# **UNIVERSITI TEKNOLOGI MARA**

# AERONAUTICAL REVENUES OPTIMISATION MODEL (AROM) FOR REGIONAL AIRPORTS VIA AIRSIDE OPERATIONS STOCHASTIC BASELINE MATRIX ANALYSIS

### WAN MAZLINA WAN MOHAMED

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

**Faculty of Mechanical Engineering** 

January 2016

### **CONFIRMATION BY PANEL OF EXAMINERS**

I certify that a panel of examiners has met on 9th July 2015 to conduct the final examination of Wan Mazlina Wan Mohamed on her Doctor of Philosophy thesis entitled "Aeronautical Revenues Optimisation Model (AROM) for Regional Airports via Airside Operations Stochastic Baseline Matrix Analysis" in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

Mohamad Nor Berhan, PhD, Ir. Professor Faculty of Mechanical Engineering Universiti Teknologi MARA (Chairman)

Wirachman Wisnoe, PhD Professor Faculty of Mechanical Engineering Universiti Teknologi MARA (Internal Examiner)

Rohafiz Bt Sabar, PhD Senior Lecturer School of Technology Management & Logistic Universiti Utara Malaysia (External Examiner)

R. Rajesh, PhD Professor Department of Mechanical Engineering Noorul Islam University (External Examiner)

#### SITI HALIJJAH SHARIFF, PhD

Associate Professor Dean Institute of Graduate Studies Universiti Teknologi MARA Date: 5th January, 2016

### **AUTHOR'S DECLARATION**

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results 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 degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student	:	Wan Mazlina Wan Mohamed	
Student I.D. No.	:	2010819986	
Program	:	Doctor of Philosophy (EM999)	
Faculty	:	Faculty of Mechanical Engineering	
Thesis Title	:	: Aeronautical Revenues Optimisation Model	
		(AROM) for Regional Airports via Airside	
		Operations Stochastic Baseline Matrix Analysis	

Signature of Student	:	
Date	:	January 2016

### ABSTRACT

Maximising revenues is one of the greatest challenges of regional airports especially after the introduction of deregulation and privatisation of airports with the increase of aggressive competition in the markets. The calculation of aeronautical revenues generation has always been considered as a straightforward method and airport managers generally overlooked on the importance of daily operational factors such as the different flight services offered at the airports, the type of aircraft airlines utilised, time of the day the flight arrives or departs, and the number of passengers the airlines ferry in and out of their airport, types of destination and how these factors influence the generation of aeronautical revenues for their airport. The first objective of this research is to measure the airside operation factors that influence the generation of aeronautical revenues deterministically. The influential variables were determined through literature reviews and case studies of regional airports in the Netherlands and Malaysia, and were validated with regression analysis. Preliminary model was developed based on the determinants and the model was analysed using Bayesian Network theory. Thus, the research is also geared towards developing a baseline matrix using stochastic approach to analyse the effect of airside operation factors on aeronautical revenues generation as the second objective. The next objective concerns with the formulation of mathematical optimisation algorithm known as Aeronautical Revenue Optimisation Model (AROM) to generate maximum aeronautical revenues for regional airport in line with the objectives of the airport. Finally, the research embarks on developing a graphical user interface (GUI) tool based on the model to estimate the possible potential aeronautical revenues that could be generated which will be useful for airport managers in their decision making. The GUI for AROM is a user friendly tool which allows airport managers to key-in the main input parameters such as mode of operations (arrival or departure), traffic types (Schedule, Business, Charter, etc.), flights details (day or night, weekday or weekend, number of passengers, international or domestic), fleet types (aircraft weight and engine type) and type of flights (domestic or international) in order to determine the composition of flight operations that produces optimum aeronautical revenues that could be achieved. Results obtained show that the maximum revenue achieved is based on flights composition, which is more focused towards certain types of traffic types with higher frequency for each of them in contrast to the current practise of offering small number of all sorts of traffic types. The model developed in this research is flexible; it allows decision makers to set the upper bound of flight constraints. The model can also be extended to include bigger sets of flight details, for example, to have day, evening and night flight instead of just day and night. Aside from that, the parameter can also be generalised such as to consider all international flights instead of domestic and international. The traffic types can also be adjusted to include shorter or longer list of traffic types to suit the airport's services.

## **TABLE OF CONTENTS**

		Page
CON	ii	
AUTHOR'S DECLARATION		iii
ABS	TRACT	iv
ACK	NOWLEDGEMENTS	v
TABLE OF CONTENTS		vi
LIST	<b>TOF TABLES</b>	х
LIST OF FIGURES		xviii
LIST OF ABBREVIATIONS		
CHAPTER ONE: INTRODUCTION		1
1.1	Background of Study	- 1
1.2	Motivation of Research	2
1.3	Problem Statement	3
1.4	Aims of the Study	5
1.5	Objectives of the Study	5
1.6	Definition of the Key Terms	6
1.7	Method of the Study	6
1.8	Scope of the Study	7
1.9	Significance of the Study	8
1.10	Organisation of Thesis	9
1.11	Summary	9
CHAPTER TWO: LITERATURE REVIEW		11
2.1	Regional Airports	11
2.2	Contributions of Regional Airports	17
2.3	Regional Airport Challenges	18
2.4	Aeronautical Revenues Resources	22
2.5	Critical Factors Influencing Aeronautical Revenues Generation	25