EXTENDED HAMMING DISTANCE METHOD FOR MEASURING THE PERFORMANCE OF ACADEMIC STAFF

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EXTENDED HAMMING DISTANCE METHOD FOR MEASURING THE PERFORMANCE OF ACADEMIC STAFF

by

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LIST OF ABBREVIATIONS

MCDM	Multi Criteria Decision Making
MADM	Multi Attribute Decision Making
MODM	Multi Objective Decision Making
UniMAP	Universiti Malaysia Perlis
IMK	Institute of Engineering Mathematics
SKT	Annual Performance Target
HRM	Human Resources Management
MBO	Management by Objectives
BARS	Behaviorally Anchored Rating Scale
AHP	Analytic Hierarchy Process
PROMETHEE	Preference Ranking Organization Method for Enrichment Evaluatio Set of Real numbers
TOPSIS	Technique for Order Preference by Similarity to Ideal Solution
OWA	Ordered Weighted Averaging
UPOWAD	Uncertain Probabilistic OWA Distance
UPOWA	Uncertain Probabilistic OWA
KUKUM	Kolej Universiti Kejuruteraan Utara Malaysia
DM-I	First Decision Maker
DM-II	Second Decision Maker
C1	Criteria One
C2	Criteria Two
C3	Criteria Three
C4	Criteria Four

C5	Criteria Five
C6	Criteria Six
C7	Criteria Seven
C8	Criteria Eight
C9	Criteria Nine
C10	Criteria Ten
C11	Criteria Eleven
C12	Criteria Twelve
C13	Criteria Thirteen
C14	Criteria Fourteen
VL	Very Low
L	Low
ML	Medium Low
M	Medium
MH	Medium High
H	High
VH	Very High
T	Terrible
MT	Medium Terrible
VP	Very Poor
P	Poor
MF	Medium Fair
F	Fair
MG	Medium Good
G	Good

VG	Very Good
ME	Medium Excellent
E	Excellent
NHDWW	Normalized Hamming Distance without Criteria Weight
NHDAW	Normalized Hamming Distance with Average Weight
WHDSE	Weighted Hamming Distance with Shannon's Entropy Concept

LIST OF SYMBOLS

α	Alpha
$\in$	Element
μ_A	Membership function of A
$\sum$	Summation
$\lvert\ldots\rvert$	Modulus

Pelanjutan Kaedah Jarak Hamming untuk Mengukur Prestasi Kakitangan Akademik

ABSTRAK

Kajian ini mencadangkan pelanjutan kaedah jarak Hamming untuk mengukur prestasi kakitangan akademik. Secara umumnya, proses penilaian prestasi dapat digunakan sewaktu menentukan tugas-tugas pekerja yang melibatkan proses membuat keputusan dan pembangunan pekerja. Selain itu, proses ini juga boleh digunakan dalam mengenal pasti prestasi pekerja. Oleh yang demikian, pemilihan kaedah yang sesuai adalah perlu bagi memilih pekerja yang memaparkan prestasi terbaik. Kaedah pembuatan keputusan pelbagai kriteria (MCDM) merupakan salah satu penyelesaian untuk masalah ini. Dalam kajian ini salah satu daripada kaedah MCDM yang sedia ada iaitu kaedah jarak Hamming telah digunakan. Diadaptasikan daripada algoritma Canós, penambahbaikan pada algoritma yang sedia ada telah dilakukan. Penggunaan pemberat subjektif dan pembolehubah linguistik kabur telah diaplikasikan di dalam kaedah yang dicadangkan. Penggunaan kriteria pemberat adalah penting bagi menilai prestasi alternatif. Oleh itu, konsep entropi Shannon telah digunakan bagi menentukan kriteria yang paling penting. Manakala, penggunaan pembolehubah linguistik kabur dapat membantu dalam mengendalikan penilaian yang subjektif. Rangka kerja bagi melaksanakan kaedah ini juga turut diilustrasikan di dalam kajian ini. Bagi mengaplikasikan kaedah yang telah dibuat penambahbaikan, satu kajian kes telah dijalankan di Institut Matematik Kejuruteraan, Universiti Malaysia Perlis, untuk menentukan kakitangan akademik terbaik bagi tiga tahun berturut-turut iaitu pada tahun 2010, 2011 dan 2012. Melalui penggunaan kaedah yang telah dicadangkan, tiga perkara telah dikenalpasti iaitu kriteria yang paling penting, kedudukan kakitangan akademik dan masalah yang wujud sewaktu menentukan kedudukan kakitangan akademik bagi tiga tahun berturut-turut. Perbandingan antara keputusan akhir kaedah yang telah dicadangkan dengan kaedah TOPSIS yang merupakan salah satu daripada kaedah MCDM yang sedia ada turut dilakukan. Berdasarkan daripada keputusan akhir satu kesimpulan dapat dibuat iaitu pemberat kriteria dan kedudukan kakitangan akademik bagi tahun 2010 dan 2011 adalah berbeza daripada tahun 2012. Bagi tahun 2010 dan 2011, A22 diisytiharkan sebagai kakitangan akademik terbaik dan bagi tahun 2012 adalah A3. Manakala, bagi tahun 2010 dan 2011, C11 diisytiharkan sebagai kriteria yang paling penting dan C6 bagi tahun 2012. Selain itu, kedua-dua keputusan akhir bagi kaedah yang dicadangkan dan kaedah TOPSIS adalah hampir sama. Melalui aplikasi kaedah yang telah dicadangkan, diharap kaedah ini dapat membantu meringankan kesulitan dalam proses membuat keputusan bagi menentukan prestasi yang terbaik daripada kalangan kakitangan akademik.

