

APPLICATION OF MULTI-CRITERIA DECISION MAKING METHOD IN
SELECTION OF ACADEMIC STAFF AT FACULTY OF SCIENCE,
UNIVERSITI TEKNOLOGI MALAYSIA

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To my beloved father, mother, brothers, sister, and friends

With love and much thanks.

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ABSTRACT

The selection of academic staff is important process for the university because the decision will affect the quality and the success of the university. Academic staff is the professional career as they are person who have the high skills in their respective fields. It is not easy for the selection committee to select appropriate personnel as they always faces up to uncertainty decision making process. Two Multiple Criteria Decision Making (MCDM) method namely Analytic Hierarchy Process (AHP) and Elimination and Choice Translating Reality I (ELECTRE I) are adopted to enable the decision makers to make effective decision in selecting academic staff. Both methods helps permit pair-wise comparison judgments in expressing the relative priority for criteria and alternatives that is translated from qualitative to quantitative data by considering the criteria that influence decision made. This study has applied six main criteria and fifteen sub-criteria for selecting the best one amongst seven candidates for the academic staff position in the Faculty of Science, UTM. The selection criteria of Academic, General Attitudes, Interpersonal Skill, Experience, Extracurricular Activities, and Referees Report that used in this study are determined based on some literature reviews and knowledge acquisition by interview Deputy Registrar from Registrars' Office and Assistant Registrar from Faculty of Science, UTM. By applying both methods, Candidate 7 should be selected as academic staff since she possesses the first rank of the generated candidate profile. Expert Choice 11.0 and Microsoft Excel 2007 are used to assist in accomplishing the calculation involved. As a suggestion for future work, other researches could apply the other of MCDM method in selecting academic staff.

ABSTRAK

Pemilihan kakitangan akademik adalah proses penting bagi universiti kerana keputusan pemilihan akan memberi kesan kepada kualiti dan kejayaan sesebuah universiti. Kakitangan akademik adalah kerjaya profesional kerana mereka mempunyai kemahiran yang tinggi dalam bidang masing-masing. Sukar bagi jawatankuasa pemilihan memilih kakitangan yang sesuai kerana mereka menghadapi ketidakpastian dalam proses pemilihan. Dua kaedah dalam Membuat Keputusan Pelbagai Kriteria (MCDM), dinamakan Proses Hierarki Analisis (AHP) dan Penghapusan dan Pilihan Penterjemahan Realiti I (ELECTRE I) membolehkan pembuat keputusan membuat keputusan berkesan dalam pemilihan kakitangan akademik. Kedua-dua kaedah ini membantu meningkatkan kaedah sedia ada dengan perbandingan penilaian berpasangan dengan menyatakan keutamaan relatif bagi kriteria dan alternatif dari kualitatif kepada kuantitatif dengan mempertimbangkan kriteria yang mempengaruhi keputusan. Kajian ini telah menggunakan enam kriteria utama dan lima belas sub-kriteria untuk memilih calon yang terbaik jawatan kakitangan akademik di Fakulti Sains, UTM. Kriteria pemilihan adalah Akademik, Sikap, Kemahiran Interpersonal, Pengalaman, Aktiviti Kurikulum, dan Laporan Pengadil digunakan dalam kajian ini adalah ditentukan berdasarkan ulasan sorotan kajian dan pemerolehan pengetahuan menemuramah Timbalan Pendaftar di Pejabat Pendaftar dan Penolong Pendaftar dari Fakulti Sains, UTM. Aplikasi dari kedua-dua kaedah, Calon 7 dipilih sebagai kakitangan akademik. Expert Choice 11.0 dan Microsoft Excel 2007 digunakan bagi membantu pengiraan. Cadangan kerja penyelidikan seterusnya, kajian boleh menggunakan lain MCDM dalam memilih kakitangan akademik.

