INTEGRATION OF INTERVAL TYPE-2 FUZZY SAW AND INTERVAL TYPE-2 FUZZY TOPSIS FOR AMBULANCE LOCATION SELECTION

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APPROVAL

I certify that an Examination Committee has met on 12th April 2015 to conduct the final examination of C. W. Rabiatul Adawiyah C. W. Kamal, on her Master of Science thesis entitled "Integration of Interval Type-2 Fuzzy SAW and Interval Type-2 Fuzzy TOPSIS for Ambulance Location Selection" in accordance with the regulations approved by the Senate of Universiti Malaysia Terengganu. The Committee recommends that the candidate be awarded the relevant degree. The members of the Examination Committee are as follows:

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Abstract of thesis presented to the Senate of Universiti Malaysia Terengganu in fulfillment of the requirement for the degree of Master of Science

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APRIL 2015

Main Supervisor: Professor Mohd Lazim Abdullah, Ph.D.

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Nowadays, Multi Criteria Decision Making (MCDM) methods are widely utilized and known as effective tools in solving real world problems. Various MCDM methods have been implemented in solving diverse applications of decision problems. One of the MCDM methods is additive weighting-based method. Unfortunately, this method is not always applicable due to the limitations in computational reliability and its applications are not-well received by many MCDM enthusiasts. The method is extended to Fuzzy Simple Additive Weighting (Fuzzy SAW) thanks to the development of fuzzy set theory. Fuzzy SAW utilized fuzzy numbers rather than crisp numbers. Nevertheless, type-1 fuzzy set is weak in handling uncertainty compared to Interval Type-2 Fuzzy Set (IT2 FS). Differently from the typical Fuzzy SAW, which directly utilized trapezoidal type-1 fuzzy numbers, IT2 FS introduced to the Fuzzy SAW to enhance judgments in the fuzzy decision making environment. IT2 FS is more sensitive in handling uncertain information or data. Besides, in this study, Interval Type-2 Fuzzy Simple Additive

Weighting (IT2 Fuzzy SAW) method is integrate with Interval Type-2 Fuzzy Technique for Order Preference by Similarity to Ideal Solution (IT2 Fuzzy TOPSIS) method to handle fuzzy multiple criteria decision making problems based on IT2 FSs. IT2 Fuzzy SAW is utilized in determining the weight for each criterion, and IT2 Fuzzy TOPSIS method is operated to obtain final ranking for alternatives. In order to examine the effectiveness of the proposed methods, the methods were implemented in a case study of ambulance location selection. The results of the case study using proposed methods show inconsistency in the preference orders either in IT2 Fuzzy SAW or Integrated IT2 Fuzzy SAW and IT2 Fuzzy TOPSIS. Obviously the final evaluation of alternatives for the four methods (Fuzzy SAW, IT2 Fuzzy TOPSIS, IT2 Fuzzy SAW and Integrated IT2 Fuzzy SAW and IT2 Fuzzy TOPSIS) shows road network as the best alternative for ambulance placement. Therefore, road network is recommended as a strategic location for ambulance placement. It is shown that the usage of IT2 FS and IT2 Fuzzy TOPSIS gives a large impact to the ranking order. Significantly, the proposed methods provide more flexibility and objective information in dealing with MCDM problems in a fuzzy environment.

Abstrak thesis yang dikemukan kepada Senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk ijazah Master Sains

PEMADUAN SAW KABUR SELANG JENIS-2 DAN TOPSIS KABUR SELANG JENIS-2 UNTUK PEMILIHAN KEDUDUKAN AMBULANS

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Pada masa kini, kaedah Pembuatan Keputusan Pelbagai Kriteria (MCDM) digunakan secara meluas dan dikenali sebagai alat yang berkesan untuk menyelesaikan masalah dunia sebenar. Pelbagai kaedah MCDM telah dilaksanakan dalam menyelesaikan pelbagai aplikasi masalah membuat keputusan. Salah satu kaedah MCDM ialah kaedah yang berasaskan pemberat tambahan. Malangnya, kaedah ini tidak selalunya dapat digunakan kerana keterbatasan dalam kebolehpercayaan pengiraan dan aplikasinya tidak diterima baik oleh kebanyakan pengemar MCDM. Kaedah ini dilanjutkan kepada Pemberat Tambahan Kabur Mudah (SAW Kabur) terima kasih terhadap pembangunan teori set kabur. SAW Kabur menggunakan nombor kabur dan bukannya nombor rapuh. Namun begitu, set kabur jenis-1 adalah lemah dalam menangani ketidaktentuan berbanding dengan Set Kabur Selang Jenis-2 (IT2 FS). Berlainan dari SAW Kabur biasa, yang mana secara langsung menggunakan nombor kabur trapezoidal jenis-1, IT2 FS diperkenalkan kepada SAW Kabur untuk meningkatkan penghakiman dalam persekitaran kabur

membuat keputusan. IT2 FS adalah lebih sensitif dalam mengendalikan matlumat atau data yang tidak menentu. Selain itu, dalam kajian ini, kaedah SAW Kabur Selang Jenis-2 (IT2 Kabur SAW) dipadukan dengan kaedah TOPSIS Kabur Selang Jenis-2 (IT2 Kabur TOPSIS) untuk mengendali masalah kabur pelbagai kriteria membuat keputusan berdasarkan IT2 FS. IT2 Kabur SAW digunakan dalam menentukan berat untuk setiap kriteria dan kaedah IT2 Kabur TOPSIS dikendalikan untuk mendapatkan kedudukan akhir alternatif. Dalam usaha untuk menyelidik keberkesanan kaedah yang dicadangkan, kaedah tersebut telah dilaksanakan dalam kajian kes pemilihan lokasi ambulans. Keputusan kajian kes menggunakan kaedah yang dicadang menunjukkan ketidakselarasan dalam perintah keutamaan sama ada dalam IT2 Kabur SAW atau pemaduan IT2 Kabur SAW dan IT2 Kabur TOPSIS. Secara jelas, penilaian akhir alternatif untuk empat kaedah (SAW Kabur, IT2 Kabur TOPSIS, IT2 Kabur SAW dan Paduan IT2 Kabur SAW dan IT2 Kabur TOPSIS) menunjukkan rangkaian jalan raya sebagai alternatif terbaik untuk penempatan ambulans. Oleh itu, rangkaian jalan raya disarankan sebagai lokasi yang strategik untuk penempatan ambulans. Ia menunjukkan bahawa penggunaan IT2 FS dan IT2 Kabur TOPSIS memberi impak yang besar kepada perintah kedudukan. Nyata sekali kaedah yang dicadangkan memberi lebih banyak fleksibiliti dan maklumat yang objektif dalam menangani masalah MCDM dalam persekitaran yang kabur.