SUBCONTRACTOR SELECTION METHOD USING ANALYTIC HIERARCHY PROCESS

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Especially dedicated
to my beloved family

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ABSTRACT

Sub-contractor selection is one of the most important aspects in construction contract. The success level of construction is very depends on the quality of subcontractor selection process. Majority of selection process are over emphasized on the bid cost rather than trade-off between other parameter such as quality, safety and environmental commitments. Instead these have contributes in project delays, cost overruns, non-confirmation on quality, lost time accident, increase number of claims, litigation and contractual issues and failure to comply with local authority and construction specification. Concerning to this problems, the subcontractor pre-qualification, evaluation and selection process needs to be reviewed to achieve the project goals based on multi criteria decision making process. The main initial thrust of this study was to identify the criteria used for selection process, which was adopted by the various type of contractor working in Putrajaya. This exercise involved "knowledge acquisition" phase to capture the expert knowledge including collecting documents of current procurements practice, knowledge from the literature review and interviews with experts from various construction companies. The data collected are used to create a theoretical model for subcontractor selection that represented by the Analytic Hierarchy Process. It is concludes that the choice of subcontractor should be consider based on multi criteria decision rather than automatically accepting the lowest bid. The finding from the research indicated that the common criteria considered by the contractor during the selection are the cost, past performance, financial soundness, technical expertise, management capability, subcontractor workload, previous work experience, and track record. The study recommended that procurers should no longer depends totally on their experience to decide on their selection process but an effective decision support system (DSS) like Analytic Hierarchy Process (AHP) is important to systematically evaluate the selection process. The research also serves as sources of information for sub-contractor to win the contract and act as platform for contractor to make an appropriate decision on the choice of subcontractor.

ABSTRAK

Pemilihan sub-kontractor adalah perkara paling penting dalam sektor pembinaan. Tahap kejayaan sesuatu projek banyak bergantung kepada kualiti pemilihan sub-kontraktor. Kebanyakkan kaedah pemilihan sub-kontraktor terlalu memihak kepada faktor harga tanpa memikirkan faktor-faktor lain seperti kualiti, keselamatan dan peranan alam persekitaran. Akibatnya banyak projek pembinaan mengalami kelewatan, kerugian, tidak dapat memenuhi kualiti piawaian, peningkatan kemalangan di tapak bina, peningkatan isu berkaitan dengan kontrak dan pembayaran serta kegagalan memenuhi kehendak pihak berkuasa dan specifikasi projek. Kajian ini adalah bertujuan untuk mengenal pasti kriteria dalam proses pemilihan sub-kontraktor yang diamalkan oleh kontraktor-kontraktor di Putrajaya. Untuk mencapai matlamat ini kepakaran pihak-pihak kontraktor dalam pemilihan sub-kontraktor diambil kira melalui pengumpulan data, pengalaman mereka dan menemubual kontraktor secara langsung. Analisis data kemudian digunakan untuk membuat satu model theoretical yang digambarkan oleh "Analytic Hierarchy Process". Kesimpulannya, pemilihan sub-kontraktor mestilah berasaskan kepada kepelbagaian kriteria dan bukan memilih secara langsung berdasarkan paras harga yang terendah. Hasil kajian menunjukkan pemilihan sub-kontraktor dipengaruhi faktor seperti harga, pencapaian masa lepas, keupayaan kewangan, kepakaran teknikal, kemampuan pengurusan, pengalaman kerja lepas, beban kerja subkontraktor dan rekod kerja. Kajian ini juga mencadangkan bahawa kontraktor tidak seharusnya menggunakan hanya pengalaman mereka dalam pemilihan sub-kontraktor tetapi mereka juga haruslah menggunakan sistem penyokong keputusan seperti "Analythic Hierarchy Process" dalam membuat keputusan pemilihan. Kajian ini juga dapat membantu sub-kontraktor untuk memenangi kontrak dan sebagai landasan kepada kontraktor dalam pemilihan sub-kontraktor.

