

UNIVERSITI TEKNOLOGI MALAYSIA

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JUDUL : THE SELECTION OF CONSTRUCTION'S PROJECT MANAGER
BY USING ANALYTICAL HIERARCHY PROCESS (AHP)

SESI PENGAJIAN : 2005 / 2006

LAU HUI SENG

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96100 SARIKEI
SARAWAK

Tarikh : **3 MAY 2006**

Disahkan oleh

Arham

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Date : **3 MAY 2006**

**THE SELECTION OF CONSTRUCTION PROJECT MANAGER BY USING
ANALYTICAL HIERARCHY PROCESS (AHP)**

LAU HUI SENG

A project report submitted in partial fulfilment
of the requirements for the award of the degree of
Master of Science (Construction Management)

Faculty of Civil Engineering
Univeriti Teknologi Malaysia

MAY 2006

I declare that this project report entitled "*The Selection of Construction's Project Manager by Using Analytical Hierarchy Process (AHP)*" is the result of my own research except as cited in the references.

The project report has not been accepted for any degree and is not concurrently submitted in candidature of any others degree.

Signature : 

Name : LAU HUI SENG

Date : 3 MAY 2006

**Special
Dedicated To
My Heavenly Father,
My Lord and Savior Jesus Christ
And
My beloved friends, parents and family.**

ACKNOWLEDGEMENT

This study would not have been possible without the assistance and support of those who guided me in the course of my graduate work. First, I would like to thank God for His grace and mercy throughout this research. It is by His hands and wisdom in guiding me to finish my work within the study period.

I would like to extend my thanks to my honorable supervisor, Dr Arham Bin Abdullah, for his academic guidance, support, encouragement, and help during the course of my study. I would like to specially thank his patience and tolerance towards me, in which he always trusts me that I am able to do it. His diligence, dedication and working attitudes are good examples for me to follow.

Last but not least, I also appreciate the love, support and encouragement given to me by my family members and friends.

ABSTRACT

The scope of this research deals with the decision making process concerning selection of the finalists for position of project manager. The Analytical Hierarchy Process (AHP) and the Decision Support Software program-Expert Choice was used to assist with the decision. The research focus on the integration of Analytical Hierarchy Process (AHP) and Decision Support Software-Expert Choice into overall decision making process. The first objective of this research is to identify procedure in selection of a project manager. The second objective is to identify the factor and criterions that should be considered in selection process. Finally, a new framework as a Decision Support System (DSS) for evaluating project manager called Project Manager Selection System (PMSS) will be developed based on AHP. The research method used includes the knowledge acquisition technique, data analysis, and model development process. The study will focus on 100 local construction companies to capture the knowledge from the expert on the selection process. It is believe that the proposed framework will provide an even more structured approach and assist in formulating guidelines for construction company in selection of a project manager.

ABSTRAK

Skop kajian ini berkaitan dengan proses membuat keputusan untuk memilih seorang pengurus projek pembinaan. Analytical Hierarchy Process (AHP) dan Decision Support Software program-Expert Choice telah digunakan untuk membantu dalam proses membuat keputusan. Kajian ini memberi fokus kepada gabungan dan penggunaan Analytical Hierarchy Process (AHP) dan Decision Support Software-Expert Choice dalam proses membuat keputusan keseluruhan. Objektif pertama kajian ini adalah untuk menentukan prosedur dalam proses pemilihan seorang pengurus projek pembinaan. Objektif kedua adalah untuk menentukan faktor dan criteria yang perlu dipertimbangkan dalam proses pemilihan. Akhirnya, satu rangka Decision Support System (DSS) untuk pemilihan pengurus projek dengan nama Project Manager Selection System (PMSS) akan dibangunkan berdasarkan AHP. Cara kajian yang telah digunakan termasuk teknik pengumpulan maklumat, analisis data, and proses pembangunan model. Kajian ini fokus kepada 100 syarikat pembinaan tempatan (kontraktor Kelas A) untuk mendapatkan maklumat awalan daripada pakar bidang tentang proses pemilihan. Daripada kajian yang telah dijalankan, terbukti sistem ini dapat menyediakan satu cara yang lebih berstruktur kepada syarikat pembinaan dalam pemilihan pengurus projek pada masa yang akan datang.