Extended Hamming Distance Method for Measuring Performance of the Academic Staff

ABSTRACT

This research presents an extended Hamming distance method in measuring the performance of the academic staff. Generally, performance appraisal is responsible in determining the employee works, in which involving in making personnel decisions and employee development. As this process can be used to identify the performance of the employee, a proper method has to be applied in selecting the best employee performance. Multi criteria decision making (MCDM) method is one of the solution for this problem. In this research one of the existing MCDM methods which is a Hamming distance method is extended. Inspired by the Canós algorithm, the extension of the existing algorithm is done. The use of subjective weight and fuzzy linguistic variables are introduced in the newly extended method. The use of criteria weight is essential in evaluating the performance of the alternative. In addition, Shannon's entropy concept is also applied to determine the most important criteria. Meanwhile, the use of fuzzy linguistic variables will help in dealing with subjective assessment. The extended Hamming distance method is presented in a well-built framework which also depicted in this research. A study case in one of the institute in Universiti Malaysia Perlis, which is Institute of Engineering Mathematics in determining the best academic staff for three years, which are 2010, 2011 and 2012 is presented to validate the extended method. By utilizing the extended method, the most important criteria, the ranking of the academic staff and problems regarding the ranking process for three years are identified. The comparison between the final results of the extended method and TOPSIS method is also done. Based on the final results obtained, it can be concluded that the results for the criteria weight and ranking of the academic staff for the years 2010 and 2011 are different than the year 2012. For the years 2010 and 2011, A22 is declared as the best academic staff. Meanwhile, for the year 2012, the best academic staff is belong to A3. C11 is declared as the most important criteria for the years 2010 and 2011. However, for the year 2012, C6 is declared as the most important criteria. The similarity in the final results between the extended method and TOPSIS method is also identified. Through the application of the extended method it is hope to ease the difficulty in decision making process especially in determining the best performance of the academic staff.

CHAPTER 1

INTRODUCTION

1.1 Overview

It is customary for the companies and organizations to be able to adapt to current conditions and situations of this world in order to survive and preferably become more successful. However, it is not easy as it seems, as in reality the rapid growth in globalization had created an intense competition among the companies or organizations. Practically, the companies and organizations had to come with a well plan and systematic strategy to survive in this 'survivors' games. In regards to this, the luck seems to shine on the pioneer companies as most of them realized that the core to sustain and win in this competitive world are started within the continuous development of the human resources. The effective management and administrations of the human resources must be able to quantify and qualify the employee's goals or performance (Andrés, García-Lapresta & Martínez, 2010). Eventually, the performance appraisal process is one of the procedures that can be used to evaluate the employee performance (Andrés et al., 2010).