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LIST OF ABBREVIATIONS

AHP	-	Analytic Hierarchy Process
ELECTRE	-	Elimination And Choice Translating Reality
MCDM	-	Muti-Criteria Decision Making
MADM	-	Muti-Attribute Decision Making
MODM	-	Multi-Objective Decision Making
WSM	-	Weighted Sum Model
WPM	-	Weighted Product Model
MAUT	-	Multi-Attribute Utility Theory
CR	-	Consistency Ratio
CI	-	Consistency Index
ADC	-	Academic
ATTD	-	General Attitude
SKILL	-	Interpersonal Skill
EXP	-	Experiences
ACTV	-	Extracurricular Activities
RFR	-	Referees Report
EDU	-	Education Background
CFD	-	Self Confident
RNP	-	Research & Publication
KNW	-	General Knowledge
AGE	-	Age
APR	-	Appearance
CMC	-	Communication Skill

TCH	-	Teaching Skill
ENG	-	Ability Communicate English
TEXP	-	Teaching Experience
WFE	-	Working Field Experience
WDE	-	Working Duration Experience
PAA	-	Participation In Activities
POA	-	Position In Activities
AWD	-	Award

LIST OF SYMBOLS

C_n	- n Criteria
a_{ij}	- Element in a matrix, judgment on pair of criteria C_i, C_j
W_i	- Weights
A	- Matrix A
x_n	- Relative importance by n experts
W	- Matrix W, Eigenvector
w_1, w_2, w_3	- Weight (element w)
p_j	- Weight of the j sub-criteria
q_{ij}	- Priority weights of the i candidates on the j sub-criteria

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Operational research is an important area of mathematics. Operational research is the application of advanced analytical methods to help make better decision. The important of operations research is the development of approaches for optimal decision making. Decision making is the study of identifying and choosing alternatives based on the values and preferences of the decision maker. Making a decision implies that there are alternative choices to be considered, and in such a case we want not only to identify as many of these alternatives as possible but to choose the one that best fits with our goals, objectives, desires, values, and so on (Harris, 1988).

Decision making process should start with the identification of the decision makers and stakeholders in the decision, reducing the possible disagreement about problem definition, requirements, goals and criteria (Baker et al, 2002). Personnel selection is the process of choosing individuals who match the qualification required to perform a defined job in the best way (Dursun and Karsak, 2010). A very common problem in the personal selection is that the biases of those the rating have a tendency to creep into the selection process (Arvey and Campion, 1982).

As in many decision problems, personnel selection such as academic staff selection is very complex in real life. Academic staff selection is an important process

for the universities as this decision affects the quality of education and the success of the university. Selection committee faces up to the uncertainty and vagueness in the decision making process (Ertugrul and Karakasoglu, 2007). In this study, Multi-Criteria Decision Making (MCDM) methods can be applied to decision making in this areas. By using MCDM method, uncertainty and vagueness from subjective perception and the experiences of decision maker can be effectively represented and reached to be more effective decision.

There are a lot of MCDM available methods in the decision making areas. Each one of them has its own features. In this study, the two types of MCDM method namely Analytic Hierarchy Process (AHP) and Elimination and Choice Translating Reality I (ELECTRE I) can be applied in academic staff selection. The AHP and ELECTRE I method applied in this study to prove that both method shows the similarity results (Salomon, 2001). As academic staffs are related to the success and failure of higher education institutions, well developed selection criteria can signify the essential element of the position, attract a high quality pool of applicants and provide a reliable standard that applicants can be considered against (Khim, 2009).

The selection committee follows the recruiting process should provide reliable and valid information about job applicants. It is crucial that everyone in the selection committee understand the list of selection criteria and use it as the focal point throughout candidate assessment. Essential criteria are those teaching skills, past experiences, qualifications, abilities and publications and researches that are relevant to the performance of the functions of a person's duties. The selection criteria provide structure to assist the selection committee in developing effective interview questions and in identifying the applicants to measure their own suitability (Khim, 2009).