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LIST OF SYMBOLS

AHP	-	Analytic Hierarchy Process
AI	-	Artificial Intelligent
AS_{ij}	-	Assigned Score
B_i	-	The n_{i-1} by n_i matrix with row consisting of estimated Eigenvectors
CI	-	Consistency Index
CIDB	-	Construction Industry Directory
CPM	-	Critical Path Methods
CR	-	Consistency Ratio
$C(I, K)$	-	The vector of composite weights of elements at level K with respect to the element on level 1
C_{ij}	-	Raw Score Each Criterion
DSS	-	Decision Support Software
EC	-	Expert Choice
GP	-	Goal programming
IR	-	Inconsistency ratio
KA	-	Knowledge Acquisition
MCDM	-	Multi-criteria Decision Making
MODM	-	Multi-Objective Decision Making
MS	-	Microsoft programs
n	-	Matrix Size
n_i	-	The number of element at level i
OSHA	-	Occupational Safety and Health Act
PC	-	Personal Computer

PDM	-	Precedence Diagramming Method
PMSS	-	Project Manager Selection System
R_j	-	Ranking Number
WPM	-	Weighted Product Model
WSM	-	Weighted Sum Model
λ_{\max}	-	Eigenvalue Max
%	-	Percent

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Project manager has an overall responsibility for such planning, organizing, and controlling. They are involved in the project from when the contract document is picked up to when all construction works has been completed and all changes or conflict has been resolved. They are responsible for ensuring that the planning phase of a project involves a complete task description, a thorough resource needs analysis, a practical time schedule, and a sound definition of requirements. Besides, they also involved in estimating, submittal preparation, coordination, project scheduling, correspondence and detail design. The contractor is a 'for profit' company and they typically prefer to have as many jobs as possible. This philosophy requires the project managers to continuously bid on new project while running the current project. This is one of the largest challenges or problem for the project manager to running the multiple jobs.

Project manager plays dynamic roles in a construction company. The company needs to hire qualified, responsible and high efficiency individual to deal with the job. Thus, a search committee for the position of project manager was formulated to meet the need. A job description was developed and advertised in daily news, professional journals and others publication. A number of qualified professionals will applied for

the position. So, it is a need for the search committee to select the most qualified candidates for the final phases of the interview and selection process. Before reviewing the material submitted by each candidate, a decision hierarchy was created that was based on the requirement of position. This requirement research used large scale survey approach or questionnaire survey to capture preliminary knowledge especially in identified the criteria which affect the selection process of a project manager. The depth survey approach, interviews and protocol analysis were used to validate and to gain a better understanding on the knowledge capture from previous approach. After reviewing all the material submitted by each applicant, a decision support software program was used to assist the search committee in the selection of the most qualified candidates for the position of project manager.

1.2 BACKGROUND OF RESEARCH

The scope of this research focused in decision making process concerning the selection process of construction project manager. Some of the applications that relates to this research include the Selection Process of Division Director (Charles McIntyre, Merlin Kirschenman, and Scott Seltveit, 1999); Selection of Demolition Techniques (Arham. B. Abdullah, 2003); Process of Contractor Selection (Jenning and Holt, 1998; Okaroh and Torrance, 1999; Fong and Choi, 2000); and Decision Support System (DSS) in Allocation of Resources in Rehabilitation Projects (Igal M. Shohet, M.ASCE, and Eldad Perelstein, 2004). In this related researches, the Analytical Hierarchy Process (AHP) and the Decision Support Software (DSS) program- Expert Choice was integrated into the overall decision making process. In selection process of division director (Charles McIntyre, Merlin Kirschenman, and Scott Seltveit, 1999), the integration is applied in selection of director at Construction Management and Engineering Division (CME), North Dakota State University. In selection of demolition techniques (Arham. B. Abdullah, 2003), the integration is applied to assist demolition engineers to select the most appropriate demolition technique. However, in process of contractor selection (Jenning and Holt, 1998; Okaroh and Torrance, 1999; Fong and Choi, 2000), the integration of AHP and DSS is developed to assist in contractor selection based on the multiple criteria listed in tender's document. This application is also assist in allocation of resources in rehabilitation project (Igal M. Shohet, M.ASCE, and Eldad Perelstein, 2004). In this

research, the extensive literature review focused in 3 major subjects, first, the responsibilities, characteristic, problem and challenges faced by a construction project manager. Second, the selection process of project manager and finally the decision making process. This can provides a theoretical background and form the basis for continuing further into the research.