According to Lussier and Hendon (2013), there are three major reasons on why the organizations performing the performance appraisal which are communicating, decision making and motivating. Theoretically, performance appraisal is also involved in dealing with making personnel decisions and employee development (Türk, 2008). In issue of making personnel decisions, this technique can be classified into three aspects

which are promotion, transfer and pay (Türk, 2008). Thus, by applying the concept of the decision making, the management can perform an evaluation regarding their employee performance; hence can determine which employee had the right in getting a promotion, transfer or pay. Nevertheless, making a right decision, especially in evaluating performance of an employee that can be used in predicting the future of organizations is not an easy task.

Initially, the difficulty in making a decision is not a new problem in this world as it is a problem arises since the civilizations of ancient humankind. The differences in tools and methods in making a decision is one thing that makes the differences between the ancient era and the global era. In most ancient era, for example, in Islamic civilization, Khalifa or sometimes scholar becomes a reference in making an important decision. The similar purpose is also done in ancient Egypt in which kings and upper clergy are having the opportunity in making decisions for a problem given (Triantaphyllou, 2000).

As times passed by, the advancement in decision making is seen in rapid pace as the researcher had applied the used of science and technology within the human judgments. Within these days, numerous decision making methods and theories had been developed and introduced through the development of existing scientific disciplines such as statistics, management science and operations research. Several researchers had also taken another step in enhancing the usage of the decision making method by implementing selected decision making methods with the use of computer programming resulting new decision making software such as D-Sight and Expert Choice.

1.2 Background of Study

The intense competitions that happen between the companies, organization or institution had also seemed to affect the higher educational institution. This can be proved by the changes and transformation in an educational system that had been done continuously and rapidly. As a result, this situation has increased the workload of the academic staff. Ironically, this problem might give an impact in academic staff enthusiasm in which in the long run could affect the stability of the academic team (Yan & Fan, 2009). Thus, in order to bring up or maintain their enthusiasm in this hectic workload, the performance appraisal process, especially in administrative area in which consist of promotion, compensation and reward should be managed in a fair manner.

However, to determine which academic staff is suitable for at least one of the aspects in administrative area is a difficult task. Regarding to this matter, there are many problems aroused from the existing performance appraisal of academic staff for instance, numerous qualitative indicators, unfair and bias due to subjective evaluation and lack of quantitative evaluation (Yan & Fan, 2009). Thus the selection process had to be precisely and carefully performed to avoid any criticism during the process. Alternatively, the selection process are involved with the decision making process and it is a need for the management to perform a proper decision making process.

The decision making process can be defined as a process of finding the best possible course or option from all of the alternatives (Jahanshahloo, Lotfi, & Izadikhah, 2006). The primary objectives of this process also can be clarified as a process of searching for the best option out of the given alternatives. Theoretically in the case of scientific research, this process will help and ease the burden of decision makers during the selection process.

The importance of making appropriate decisions is differing for each situation. Most cases, the good decision making are a compulsory and important for the future performance and it is obvious that, the good decision process normally leads to good outcomes (Anderson, 2002). Perhaps this is the reasons why this field had attracted not only psychologists, but also mathematicians, economists and decision analysts. Alternatively, for the mathematicians, this circumstance had given the idea to researcher in developing and improving numerous decision making methods as a solution for this problem.

1.3 Problem Statement

Up to these days, several methods have been proposed in measuring the performance appraisal of the academic staff. However, it is not enough to only measure the performance of the academic staff. The ability to make a right decision in choosing or selecting the best academic staff performance also should be considered and possessed by the person that responsible in the performance appraisal process. Literally, the performance is not only center on producing reports, but it also expands in making the decision within a given information and situation (Yu et al., 2009). Thus, to determine the excellent performance of the academic staff, a decisive proof on choosing and making the right decision need to be presented to verify the results.