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A Crj	-	Score for contractor *j*
Vij	-	Variable (attribute) *i* score respect of *j*
Wi	-	Maximum score
Σ	-	Total
n	-	Number of independent variables
Ui	-	Represents the attribute consider by decision maker
f(uxi)	-	Calculation based on considered parameter
Y*	-	Represents the dependent variable
Co	-	Permanent constant
Ci	-	Partials regression coefficients
∞	-	Infinite
CI	-	Consistency index
I_{max}	-	Eigenvalue $_{max}$
IR	-	Inconsistency ratio

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CHAPTER 1

INTRODUCTION OF STUDY

1.1 Introduction

The construction industry in Malaysia has experience a wide range of expansion during the past 20 years. Today, most of the construction project undertaken are more complex in nature, demanding greater skill and technologies, fast track and concurrent works practices, very competitive in term of price, demanding for end-product quality and good decision making skill, capabilities in utilizing knowledge management and very critical in dealing with contractual issue than ever before. There are increasing number of research/ professional are being conducted/engaged to confronted with the problems and challenges faced by the modern construction industry. Since, many of these issues are of relatively new concern to the industry and directly related to the sub-contractor performances, the selection and evaluation process of sub-contractor needs to be reviewed to cope with these challenges. There are many methods of tendering system applied in the construction contract. However the open tender system seems be the most popular for the client for awarding the contract. Normally, the client awarded the works to the contractor, then the contractor will engaged a few companies called “sub-contractor” to carry-out the works according to the work assigned. Therefore the selection of the sub-contractor is consider the important aspects and critical issue in any construction contract.

The success level of any construction project may depend on the basis philosophy of "the right person for the right job". But, in many cases, the selection of sub-contractor are over emphasize on the lowest bid acceptance. In reality, sub-contractor with the lowest tender price is usually awarded a contract. This trend may be valid when the client are very clear of the "likely cost" of the project and being experience with similar type of project and working environment. However, it may not works in most of the project, because the selection of sub-contractor based on the lowest tender price alone may result in a "false economy" to the project.

Various research methodologies were adopted in several countries to achieve the "Value procurement" to the procures in the selection of sub-contractor. The "value procurement" is one that considers price and other factors in the bid greatest "value for money" to the client. Finding from experts reveal that the tradition "lowest price wins" in practice is being replaced by "multi criteria judges". This indicates increase awareness of procures in selecting sub-contractor attributes via a more multi criteria selection methodologies. Certainly it is not a easy concept to identify the universal criteria for bid selection, as it depends on certain factors consider such as client demands, contractual issue, project viabilities, authority requirement and construction methods.

Although, that is growing realization on the "value procurement" to the client, but the basic fundamental problems is " what constitutes a sound sub-contractor selection methodology" for the bid selection. According to the previous research by many experts, there are few types of selection methodologies can be applied by the procures in the bid selection. These methodologies including Bespoke approaches (BA), Multi-attribute analysis (MAA), multi attribute utility theory (MAUT), Multi regression (MR), Cluster analysis (CA), Fuzzy set theory (FST) and Discriminate analysis (MBA).

1.2 Problem Statement

The correct choice of sub-contractor is a great concern for procurers during the selection process, as it has a significant impact on the success of the project. Although considerable effort has been focused on pre-qualification, but the majority of selection are over emphasize on cost priority rather trade in between cost, time and quality. In most circumstances, the lowest price bid is automatically win the tender. Finding also suggest that contractor are not aware of all the options, methodologies and decision support system that is available for sub-contractor selection and evaluation. The human judgment and experience is used to select the most appropriate sub-contractor during the evaluation process.

1.3 Background of The Research

This study begin with the identification the various criteria used by the procures during the selection process. It will allows to address the issues of "which decision criteria is most considerable in the selection process". The background of the research focused on the collection of data through "knowledge acquisition". The knowledge acquisition activities included extensive literature reviews, interviews, questionnaires and correspondence with the experts in the construction company. The purpose of the knowledge acquisition is to capture the nature of selection process, potential criteria and ranking method applied by the construction experts during the selection bid. It is also to reveal if any decision support system is applied in the selection process.

