MODIFICATION OF INTERVAL TYPE-2 FUZZY TOPSIS AND ITS APPLICATION TO FLOOD CONTROL PROJECT SELECTION

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Dedication

The dedication of this thesis is split six ways:

To Faidah Mansor, my Mama, who supports from the beginning to the end

To Asma Abdullah, my Nena, who always wipes my tears

To Mohd Zahanapi, my Husband, who makes my day cheerful and joyful

To Nabilah Husna, my beautiful daughter, I dedicate her ink and paper twin

To Nur Adibah, Nur Afiqah, Nur Liyana, my sisters, this journey is a big spirit for you

And to you, if you have stuck with 'Interval Type-2 Fuzzy TOPSIS' until the very end.

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Multi-Attribute Decision Making (MADM) method is one of the widely used approaches to deal with decision making problems. One of the famous techniques in MADM is Interval Type-2 Fuzzy Technique for Order Preference by Similarity to Ideal Solution (IT2FTOPSIS). However, there are some circumstances in IT2FTOPSIS still needs to be improved. Therefore, the problems are divided into four phases including, Rating phase, Weighting phase, Aggregating phase and Ranking phase. In the Rating phase, there exists conflicts in evaluation process of linguistic variable. In the Weighting phase, subjective weights for attributes are used in IT2FTOPSIS and neglected the objective weights. Besides, the used of standard deviation is believed influenced by extreme scores and the method is depended only on the dispersion's data in the Aggregating phase. Lastly, the scoring or compromising method uses two reference points in the Ranking phase, but it does not consider the relative

importance of the distances from these points. In order to overcome these weaknesses, there is a need of distributing a new IT2FTOPSIS. It is in line to overcome difficulties in the selection of flood control project. Selection of flood control project is typically a complex process, exists conflicts and characterized by trade-offs between social, environment, economic and technical aspects. Therefore, this study focuses on the development of a new IT2FTOPSIS where; to develop a new linguistic variable to consider both sides; positive side and negative side (Rating phase development), to develop an objective weight with Interval Type-2 Fuzzy Sets (IT2FSs) (Weighting phase development), to propose a hybrid averaging approach of linear order method (Aggregating phase development), to extent the relative closeness of Positive-Ideal Solutions (PIS) and Negative-Ideal Solutions (NIS) with the ELimination and Choice Expressing REality (ELECTRE) based IT2FSs (Ranking phase development). The illustration of the flood control project selections' case study towards the proposed model. The demonstration of the feasibility of the proposed models towards the selection of the flood control project using the sensitivity analysis method. The results show that the best ranking of the flood control project selection is achieved. Besides, consistent with the sensitivity analysis, in the decision making process. Thus, our proposed model offers an alternative, user-friendly method that is robust in the decision making framework.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai mematuhi keperluan untuk Ijazah Kedoktoran.

PENGUBAHSUAIAN SELANG SET KABUR JENIS-2 TOPSIS DAN APLIKASI TERHADAP PROJEK PENGAWALAN BANJIR

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Kaedah pembuat keputusan multi-kriteria (MADM) adalah salah satu pendekatan yang digunakan secara meluas untuk menangani masalah pembuat keputusan. Salah satu teknik terkenal dalam MADM adalah selang jenis-2 set kabur teknik penyusunan persamaan untuk penyelesaian ideal (IT2FTOPSIS). Walau bagaimanapun, terdapat beberapa keadaan yang masih perlu dipertingkatkan. Oleh itu, masalah IT2FTOPSIS ini dibahagikan kepada empat fasa iaitu fasa Penilaian, fasa Pemberat, fasa Pengaggregatan dan fasa Kedudukan. Dalam fasa Penilaian, wujud konflik di dalam proses penilaian bagi pembolehubah linguistik. Dalam fasa Pemberat, pemberat subjektif bagi kriteria telah digunakan di dalam kaedah IT2FTOPSIS asal, dan mengabaikan pemberat objektif. Selain itu, penggunaan sisihan piawai dipercayai boleh mempengaruhi nilai ekstrem skor dan kaedah ini hanya bergantung pada data penyebaran sahaja di dalam fasa Pengaggregatan. Akhir sekali, kaedah

penskoran dan kaedah kompromi menggunakan dua titik rujukan di dalam fasa Kedudukan, tetapi kaedah ini tidak mengambil kira kepentingan jarak relatif dari titik-titik ini. Untuk mengatasi kekurangan ini, pembinaan kaedah baru IT2FTOPSIS adalah sangat diperlukan. Ia adalah selaras bagi mengatasi kesukaran di dalam proses pemilihan projek kawalan banjir. Pemilihan projek kawalan banjir ini adalah suatu proses yang rumit, berkonflik dan melibatkan semua aspek keseimbangan iaitu antaranya aspek-aspek sosial, alam sekitar, ekonomi dan teknikal. Oleh itu, kajian ini tertumpu pada pembangunan kaedah IT2FTOPSIS baru di mana; untuk membangunkan satu pembolehubah linguistik baru bagi mempertimbangkan kedua-dua belah sisi; sisi positif dan sisi negatif (pembangunan fasa Penilaian), untuk membangunkan pemberat objektif iaitu kaedah entropi (pembangunan fasa Pemberat), pembinaan satu pendekatan hibrid purata kaedah susunan linear (pembangunan fasa Pengaggregatan), pembaharuan kaedah kedekatan relatif melalui kaedah penyelesaian ideal positif (PIS) dan penyelesaian ideal negatif (NIS) sedia ada dengan kaedah ELimination and Choice Expressing REality (ELECTRE) di dalam konteks IT2FSs (pembangunan fasa Kedudukan). Ilustrasi pemilihan projek kawalan banjir terhadap kaedah yang dibangunkan. Demonstrasi dalam menguji kejituan model yang dibangunkan terhadap pemilihan projek kawalan banjir dengan menggunakan kaedah analisis sensitiviti. Keputusan mendapati, projek kawalan banjir terbaik boleh didapati daripada hasil dapatan terhadap pemilihan projek kawalan banjir ini. Selain itu, hasil yang konsistensi terbentuk selaras dengan analisis sensitiviti, dalam proses membuat keputusan. Oleh itu, model yang

dicadangkan menawarkan alternatif, mesra pengguna, sebagai satu kaedah yang mantap dalam rangka pembuat keputusan.