UNIVERSITI PUTRA MALAYSIA

DEVELOPMENT OF GROUP DECISION MAKING MODEL UNDER FUZZY ENVIRONMENT

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DEVELOPMENT OF GROUP DECISION MAKING MODEL UNDER FUZZY ENVIRONMENT

By

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DEDICATION

To my dear mother Sedigheh, and to my dear wife Fatemeh, without whose patience and constant encouragement it was impossible to complete the study. Thank you for being the statue of patience and perseverance.

To my cute daugthers, Zeinab and Sajedeh whom I feel greatly in debt.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

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Multi criteria group decision making (MCGDM) methods are broadly used in the real-world decision circumstances for homogeneous groups. Some decision-makers' viewpoints at times are more important or reliable than others, or they may differ in terms of the decision-maker experience, education, expertise and other aspects. Thus, a heterogeneous group of decision makers with dissimilar members has to be composed in MCGDM. Multi-dimensional personnel evaluation is one of the most critical decisions to make in order to achieve the organization goals. In many situations, raters may decide on the basis of imprecise information coming from a variety of sources about ratee with respect to criteria. In fact, some criteria are completely quantifiable, some partially quantifiable, and others completely subjective; moreover crisp data is inappropriate to model real-world circumstances. Linguistic labels or fuzzy preferences are therefore, used to deal with uncertain and inaccurate factors involved and seem more reliable in complex group decision situations.

In this research, heterogeneous group decision making models under fuzzy environment for multi-dimensional personnel evaluation were proposed to compensate the differences of decision makers' knowledge such as: education, expertise, experience and other aspects. A new fuzzy group decision making method was developed under the linguistic framework for heterogeneous group decision making that aims at a desired consensus. The method allocates different weights for each decision maker using linguistic terms to express their fuzzy preferences for alternative solutions and for individual judgments. Besides, the classical ordinal approach method under a linguistic framework is developed for heterogeneous group decision making, which allows group members to express their fuzzy preferences in linguistic terms for alternative selection and for individual judgments. Furthermore, a fuzzy extension of technique for order preference by similarity to ideal solution (TOPSIS) method under fuzzy environment was proposed. The method covers heterogeneous group decision making by considering the decision makers' viewpoint weights. In order to solve the problem of discrepancy between decision making methods' results, a new optimization method was developed, to aggregate the results' of different decision making models.

The four proposed methods were used in a case study. Proposed methods focused on the implementation of fuzzy logic approach in the personnel evaluation system. Furthemore, personnel were evaluated from different points of view (supervisors, colleagues, inferiors and employee him/herself). A fuzzy Delphi method and linguistic terms represented by the fuzzy numbers were developed to elicit qualitative and quantitative criteria and assess criteria weights and relative importance of evaluation group's viewpoints. Then, the proposed methods' results were compared

to already established methods. The study identified that the results of the proposed methods are closely related to other methods and the selections made by the proposed methods approximately are identical with the other already established methods. The Spearman's rank correlation coefficient shows highly consistent rankings obtained by the methods. No significant difference in the ranking of the proposed methods and the other established methods was observed. The results of the problems solution based on the aggregated proposed model show that the aggregated model achieved the highest value in the Spearman's rank correlation compared to the average method and Copeland function. Furthermore, the high Spearman's rank correlation coefficient between the rankings supports the consistency of the results and similarity of applicability of the methods.

Abstrak tesis dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PEMBANGUNAN MODEL MEMBUAT KEPUTUSAN BERKUMPULAN BAWAH PERSEKITARAN KABUR

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Kaedah membuat keputusan berkumpulan pelbagai kriteria (MCGDM) adalah luas digunakan dalam keadaan keputusan dunia sebenar bagi kumpulan homogen. Pandangan beberapa pembuat keputusan adalah lebih penting atau dapat dipercayai daripada yang lain, atau mereka mungkin berbeza dari segi pengalaman pembuat keputusan, pendidikan, kepakaran dan aspek-aspek lain. Oleh itu, satu kumpulan heterogen pembuat keputusan dengan ahli-ahli yang tidak serupa perlu disusun dalam MCGDM. Penilaian kakitangan pelbagai dimensi adalah salah satu keputusan yang paling kritikal untuk dibuat bagi mencapai matlamat organisasi.Dalam banyak keadaan, pemberi kadar mungkin membuat keputusan berdasarkan maklumat tidak tepat yang datang dari pelbagai sumber-sumber mengenai ratee dengan merujuk kepada kriteria. Malah, beberapa kriteria adalah boleh diukur sepenuhnya, ada yang sebahagiannya boleh diukur, dan yang lainnya adalah subjektif sepenuhnya; lebih-lebih lagi data yang tajam tidak sesuai untuk model keadaan dunia sebenar. Tanda bahasa atau keutamaan kabur oleh itu, digunakan untuk menangani faktor-faktor

terlibat yang tidak tentu dan tidak tepat dan kelihatan lebih dipercayai dalam situasi keputusan kumpulan yang rumit.

