

**FUZZY HYBRID MULTI-CRITERIA DECISION-  
MAKING MODEL FOR MUNICIPAL SOLID  
WASTE DISPOSAL SELECTION**

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**DEGREE DOCTOR OF PHILOSOPHY  
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**Thesis Submitted in Fulfillment of the Requirement for the Degree of  
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## Dedication

This thesis special dedicated to ...

late of my lovely father Hj. Tarmudi Kardi, and  
to my wonderful mother...Hjh. Poniah Hj. Tarkum,

Also to my amazing and lovely wife... Sarinah Selamat,

and

to my smart kid... Aliff Nur Syakirin ...always remember ...

*Wahai anakku muda terbilang,  
Kesusahan menuntut bukan kepalang,  
Enam syaratnya janganlah kurang,  
Akan dinyatakan dengan terang,*

*Cerdik dan tamak(ilmu) hendaklah ada,  
Bersungguh-sungguh, wang pun ada,  
Hormati guru sekali pun muda,  
Sepanjang masa janganlah tiada,*

*~Imam Shafie~*

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

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**Chairperson: Mohd Lazim Abdullah, Ph.D.**

**Member : Professor Abu Osman Md Tap, Ph.D.**

**Faculty : Science and Technology**

In recent years, the tremendous increase of municipal solid waste generation in Malaysia has received significant attention from both the government and public communities. The increased amount cannot be totally absorbed by existing disposal sites. Moreover, the expected usage of the existing disposal sites has reached the maximum capacity. Several efforts such as to construct new disposal sites or to extend the existing landfills are difficult to implement due to issues pertaining to environmental degradation as well as strong opposition from surrounding residential communities. As a result, other disposal system such as sanitary landfilling, incineration, composting and/or recycling materials are observed as the best compromising alternatives to overcome such problems. However, the decision process of systems mentioned above involves uncertainty, mixture datasets, and difference in preference within multiple stakeholders involved. Our research is to propose a multi-criteria decision-making model as a framework to achieve an integrated decision and well-suited with the local conditions. An equilibrium linguistic approach was applied as an alternative method that is user-friendly and systematic, based on the *conflicting bifuzzy sets*. The

approach hybrid the fuzzy analytic hierarchy process and fuzzy ideal solution. The model proposed complies with the validating analysis; risk attitudes, level of confidence as well as a sensitivity analysis. A case study in order to demonstrate the feasibility of the proposed model when dealing with uncertainty was conducted in the state of Selangor and Kuala Lumpur Federal Territory. The result shows consistent outcomes with the risk attitudes, confidence levels and 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 memenuhi keperluan untuk Ijazah Kedoktoran.

**MODEL KACUKAN PEMBUAT KEPUTUSAN MULTI-KRITERIA KABUR  
UNTUK PEMILIHAN SISTEM PELUPUSAN SISA PEPEJAL  
PERBANDARAN**

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**Fakulti : Sains dan Teknologi**

Sejak beberapa tahun kebelakangan ini, peningkatan mendadak penghasilan sisa pepejal perbandaran di Malaysia telah mendapat tumpuan luar biasa daripada pihak kerajaan dan orang ramai. Jumlah penghasilan yang besar ini tidak dapat ditampung keseluruhannya oleh tapak pelupusan sedia ada yang kebanyakan jangka hayatnya telah mencapai tahap maksimum. Beberapa usaha/langkah seperti membina tapak pelupusan baru dan/atau memperluas tapak pelupusan sedia ada dilihat amat sukar untuk dilaksanakan disebabkan isu alam sekitar serta tentangan kuat daripada penduduk setempat. Justeru, sistem pelupusan lain seperti kaedah pengambusan sanitari, penunuan, penguraian, dan kitar semula bahan terpakai dilihat sebagai langkah terbaik untuk mengatasi masalah tersebut. Bagaimanapun, proses pemilihan sistem di atas melibatkan faktor ketidaktentuan, data masukan yang pelbagai, dan keutamaan yang berbeza di antara pihak berkepentingan. Justeru kajian kami mengusulkan model multi-kriteria kabur sebagai mekanisma untuk mencapai keputusan bersepadu serta sesuai dengan situasi tempatan. Pendekatan linguistik

secara keseimbangan digunakan sebagai kaedah alternatif yang mesra pengguna dan sistematik berasaskan set dwikabur konflik. Model ini adalah kacukan kaedah proses analitik berhierarki kabur dan penyelesaian unggul kabur serta memenuhi analisis kesahan iaitu sikap berdepan risiko, tahap keyakinan dan juga analisis sensitiviti. Kajian kes di Wilayah Persekutuan Kuala Lumpur dan Selangor digunakan untuk menunjukkan kesahan model bagi menangani data masukan yang bersifat ketaktentuan. Dapatan menunjukkan, keputusan yang konsisten diperolehi hasil daripada analisis sikap berhadapan risiko, tahap keyakinan dan analisis sensitiviti dalam proses membuat keputusan. Justeru, model usulan kami menawarkan kaedah alternatif, mesra pengguna serta berdaya tahan sebagai mekanisma pembuat keputusan.