Having set out the criteria, the research then consider to develop a theoretical model that represents the appropriate sub-contractor selection by using Analytic Hierarchy Process Model (AHP).

1.4 Justification of The Research

The growing importance of sub-contractor selection criteria renews the interest of both practitional and academia working in the construction industry. Furthermore the current selection process is critized and typically emphasized on the lowest tender price which eventually would lead to the false economy of the project. There is a serious outcry in the construction industry demanding a revolution in the tender awarding system for sub-contractor as it has significant impact on the project success. This research is carry-out to justify that the selection of sub-contractor should not based on lowest price alone but should consider other parameter such as cost, quality and time.

In additional, the current selection process is performed in an un-structure initiative manner with considerable reliance on the experience of procurers and his judgment. The procurers can no longer depends totally on their past experience to decide the appropriate sub-contractor, because the nature of selection process which involves multi criteria decision skill has become more complex. In response to the need for a robust sub-contractor selection system, this research is justify to develop a theoretical model based on Analytic Hierarchy Process for the selection of sub-contractor. In order to provide a better platform for subcontractor selection process, it is essential to capture the knowledge of experts and to develop a more formalized and accuracy process with the support of decisions making tools.

1.5 Aim of The Research

The specific aim of this research are to identify the criteria used in sub-contractor selection and to help the procures in making decision on selecting the

most appropriate sub-contractor based on the combination multi criteria and application of Analytic Hierarchy Process.

1.6 Objective of The Research

The research is set-up to examine the criteria of subcontractor selection and to support the procurers on the appropriate subcontractor selection using the decision support system.

In order to satisfy these needs, it initiated with 3 objectives:

a) To understand the nature of subcontractor selection approaches practiced by various contractor.
b) To explore and define the potential criteria which affect the selection of sub-contractor.
c) o develop theoretical model that represents the appropriate sub-contractor selection based on AHP process.

1.7 Scope and Limitation of The Research

The scope of the research is to identify the criteria for subcontractor selection using knowledge acquisition phases and to assess the information which involves multi criteria decision making ability using Analytic Hierarchy Process. Hence, the research is limited to the following scope:

a) The knowledge acquisition phases only involved the main contractor working in Putrajaya.

b) Assessment of the information is used to develop the theoretical model based on Analytic Hierarchy Process.

c) The study is not consider what is the best methodology for subcontractor selection but it will focus on the application of AHP as one of tool for decision support system.

1.8 Brief Research Methodology

The research methodology used to achieve the objectives of the research is depicted in figure 1.1. A brief guideline of the research methods is explained in this section and the details research methodology is represented in Chapter 3.

a) Literature Review :- The extensive literature review focused on two major subjects . First, the overview understanding of the criteria used for sub-contractor selection in various countries. Secondly, the review of various methodologies for sub-contractor selection based on the decision support system. This literature review provided a theoretical idea and profound knowledge of the topics and to frameworks the structure of the research. The literature review focused in obtaining the information through a combination of several sources, which includes, publication from several professional bodies, construction magazines, experience, interaction with experts and the used of local university library to assist books, journals, conference papers and internet facilities.

b) Knowledge acquisition :- The process involved a capturing of knowledge from the experts directly involved in the pre-qualification, selection and evaluation process. The knowledge acquisition activities

included interview, questionnaires survey and correspondence with the contractors.

c) Theoretical model development :- The data collected in the knowledge acquisition phases are use to develop a theoretical model based on the Analytic Hierarchy Process as a propose decision support system for this research.