Dalam kajian ini, model membuat keputusan berkumpulan heterogen di bawah persekitaran kabur bagi penilaian kakitangan pelbagai dimensi telah dicadangkan untuk membayar pampasan kepada perbezaan pengetahuan bagi pembuat keputusan seperti: pendidikan, kepakaran, pengalaman dan aspek-aspek lain. Satu kaedah membuat keputusan berkumpulan kabur yang baru dibangunkan di bawah rangka kerja bahasa bagi membuat keputusan berkumpulan heterogen yang menuju kepada persetujuan yang dikehendaki. Kaedah ini memperuntukkan beban yang berbeza bagi setiap pembuat keputusan dengan menggunakan istilah ilmu bahasa untuk menyatakan keutamaan kabur mereka bagi penyelesaian alternatif dan keputusan secara individu. Selain itu, kaedah pendekatan ordinal bersifat klasik di bawah rangka kerja ilmu bahasa dibangunkan untuk membuat keputusan berkumpulan heterogen yang membolehkan ahli-ahli kumpulan untuk menyatakan keutamaan kabur mereka dalam istilah ilmu bahasa bagi pilihan alternatif dan keputusan secara individu. Selain itu, satu kaedah teknik lanjutan kabur bagi keutamaan perintah berdasarkan persamaan kepada penyelesaian ideal (TOPSIS) di bawah persekitaran kabur dicadangkan. Kaedah ini merangkumi membuat keputusan berkumpulan heterogen dengan mengingati beban pandangan pembuat keputusan. Dalam usaha untuk menyelesaikan masalah percanggahan antara keputusan kaedah membuat keputusan, kaedah optimasi yang baru dibangunkan untuk menjumlahkan keputusan model membuat keputusan yang berbeza.

Kaedah yang dicadangkan telah digunakan dalam kajian kes yang memberi tumpuan kepada pelaksanaan pendekatan logik kabur dalam sistem penilaian kakitangan, di mana kakitangan dinilai dari sudut pandangan yang berbeza (penyelia, rakan sekerja, inferiors dan pekerja sendiri). Satu kaedah Delphi kabur dan istilah ilmu bahasa yang diwakili oleh nombor kabur telah dibangunkan untuk mendapatkan kriteria kualitatif dan kuantitatif dan menilai beban kriteria dan kepentingan relatif pandangan kumpulan penilaian. Kemudian, kaedah yang dibangunkan, prosedur pengumpulan data mereka dan keputusan mereka dibandingkan dengan kaedah yang telah ditubuhkan. Kajian ini mengenal pasti bahawa keputusan kaedah yang dicadangkan adalah berkait rapat dengan kaedah-kaedah yang lain dan pemilihan yang dibuat oleh kaedah yang dicadangkan agak sama dengan kaedah yang telah ditubuhkan. Pekali korelasi pangkat Spearman menunjukkan kedudukan yang sangat tetap diperolehi oleh kaedah ini. Tiada perbezaan yang bererti dalam kedudukan kaedah yang dicadangkan dan kaedah lain yang ditubuhkan. Keputusan penyelesaian masalah yang berdasarkan model jumlah yang dicadangkan menunjukkan bahawa model jumlah mencapai nilai tertinggi dalam korelasi pangkat Spearman berbanding dengan model lain yang ditubuhkan. Tambahan pula, pekali korelasi pangkat Spearman yang tinggi di antara kedudukan menyokong ketetapan keputusan dan persamaan kebolehgunaan kaedah ini.

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I certify that a Thesis Examination Committee has met on 31 October 2011 to conduct the final examination of Mohammad Anisseh on his thesis entitled "**Development of Group Decision Making Model under Fuzzy Environment**" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P. U.(A) 106] 15 March 1998. The committee recommends that the student be awarded the Doctor of Philosophy.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledge. I also declare that it has not been previously and is not submitted for any other degree at Universiti Putra Malaysia or other institutions.

MOHAMMAD ANISSEH

Date:31 October 2011

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