of a project through adopting industrialised building system has led to an urgent search for a systematic and effective method in selecting an appropriate building system.

In the initial stages of project designs, construction owners and engineers are often faced with decision involving the pursuit of one of two options in project realisation: industrialised or conventional design and method of construction. However, the research presented in the study focuses on the decision support in selecting the most appropriate building system regardless of the conventional design or conventional method of construction.



Selection of an appropriate building system is an extremely complicated task where the number of decision attributes to be considered is large and complex. This is due to each building system has it advantages and disadvantages. Lack of information, time limitations, and the large number of system alternatives generally force the decision maker to rely on past experience and impractical judgement to make rapid alternative selection. If this natural, physical process of growth remains not guided by administrative means, it is likely that haphazard, uneconomical and unhealthy development will occur.

Prior to selection of an appropriate building system, the decision attributes in selecting an appropriate building system is to be identified. Subsequently, a decision making model is proposed that serves as a guideline for professionals in the industry to perform an initial feasibility study on the use of industrialized building system.

Problem Statements

Of all industrialised building system implemented in Malaysia, each has its own characteristics, features, advantages and disadvantages. Din (1984) stated that

... while adopting modern innovations and techniques ... not all industrialised building systems that is imported from foreign countries are suitable for practice in our country. Most of the developing countries have encountered big and costly mistakes on adopting modern industrialised building systems. Most systems chosen were found not compatible with the economy and cultural of the people in some countries.



Din (1984) also stated that

... industrialised building systems had not achieved results as what was claimed to be ... There was not enough consideration given for the development of a true building industry ... without detailed and minute planning and effective management, industrialised building techniques will certainly not lead to the desired result.

Thus, careful preparation and detailed planning are essential in order to obtain full advantages offered by industrialised building systems.

The significant element in adopting industrialised building systems depends very much on the proper management and co-ordination among the three principal project participants, i.e., clients, consultants and contractors, which our industry is still lack of (Lai, 1997). This is due to the physical implementation of a building involves many inter-related activities in the total delivery system before turning into the production of building which also involve various project participants.

Therefore, new building systems or components need to be evaluated before applying them (Murthy, 1984). However, many potential users (e.g. owners, contractors, etc) of innovative technologies currently have no formal system to evaluate innovative construction technologies for potential implementation into the construction programme (Lutz et al., 1990).

None of the building systems is universally applicable to all building situations. However, it has been suggested that there are a number of appropriate industrialised building systems, which are useful for a wide range of specific uses and situations. To resolve the problem, a systematic evaluation system is required in order to select the most appropriate industrialised building systems. Prior to the development of a systematic evaluation system, decision criteria of building trade professionals – one of the most fundamental prerequisites has to be identified.

Apart from decision criteria, attention should also be given to choosing an appropriate contracting method for a proposed project because the success or failure of a project is very much dependent on the contracting method selected. It is believed there is a false impression that using industrialised building system is always quicker and simpler than traditional construction method. The type of contracting method selected does play an important role for a project adopting industrialised building system to be undertaken successfully.

According to Gordon (1994), certain contracting methods can shorten the project duration, provide flexibility for changes, reduce adversarial relationships, allow for contractors participation in design, provide cost saving incentives to the contractor, and provide alternative financing methods. Some methods are much more appropriate for some projects than others, an owner must first understand the various components of the contracting methods, the characteristics of the proposed project, and their own abilities in order to select an appropriate contracting method.

With respect to the aforementioned problem statements, this study compiles the knowledge for decision support that enables the decision-maker to perform a feasibility study on the selection of industrialised building system. The motivation of this effort has been twofold:



- Due to the lack of documented sources of information about industrialisation decision support, there is a need to compile knowledge obtained from practitioners in the field into a structured resource.
- 2. Due to the absence of a conceptual decision making framework to select an appropriate building system on a proposed project, there is a need to produce one.

Therefore, this study is carried out as a descriptive research to answer the following three research questions:

- 1. What are the decision criteria of principal project participants in selecting an appropriate building system?
- 2. To what extent are there similarities and differences in decision criteria between principal project participants?
- 3. To what extent are there similarities and differences in decision criteria in accordance to different types of contracting method, building system, and types of project?
- 4. How to select an appropriate building system?



