# **UNIVERSITI TEKNOLOGI MARA**

# ENHANCING DEA MODEL: FOCUS ON TIME-CONTROLLED PROCESSES

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Thesis submitted in fulfilment of the requirements for the degree of **Doctor of Philosophy** 

**Faculty of Computer and Mathematical Sciences** 

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### **Candidate's Declaration**

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Technologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non- academic institution for any other degree or qualification.

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#### ABSTRACT

Data envelopment analysis (DEA) models have been applied to assess the relative efficiency of decision-making units, (DMUs). Here, the research problems focused on extending the application of DEA to incorporate time as one of the variables into the model formulation. The other focuses of this research are to enhance the ranking approaches and to explore a method of reducing the subjectivity of obtaining the weight bounds. Weight bounds are an example of values used to impose weight restrictions in DEA models. To date, time has not being included as one of the variables in the DEA models formulation. This is needed when assessing the relative efficiency of processes with time controlled. The data from the clinical tests done at hospital laboratories, specifically at Seremban General Hospital were used to illustrate the extension of the application. Time was incorporated as one of the output variables into the DEA model formulated. This model was used to obtain the relative efficiency of the processes carried out. By incorporating time, the model discriminated the processes better. A Modified Cross Efficiency Matrix (MCEM) approach was introduced to enhance the two commonly ranking approaches, Andersen Petersen (AP) and Cross Efficiency Matrix (CEM). The MCEM approach introduced, based on the CEM approach, was found to give more consistent ranking results and found to be less sensitive to possible erroneous values. It was able to rank the DMU when AP approach produced the infeasible solutions. This result was illustrated by simulated data. A bootstrapping technique was used to reduce the subjectivity of selecting the weight bounds. In this way certain decision based on the decision-maker's judgment could be avoided. In conclusion, DEA model with time incorporated discriminated the DMUs better when assessing the relative performance of time-controlled processes. MCEM is a simple and better alternative approach to obtain complete ranking compared to the two commonly used approaches. If weight restrictions are needed, for cases with large sample, then bootstrapping technique can be used to reduce the subjectivity of obtaining the weight bounds.

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