DEVELOPING A COST MODEL FOR RUNNING AN AIRLINE SERVICE

SSAMULA BRIDGET

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SUMMARY

DEVELOPING A COST MODEL FOR RUNNING AN AIRLINE SERVICE

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Supervisor: Professor R. Del Mistro

Department: Civil and Biosystems Engineering

University: University of Pretoria

Degree: Master of Engineering (Transportation engineering)

There are many problems facing the African airline industry, from high airfares to unnecessarily long travel times necessary for airlines to consolidate passenger traffic. From the NEPAD objective of improving accessibility within the continent, the following questions need to be addressed:

1. What is the basic minimum cost for providing an airline service on a given route?

2. Can the airfares on the market equally representative of this basic operating cost, sector length and passenger demand?

3. Can the operating costs for a route be designed optimally, such that the basic service is provided, moving air passengers from their origin to destination without compromising on the extra distances travelled, for example by choosing smaller cheaper aircraft for shorter routes?

The purpose of this study was to develop a model that would be able to estimate the cost of an airline service and analyse service level along a given route, giving various aircraft technical specifications and data relevant for different components of the cost structure.

Collecting literature necessary to understand route economics initiated the study, in the following areas:

- The costing structure of the airline service and its components.

- The information of the various components contributing to the cost including: equations, default values, technical data etc.
- Understanding the different aspects of the airline industry that affect the costs i.e. aircraft type, passenger demand, route competition, etc.

This was then narrowed down to the components of the cost structure to be focused on in the study. A review of the airline industry was done from available literature, giving insight to the operating cost components and the key determinants or indicators, which affect the operating costs.

The structure of the model was developed using the operating cost components to calculate the cost of running an airline service along a route. The cost structure adopted and the relevance of components was outlined.

The data from specified sources relevant in order for the model to compute the costs was collected and applied. In situations where the data was lacking, assumption and explanations were given. Model default values that were compiled and deemed necessary were chosen and justified, in light of their applicability to the model situation.

The results of the model were then used to analyse the route operating costs, suitable aircraft options and service analyses. Trends, graphs and tables were used to explain the above analyses, in terms of cost effectiveness, quality of service and aircraft choice. The model was then used to analyse the effect of the input components of distance and passenger number on; fleet size, operating costs and other aspects of the airline service.

Finally it was shown how the cost model could be applied to the analysis of route options for Africa (including trip generation, distribution and hubbing in which further research is required). Because of the number of assumptions in the model the results are useful in relative terms, but not necessarily in absolute terms. It compiles the operating costs and can be used to design an optimum transport service for any route within Africa.

Key words: African airlines, cost structure, operating costs components, cost model, aircraft types, passengers, sector distance, fleet size, route cost analysis, service indicators.

ABSTRACT

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The study involves, describing the nature of the airline industry, especially in the African situation with some of its problems being high airfares and inaccessibility within the continent. In order to address these problems an analysis of the minimal operating costs and challenging factors affecting route costs needs to be carried out. The aim of the study was to develop from first principles, a cost model to calculate operating costs along any route in the African continent. The costing of an airline service is reviewed through existing literature and a compilation of the structure, components and their equations and default values was done. A model structure to calculate these operating costs on a route is set up, while data is analysed to provide inputs to the model. The model is then applied to carry out an analysis of the type of service provided in terms of costs and service quality. Africa specific data is then included in the model in terms of passenger trips and sector distances and these are embedded into the model The main conclusion drawn from the study was that this model could be used to design optimally an airline service based on operating costs using existing passenger demand and sector distance. The model was applied to a route within Africa and results showing how smaller capacity aircraft even though limited by maximum range are the most economical to run along routes when the frequency of flights is high.

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DECLARATION

I the undersigned do declare that the work that has been written and produced, is my own work, all work that has been quoted, is referenced, accordingly.

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SSAMULA BRIDGET

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

ACSA = Airports Company South Africa

ASK = Available seat-km

ATA = The Air Transport Association

A320-200 = Airbus A320-200 Aircraft

A340-200 = Airbus A340-200 Aircraft

B737-200 = Boeing 737-200 Aircraft

B737-400 = Boeing 737-400 Aircraft

B737-800 = Boeing 737-800 Aircraft

B747-200 = Boeing 747- 200 aircraft

B747-400 = Boeing 747-400 aircraft

B767-200 = Boeing 767-200 Aircraft

B767-300ER = Boeing 767- 300ER Aircraft

C_{air} = Cost of one furnished airframe with spares (US$)

C_{am} = Cost per air mile

C_{eng} = Cost of the engines installed in one airframe, and the spare engines together with the engine spares holding per airframe. (US$)

C_{equ} = Equipment (including radio and radar) installed together with the spares holding of equipment per airframe. (US$)

C_{ft} = Cost of Fuel per US gallon (US$/US gal)

C_{ct} = Cost of oil for turbine engines consumed per flight hour (US$/quart)

C_{ins} = Cost of insurance (US$)

C_{sd} = Cost per hour of the depreciation of the flight equipment (US$).