Objectives

With respect to the aforementioned research questions, the objectives of this study are as follows:

- to identify decision criteria that help in the selection of an appropriate building system;
- 2. to determine the relationship of decision criteria among principal project participants in selecting an appropriate building system in accordance with different types of contracting method, building systems, and types of project.; and
- 3. to propose an evaluation model in selecting an appropriate building system.

Justification

Industrialisation of building system is an inter-disciplinary field of activity and does not entirely rely on the technological aspects of the process. The success of that industrialised building system depends largely on the balanced combination between the "software" and "hardware" elements of industrialised building system (Syed Junid, 1986).

It can be noticed that it is not solely dependent on the "hardware" elements of building system. "Software" elements of building system do play a very important role. Software elements of building systems research utilises accumulated technical knowledge and best technical foresight, to improve building performance; to make



buildings more economical to own; to build them safely and safer for living; to build and use them with lesser resources waste and lesser environment pollution; and to improve the quality of private and public lives (Dulaimi, 1995). Hence, this study is essential towards the contribution of "software" elements of the building system's research.

The decision criteria of each principal project participant are the most fundamental prerequisites prior to the development of an evaluation system. As Lutz et al. (1990) stated, a technology evaluation system would place the project participants in a proactive mode rather than a reactive mode with regard to implementation of innovative construction technologies.

Therefore, this study identifies and investigates the decision criteria of principal project participants in selecting an appropriate building system. Additionally, this study also investigates the relationship between decision criteria and principal project participants in accordance with different types of contract. This is due to the belief that types of contract would have an influence on the criteria of each principal project participant.

The findings of this study should contribute to a better understanding of the relationship among decision criteria and principal project participants according to different types of contract, methods of construction and types of project. This would enable a decision-making framework to be proposed based on the decision criteria identified as to arrive at logical conclusions for application or extension of the relevant system.

Thesis Overview

This study consists of seven chapters. A schematic diagram of the thesis layout is presented in Figure 1.1 with the summary of each chapter is described below:

Chapter one initially introduces the background of the study. Then, it outlines the statement of the problems and research questions. Subsequently, the objectives of the study followed by justification of the study are specified. Finally, the overview of thesis is also presented.

Chapter two begins with some background information on this study, which involves the definition of some predominant terms covered in the study. Then, it focuses on the adoption of decision criteria of principal project participants. Subsequently, the classification of industrialised building systems is presented. In addition, relevant contracting methods are being reviewed. The chapter ends with the review of possible decision making process, evaluation methods and model building.

Chapter three presents a detailed discussion of the research methodology employed.

Questionnaire development, pre-testing of the questionnaire, the sampling procedure, and data collection are presented. The chapter also presents the analytical methodology – data analysis.



Chapter four presents the outcome of analyses, result and discussion based on the respond of questionnaire survey. The chapter is divided into two parts. Part one presents a descriptive statistics, which includes the discussion of the profile of respondents, followed by a description of the priority of principal project participants' criteria and the correlation of decision criteria among principal project participants.

Part two of chapter four focuses on the inferential statistics. The findings pertaining to the similarities or differences of criteria of each principal project participant is presented. The chapter also examines how contracting methods, construction methods, and project types influence the criteria of each principal project participant.

Chapter five proposes an evaluation model for the selection of an appropriate building system.

Finally, chapter six presents a summary of the findings and conclusions drawn from the research. The chapter then outlines the recommendations for future research.

RESEARCH BACKGROUND

CHAPTER I INTRODUCTION

- Introduction/Background
- ♦ Problem Statements
- ♦ Objectives
- Justification
- ♦ Thesis Overview

CHAPTER II LITERATURE REVIEW

- Definitions of Predominant Terms
- Selection Criteria
- Classification of Building Systems
- Contracting Methods
- Decision Making
- Model Building



RESEARCH CONTRIBUTION

CHAPTER III RESEARCH METHODOLOGY

- ⇒ Questionnaire Development
- ⇒ Pre-test of Questionnaire
- ⇒ Sampling Procedure
- ⇒ Data analysis

CHAPTER IV RESULTS AND DISCUSSION

- ⇒ Profile of Respondents
- ⇒ Criteria of Project Participants
- ⇒ Correlation of the Criteria

CHAPTER V RESEARCH MODEL

⇒ Propose an Evaluation Model

CHAPTER VI CONCLUSIONS AND RECOMMENDATIONS

- ⇒ Conclusions
- ⇒ Implications and Recommendations

Figure 1.1: Thesis Layout