Academic staff selection is a multiple criteria decision making problem which is refers to making decisions in the presence of multiple, usually conflicting criteria (Zanakis et al, 1998). A MCDM method, as its own name suggests is for use in situations when more than one criterion must be considered. It is one of the well-known

topics of decision making. MCDM problems are commonly categorized as continuous or discrete, depending on the domain of alternatives. The problems of MCDM can be classified into two categories: Multiple Attribute Decision Making (MADM) and Multiple Objective Decision Making (MODM), depending on whether the problem is a selection problem or a design problem.

1.2 Background of the problem

One of the applications of MCDM in the area of operational research is the selection of employees. The selection of employees is very important to ensure the success and effectiveness of an institution. Employee selection is a process that consists of recruiting, interviewing and selecting the best employees. The goal of employee selection is to choose the most competent person for the position by obtaining and carefully reviewing all relevant information. Usually, the most typical problem is the selection of the best candidates. Relevant information should be emphasized to ensure the right person is selected.

Career as academic staff in an academic institution is the professional career as they are experts who have the high skills in their respective fields. Academic staff is responsible to produce individuals who are able to contribute their services to religion, race and nation. The selection of academic staff for the universities is very important process because the decision will affect the quality and the success of the university. To make a decision we need to know the problem, the need and purpose of the decision, the criteria of the decision, their sub-criteria, stakeholders and groups affected and the alternative actions to take (Saaty, 2008).

Multi-Criteria Decision Making (MCDM) is a branch of decision making. MCDM is all about making choices in the presence of multiple conflicting criteria. This method uses numeric techniques to help decision makers choose among a discrete set of alternative decisions. This is achieved on the basis of the impact of the alternatives on

certain criteria and thereby on the overall utility of the decision maker. MCDM research in the 1970s focused on the theoretical foundations of multiple objective mathematical programming and on procedures and algorithms for solving multiple objective mathematical programming problems (James, 2008).

According to Zanakis et al (1998), MCDM problems are commonly categorized as continuous or discrete, depending on the domain of alternatives. Multiple Attribute Decision Making (MADM), with discrete usually limited, number of prespecified alternatives, and involving implicit or explicit tradeoffs. While, Multiple Objective Decision Making (MODM) have decision variable values that are determined in a continuous or integer domain, with either an infinitive or a large number of choices, the best of which should satisfy the decision maker's constraints and preference priorities (Hwang and Yoon, 1981).

In this study, we focus on MADM that is used in a finite 'selection' or 'choice' problem. The two method of MADM used in this study are Analytic Hierarchy Process (AHP) and Elimination and Choice Translating Reality I (ELECTRE I) method. AHP first presented by Thomas L. Saaty (Saaty, 1987) is a MCDM method and is structured using sets of pair-wise comparisons in a matrix to derive both the relative weights of the individual decision criterion and the rating of options in terms of each of the criteria. It aims providing the decision maker a precise reference for adequately making decision and reducing the risk of making wrong decision through decomposing the decision problem into a hierarchy of more easily which can be evaluated independently (Zolfani, 2012).

ELECTRE method was developed by Bernard Roy in the mid-1960s in Europe (Figueira et al, 2005). This method is based on the study of outranking relations using concordance and discordance indexes to analyze such relation among the alternatives. The concordance and discordance indexes can be viewed as measurements of dissatisfaction that a decision maker uses in choosing one alternative over the other (Rouyendegh and Erkan, 2012). Moreover, it has the ability to handle both quantitative

and qualitative judgments. On the other hand, it is a rather complex decision making method and requires a lot of primary data (Papadopoulos, 2011).

According to Zanakis et al (1998), their paper stated that it is impossible or difficult to answer questions such as (i) Which method is more appropriate for what type of problem? (ii) What are the advantages or disadvantages of using one method over another? and (iii) Does a decision change when using different methods?. They stated that the major criticism of MADM methods is that different techniques yield similar results when applied to the same problem. Based on this statement, this study developed to applied MADM method namely AHP and ELECTRE I method in selection of academic staff to prove that both MADM method yield similar result by using different methods.