However, the decision process can become a complex and difficult process when there are multiple criteria or goals that need to be achieved. Hence, the decisions need to be done meticulously in which a proper framework and a group of people consisting the decision makers are prepared. Eventually, this condition is relevant with the performance appraisal process. Based on the existing literature on performance

appraisal process (Türk, 2008; Jafari, Bourouni, & Amiri, 2009; Jati, 2011), it is clear that this process involves with more than one criterion that need to be evaluated. In a wake of this problem, the decision makers have to choose an appropriate tool or method that had included all the available data and possible scenarios to ensure that the right decision had been made (Duenas & Mort, 2002).

One of the best solution that can be used to solve this problem is by performing multi criteria decision making (MCDM) methods. MCDM is known for its capabilities in evaluating, electing or ranking a finite set of available alternatives with respect to multiple and conflicting criteria (Chang, Yeh, & Chang, 2013). MCDM is also used as a methodological and modeling tool in handling the complex engineering problems (Kahraman, 2008) and as the support system to help the decision makers (Duenas & Mort, 2002). According to Kahraman (2008), the MCDM can be divided into two basic approaches which multiple attribute decision making (MADM) and multiple objective decision making (MODM).

In the existing literature, one of the MADM approaches that can be used in solving decision making process is by using distance measure methods in which Hamming distance method is one of them. Canós et al., (2011), had presented a well-built Hamming distance method to solve the decision making problem. However, this method had lacked one criteria that essentially need in the decision making process which is criteria weight. As noticed by Liu and Kong (2005), the criteria weight is compulsory in any method as this weight reflects the relative importance of the criteria. Furthermore, when the decision making process is done in the large scale of alternative, the probability of some alternatives to share the same ranking are high.

Thus, to identify and determine which alternatives are suitable for certain positions or ranking the use of criteria weight will become handy. Hence, in this

research the use of weight is incorporated in the existing algorithm which resulting an improve algorithm from the previous one. Within the two types of weights which are objective and subjective weights, the subjective weight will be used. The use of subjective weight is appropriate in the real world situation as the decision makers had their own evaluation of criteria weight. The use of an appropriate method to calculate the criteria weight will also be able to identify which criteria are the most important criteria when there are many decision makers involved in evaluating the criteria weight.

Since the decision making process usually dealt with the human judgment, this process could become a tedious and challenging task. Naturally, when performing the evaluation process, human have a tendency to have a good guess at predicting qualitative forecasting, whereas having a problem in predicting quantitative problems (Güngör et al., 2009). Therefore, one of the best resorts to solve this problem is by applying fuzzy set theory. The fuzzy set theory is known for its flexibility in handling imprecise and uncertainty in human judgments. Bellman and Zadeh (1970) had introduced the use of fuzzy set theory in MCDM and it had proved to be an effective approach in dealing with uncertainty in human decision making process. Since then, it had become an important tool in constructing a decision making framework that incorporates subjective judgments entails in the decision making process.

The ranking process is one essential process in the Hamming distance method that recorded important step in the decision making process. It is because during the decision making process, the ranking process will rank the alternatives according to their performance either from the best to the worst alternatives or from the worst to the best alternatives. The ranking of the alternatives will help the decision makers to identify which alternatives that had shown a better performance in a given situation and in certain criteria specifically. Plus, when there is a misconception or some clashes in

opinion on choosing the right alternatives between the decision makers, this ranking process can become a useful resource.

1.4 Objectives

The main objective of this research is to extended an existing decision making method by incorporating a fuzzy set theory in the classical Hamming distance method in selecting the best academic staff performance. The specific objectives are:

1. To improve the previous algorithm by Canós et al. (2011) by integrating the use of subjective weight resulting a new algorithm.
2. To determine the most important criteria in measuring the performance of the academic staff by using Shannon's entropy concept.
3. To validate the extended method by comparing with the existing MCDM method which is TOPSIS and with the actual result of IMK's academic staff performance appraisal reports.

1.5 Scope of Study

A case study involving the staff performance evaluation is done to validate the extended Hamming distance method. The data are taken from the Institute of Engineering Mathe matics (IMK) in Universiti Malaysia Perlis (UniMAP). The performance appraisal reports which are based on Annual Performance Target (SKT) from that institute are used in order to clarify this method. This research is also solely focusing on the performance appraisal of the academic staff at IMK. By using the proposed method, the ranking of academic staff performance will be made, hence will