1.2.1 CONSTRUCTION PROJECT MANAGER

This section gives an overview of responsibilities, characteristic, problems and challenges faced by construction project managers now days in construction industry. Construction management is usually defined as the organization and direction of man, materials, and equipment to accomplish the purpose of the designer. Historically, construction project managers have been contractors that have gained experiencing running projects or construction inspectors that have moved up the ranks while gaining valuable experience. It also can be an employee of the contractor or a potential project owner, which referred to as a construction project manager. The construction project manager then coordinates and communicates the entire project process which may include project feasibility, planning, design, construction, and project implementation. The primary objective is to minimize time and cost while maintaining project quality.

1.2.2 SELECTION PROCESS

This section gives an overview on how to find qualified personnel. Explained are the steps in locating candidates, interviewing applicants, and selecting the correct employee. A hiring checklist provides step to ensure success. Form of job specification, employment application, interview notes, and applicant evaluation are investigated to help in selection process. This information provides a theoretical support in the research.

1.2.3 DECISION MAKING

This section gives a basic concept of decision making including its definition and phases. The chapter then describes Multi-criteria Decision Making (MCDM) in

terms of its method and justified why Analytic Hierarchy Process (AHP) as one of the MCDM methods was selected for this research. In addition the background and theoretical aspect of the AHP are presented to give a clear perspective of this powerful decision support tool. Next, the chapter reviews the basic concept of Decision Support System (DSS) and justifies why Expert Choice software was selected as the DSS tool to used in the research.

1.3 PROBLEM STATEMENT

Construction management is a process by which a potential owner engages an agent, referred to as a construction manager or Project manager. The project manager then coordinates & communicates the entire project process which may include project feasibility, planning design, construction, and project implementation. The primary objective is to minimize time and cost while maintaining project quality.

The project manager has the obligation to serve the owner as if he or she is an employee of the owner. A construction project manager has the legal authority to represent the owners and to carry out business dealing in the owners behalf. Besides working with the owner and general contractor, the project manager has to work with the designer, testing labs, and equipment suppliers. On each project, the project manager has a group of inspector to supervise. The project managers has to be familiar with standard construction practice and keep abreast of new development and changes in the field. The project managers performs a wide variety of services such as detail planning and scheduling, construction estimating, operating procedures, supervision, inspection, plan review, submittal review, property management, correspondence and testing.

The project managers play a challenging and dynamic role in a construction company. Thus, the selection of the position of company's project managers may need careful consideration. It is not easy to select qualified professional among a numbers of candidates. Although the selection process can based on the knowledge, preferences and experience of decision makers, it is more preferable that the company develop a systematic method to assist in the selection process. The AHP and Expert choice was integrated into overall decision making process. It is believe that this

systematic approach will reduce the time in selection process, save manpower resources and provide a structured guideline in the selection of the most qualified candidates for the position of project manager to assist in future decision making application.

1.4 RESEARCH AIM AND OBJECTIVE

The main aim of the research is to develop a decision support system to aid the search committee in the selection of most qualified candidate for the position of project manager. The specific objectives were:

- i) To understand the responsibilities, characteristic and challenges of a project manager;
- ii) To identified the selection process of project manager in various type of construction company;
- iii) To investigate and define the criteria which effect the selection process of project manager; and
- iv) To develop and evaluate a decision support system to assist in the selection of most qualified candidate for the position of project manager.

1.5 SCOPES OF STUDIES

The scopes of studies are focused on local construction's company to capture preliminary knowledge especially in identified the criteria which is significant in the selection process of a construction project manager.

1.6 RESEARCH METHODOLOGY

Research methodology is the research method used to achieve the specific objective of the research. A brief description of the research method used is given in this section. The detailed research methodology is presented in Chapter 3.

i) Literature Review

The extensive literature review focused in two major subject. First, the responsibilities, characteristic and challenges of a construction project manager. Secondly, the selection process of project manager in various type of Construction Company. Literature reviews on these two subjects provide a theoretical background and form the basis for continuing further into the research. Review of literature was achieved through several sources, which includes: books and publication from library, internet searching, and INFOLAN of University library to assess report, thesis, journals and conferences papers related to the subject.

ii) Knowledge Acquisition

The process involved capturing and transforming appropriate knowledge from several sources such as books, publications, journals and experienced expert into some manageable form in order to develop a decision support system in selection of a most appropriate project manager. This research used large scale survey approach or questionnaire survey to capture preliminary knowledge especially in identified the criteria which affect the selection process of a project manager. The depth survey approach, interviews and protocol analysis were used to validate and to gain a better understanding on the knowledge capture from previous approach.

iii) Prototype Development

The development of the proposed decision support system was based on the result capture from the knowledge acquisition process. A decision hierarchy is developed based on the requirement of the position. Rapid prototyping methodology was used in the prototype development.

iv) Evaluation

The complete prototype was evaluated before and after the development process to access it functionality and usability. The evaluators were drawn from

company's managers and researchers. The selection process of project managers in 5 construction companies was used as a case study in the evaluation process. The evaluators were requested to complete a questionnaire that assessed the prototype from various perspectives.