C_{total} = Total aircraft cost including engines (US$)

D = Serviceable operating days in the year

Erj 135 JET = Embraer Erj 135-Jet aircraft

F_{am} = Six minutes at best cruise procedure consistent with airline practice (no credit for distance), to allow for cruise (US gal)

F_b = Block fuel (US gal)

F_{cl} = Fuel to climb to cruise altitude. (US gal)

F_{cr} = Fuel consumed at cruise altitude (US gal)

Fd = Fuel required to descend including deceleration to normal approach speed. (US gal)

F_{gm} = Ground manoeuvre fuel (US gal)

F50 = Fokker F50

GDP = Gross Domestic Product

GNP = Gross National Product

H = Usable hours in the operating day

ICAO = International Civil Aviation Organisation

IATA = International Air Transport Association

IRa =Rate/US$ value (%)

K_a = Airway distance increment

L = Depreciation period (years)

n = Number of flights per day

N_e = Number of engines

NEPAD = The New Partnership for Africa's Development

R = Mean distance per route

R_c = Distance to climb plus distance to accelerate from takeoff speed to climb speed. (Statute miles)

R_d = Distance to descend including distance to decelerate to normal approach speed. (Statute miles)

R_L = Labour Rate (US$/block hour)

RPK = Revenue Passenger-km

r_v = Residual value as a proportion of the fully equipped aircraft after the assumed life period (%).

SFC = Specific Fuel Consumption

T = Maximum Certificated takeoff thrust (Ibf)

T_{am} = Time for air manoeuvre (min)

T_b = Block time (hours)

T_{cl} = Time to climb including acceleration from takeoff speed to cruise speed (min)

T_{cr} = Time at cruise altitude (including traffic allowance)(min)

T_d = Time to descend including deceleration to normal approach speed (min)

t_f = Flight time (hours)

t_g = Average ground time at transit and terminal points

T_{gm} = Ground manoeuvre time in hours including one minute for takeoff (min)

t_l = Average time lost during take-off, climb, and descent and taxi time

ToGWmax = Maximum certificated take-off Gross Weight (Kg)

U = Average utilisation per aircraft in revenue (block hours/year).

V_b = Average block speed of the aircraft (km/hr)

V_{cr} = Average true airspeed in cruise (mph)

W_a = Basic Empty Weight of the Aircraft Less Engines (Kg)

X = Annual insurance premium rate (%)

DEFINITIONS

Aircraft-km is the distance flown by an aircraft which is obtained by multiplying the number of flights performed on each flight sector by the sector distance.

Aircraft utilisation is the average number of block hours that each aircraft is in use. This is generally measured on a daily or annual basis.

Available seat-km (ASKs) obtained by multiplying the number of seats available for sale on each flight by the flight sector distance.

Average aircraft capacity is obtained by dividing an airline's total available tonne km (ATKs) by aircraft-km flown.

Average sector length is obtained by dividing an airline's total aircraft-km flown in a year by the number of aircraft departures; it is the weighted average of sector/sector lengths flown by an airline.

Block time (hours) is the time for each sector flight or sector, measured from when the aircraft leaves the airport gate or stand (engine on) to when it arrives on the gate or stands at the destination airport (engine off). It can also be calculated from the moment an aircraft moves under it's own power until it comes to rest at its destination.

Break-even load factor (percent) is the load factor required to equate total traffic revenue with operating costs.

Block speed (km/h) is the average speed at which an aircraft will fly over a given sector. It usually takes into consideration the cruising, take-off and the landing speed.

Cabin crew refers to stewards and stewardesses.

Degree of Freedom this is a privilege that is given by one country to another before it can fly in and out of the country, or even before it can fly over a country before landing. These degrees range from the 1st the 8thdegree of freedom, depending on the agreement between the countries.

Flight or cockpit crew refers to the pilot, co-pilot and flight engineer

Length of passenger haul the average distance flown by an airline's passengers. This is obtained by dividing the airline's total passenger-km by the number of passengers carried

Operating costs per Available Tonne Kilometre (ATK) is a measure obtained by dividing total operating costs by total ATKs. Operating costs exclude interest payments, taxes and extraordinary items. They can also be measured per Revenue Tonne Kilometre (RTK).

Operating ratio (percent) is the operating revenue expressed as a percentage of operating costs, sometimes referred as the Revex ratio.

Passenger-km or Revenue passenger-km (RPKs) is obtained by multiplying the number of fare paying passengers on each flight sector by the flight distance. They are a measure of an airline's passenger traffic.

Passenger load factor (percent) is revenue passenger-km (RPKs) expressed as a percentage of available seat-km (ASKs) on a single sector; this is simplified to the number of passengers carried as a percentage of seats available for sale.

Payload capacity total aircraft capacity available for the carriage of passengers, baggage, cargo or mail measured in metric tonnes

Revenue tonne-km obtained by multiplying amount of freight charged for weight in tonnes per km of distance travelled.

Seat factor or passenger load factor on a single sector is obtained by expressing passengers carried as a percentage of seats available for sale; on a network of routes it is obtained by expressing the total passenger-km's (RPKs) as a percentage of the total seat-km's available (ASKs).

Slot at an airport is the right to operate one take-off or landing at that airport within a fixed time period.

Sector/sector distance the air route or flying distance between two airports.