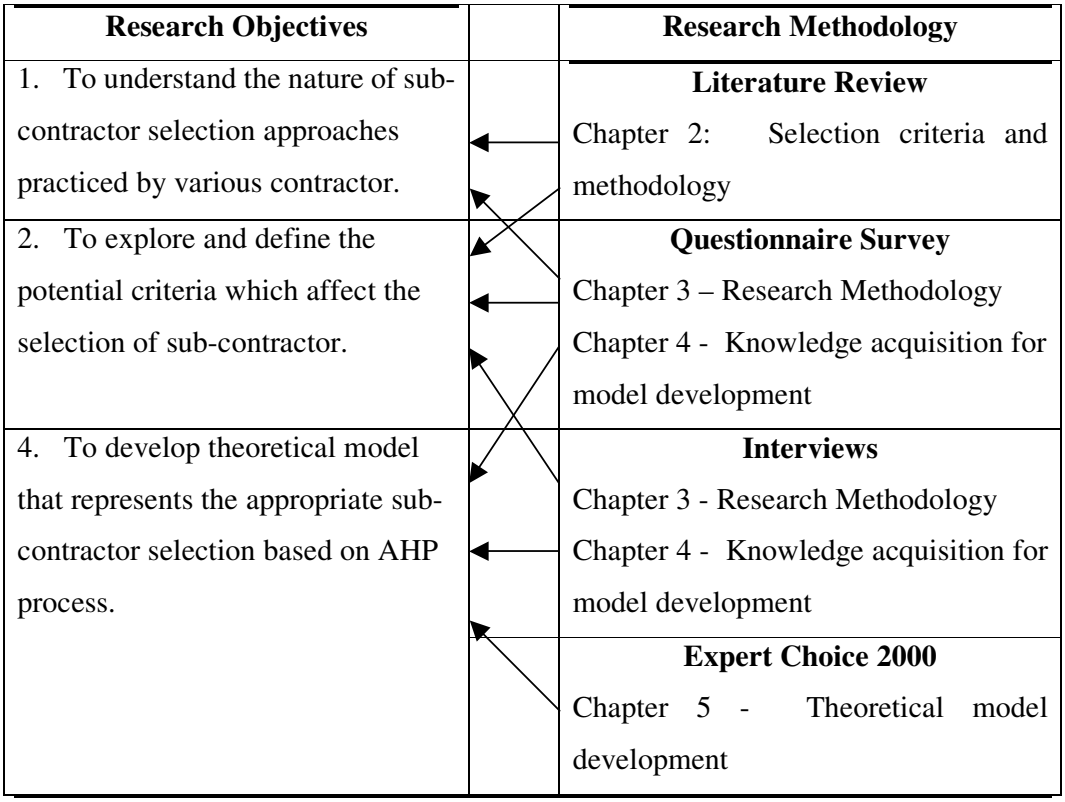

Figure 1.1 - Research objective and methods

1.9 Structure of Dissertation.

The structure of the dissertation is frame into 6 major chapters and a brief summary of each chapter's contents is presented below:-

Chapter 1 : Introduction of study, discuss on the research project undertaken and the important of the research. It then justifies the need for the research; aims, scope, objective, limitation of research and brief research methodology adopted.

Chapter 2 : Literature review - more details literature review of sub-contractor selection and construction practiced are considered. This including the construction on project life cycle, sub-contractor tendering process, criteria of evaluation & selection and methodology analysis for selection process.

Chapter 3 : Research methodology - give the overall view of research methodology including the knowledge acquisition phases, basic concept of decision making including its definition and phases, concept of model development and detail information of Analytic Hierarchy Process – the theoretical aspect, justification of using the model for the research and explanation of expert choice software as a decision support system.

Chapter 4 : Knowledge acquisition for model development – presents the method of data collection and the result obtained from the questionnaires survey, semi-structured interviews and analysis.

Chapter 5 : Development of theoretical model– Described the development process of theoretical model and the operation system.

Chapter 6 : Conclusion and recommendation presents the summary and conclusion of the dissertation. It discuss and concludes the key finding of the research and recommendation for future works.

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