The solutions obtained by different MADM methods are essentially the same. Belton (1986) concluded that AHP and a Simple Multi-Attributed Value Function are the approaches best suited and the most widely used in practice. Goicoechea et al (1992), determine the relative utility and effectiveness of MCDM models for applications in realistic water resources planning settings. Based on a series of nonparametric statistical tests, the results identified Expert Choice for AHP method as the preferred MCDM model based largely on ease of use and understandability. The different additive utility models produce generally different weights, but predicted equally well on the average (Schoemaker and Waid, 1982).

The traditional personnel selection method uses an experimental and statistical techniques approach. After using the experimental approach, decision makers select personnel hinge on their experiences and understanding of the job specifications. In the statistical techniques approach, decision makers finalize their decision through the arrangement of test scores and the measure of accomplishment for the candidate. Interviewing the related candidates is one of the techniques concerning the personnel selection (Yusuff et al, 2012).

Selection of academic staff in university, particularly UTM, has been done using a guideline outlined by the Registrar Office and adapted by the various departments in various faculties in university. Even though the selection process adopted by the departments of the faculties to include elements of quantitative evaluation as well as some qualitative. However, it does not use any standardized or established selection model customized for the university. By applying both AHP and ELECTRE I method in selection of academic staff, it can help standardized selection model in the university.

1.3 Statement of the problem

This study will develop the selection model of academic staff at the Faculty of Science, UTM by using MCDM methods, namely Analytic Hierarchy Process (AHP) and Elimination and Choice Translating Reality I (ELECTRE I) method.

1.4 Objectives of the study

The objectives of the research are:

1. To identify the criteria that will affect the selection process of academic staff of Faculty Sciences in UTM.
2. To develop the AHP and ELECTRE I model in academic staff selection.
3. To compare the result obtain from AHP and ELECTRE I method in selection of academic staff.

1.5 Scope of the study

In this research, the attention is focused on the application of AHP and ELECTRE I as tools for academic staff selection in Faculty Sciences, UTM. There are several criteria considered to the selection decision used in the ranking of the academic staff selection problem.

The profiles of candidates used in simulation of the selection model developed are simulated data. The collection and information of actual profile of those who has holding the posts of academic staff and those who are potential candidates for this position, is not done. This is because due to the sensitivity of the data involved.

Microsoft Excel 2007 software is used in this study for synthesizing the pair-wise comparison matrices and used for calculation of ELECTRE I method. Expert Choice software will be used in this study for applying the AHP method. This software provides a structured approach and proven process for prioritization and decision making. It help decision makers get the best result.

1.6 Significance of the study

From this study, it is hope that we can select the most appropriate academic staff in Faculty of Science, UTM. Other than that, this study will contribute to more effective decisions in the process of selection academic staff in Faculty of Science, UTM. This effectiveness is achieved through the application of AHP and ELECTRE I using decision making process. The MCDM method will provide support to the process of decision making in problems that are too complex to be solve such as in this study the selection process for academic staff at the university. The best performance of MCDM method will be the most suitable method to apply for selection of academic staff in Faculty of Science, UTM.

1.7 Thesis Organization

This dissertation consists of six chapters. In Chapter 1, an overview of this study has been addressed. In this chapter, we include the background of the study, objectives of the study, scope, and the significance of the study.

Chapter 2 focuses on the literature review. This chapter describes the academic staff selection problem and the criteria for the selection process. There are also has explanation on application of MCDM method by different researchers.

In Chapter 3, we describe the methodology adopted in this study. This chapter presented the AHP and ELECTRE I aided selection model developed in this study. The selection criteria and sub-criteria are determine and the priority weights synthesize are discussed in this chapter.

Chapter 4 details the application of AHP and ELECTRE I method in the academic staff selection process in Faculty of Science, UTM. This chapter shows the use of Expert Choice 11.0 and Microsoft Excel 2007 software. The calculations involved are shown in detail.

Chapter 5 presents the ranking of candidates in order to select the best candidate for the faculty by using Microsoft Excel 2007 and Expert Choice 11.0 software.

In Chapter 6, we states the summary and conclusion of this research based on the results that we showed in Chapter 5. Then, there are some suggestion and recommendations for future researchers.

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