1.7 EXPECTATION

Integration of analytical hierarchy process (AHP) and Decision Support Software (DSS)-Expert Choice into overall decision making process will give a more structured and systematic guideline in the selection process of most qualified candidates for the position of project manager in construction's companies.

1.8 HYPOTHESIS

The AHP and Expert choice was integrated into overall decision making process. This systematic approach will reduce the time in selection process, save manpower resources, and provide a guideline in decision making process.

1.9 LIMITATIONS OF STUDY

- i) The fundamental construction of a decision hierarchy was the single most important aspect of the research. So, the criteria or exact requirement of the position may need careful consideration. Wrong and inadequate information will effect and reduce the usability of the system.
- ii) The research focused on selected construction companies only due to the limitation of resources. It may affect the overall efficiencies of the system developed.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter gives an overview of the responsibilities and challenges of a construction's project manager in construction industry. It also discusses various type of construction firm organizing and the selection process of a construction project manager.

2.2 OVERVIEW OF CONSTRUCTION PROJECT MANAGER

Construction management is usually defined as the organization and direction of man, materials, and equipment to accomplish the purpose of the designer. The contractor must price his work before he start, estimating is critical; determining his efficiency before the work is done is as important as doing it efficiently. The management cycle is a endless chain of estimate-spend-estimate spend, in which the weakest link determines the profit of the firm. Historically, construction project managers have been contractors that have gained experiencing running projects, construction inspectors that have moved up the ranks while gaining valuable experience. Besides, in can be an employee of the contractor or a potential project owner, which referred to as a construction project manager. The construction project manager then coordinates and communicates the entire project process which may

include project feasibility, planning, design, construction, and project implementation. The primary objective is to minimize time and cost while maintaining project quality.

Project Manager has an overall responsibility for such planning, organizing, and controlling. They are responsible for ensuring that the planning phase of a project involves a complete task description, a thorough resource needs analysis, a practical time schedule, and a sound definition of requirements.

In addition, they must organize the project so that sufficient staffing is available to produce the necessary services for reaching the project's objectives. They must ensure that those individuals participating in the project have sufficient authority and responsibility to accomplish their tasks.

Project managers have the responsibility for controlling the project. They see that standard is available to determine the progress of a project and that clear communication channels exist for providing feedback.

Further, they make sure that there is a timely accounting of the progress in project by conducting periodic reviews of time and cost. To obtain the necessary feedback, the project managers periodically compares the actual progress with the proposed progress to ascertain if there are any serious variances with respect to costing and scheduling.

Among planning, organizing, and controlling, the third managerial function has the highest significance to project managers. As the project progresses, project managers must be able to check that what was planned and organized is, in fact, occurring. Project managers can specifically accomplish that feat by ensuring that the following steps occur.

1. Objectives have been converted into meaningful standards.
2. Performance standards are reliable and accurate enough to assess the progress of a project.

3. Reliable budgets and time schedules are formulated so that an accurate comparison can be made between what was suppose to happen and what did happen.
4. A means exists for a detailed comparison between resources expended as of a specific date and what was estimated for what particular point in time.
5. A reevaluation occurs whenever significant variances to project activities exist.

2.2.1 RESPONSIBILITIES OF PROJECT MANAGER

All managers have three principal functions to perform: planning, organizing, and controlling. The same is true for construction project managers. Each function requires a manager to take a certain perspective and to employ certain techniques throughout a project.

Planning requires managers to be forecasters, that is, to determine future needs which must be met during the course of a project. This requires them to perform four major activities.

- i) To establish objectives and their priorities.
- ii) To determine the activities necessary to reach those objective.
- iii) To budget enough monies to finance those activities.
- iv) To develop policies that will direct those activities toward those objectives.

To accomplish that, a project manager must be able to establish objective, develop program, schedule activities, forecast resource requirement, establish an effective organizational structure, and provide a detailed means for implementing its decisions.

Organizing is the second managerial function. Managers must effectively and efficiently arrange the personnel and physical resources of a firm in a way which will expedite the firm's commitment to reach project objectives. Organizing also entails having management delegate authority and responsibility throughout a firm. By