

DETERMINING FUTURE DEMAND: STUDIES FOR AIR TRAFFIC FORECASTING

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Abstract: The world has seen a rapid increase in air traffic and movement of passengers in the past two decades. Within Asia-Pacific itself, the number of aircraft departures saw a growth of approximately 200% in less than 10 years [1]. Air traffic forecast models would be useful in predicting the growth of air traffic in the future, so as to facilitate the development of technology, operations and infrastructure for the aviation industry. This paper aims to study air traffic models and find the best approach for air traffic growth in Singapore. This paper applies the forecasting methodologies to predict the air traffic growth and checks the growth within region by using simulations and modeling.

Keywords: Air Traffic Forecasting, Traffic Growth, Time Series Forecasting

1. INTRODUCTION

Air transportation has seen a rapid growth each year and ICAO estimated a growth rate of 6.3% for the whole world. Within Asia-Pacific itself, the number of aircraft departures increased from more than 4,000,000 in 2006 to nearly 8,000,000 in 2014, a growth of approximately 200% in less than 10 years [1]. For South East Asia, ICAO estimated an annual growth rate of 6.7% for world passenger traffic over 2010 – 2030 [2].

This paper focuses on the detailed growth rate and amount of traffic in the future for Singapore. This study bases on the Time Series analysis. The Linear Trend Projection method and Parabolic Trend Projection method are used as forecasting methodologies to predict the air traffic growth in Singapore.

2. THE DATA

This study is not only to identify the actual traffic data but also to find the top city pair with Singapore FIR. This study

uses the Singapore 1998 to 2015 numbers of flights and 2015 June flight plan data for simulation and modeling.

3. TIME SERIES ANALYSIS

A *time series* is a set of observations measured sequentially through time. These measurements may be made continuously through time or be taken at a discrete set of time points [3]. The number of traffic to be forecasted is plotted on the vertical axis and time (year) is plotted on the horizontal axis in this study.

For this paper, the trend in air traffic growth is represented by two different types of trend curves.

- Linear Trend:

$$\mu_t = \alpha + \beta t \quad (1)$$

- Parabolic Trend:

$$\mu_t = \alpha + \beta t + \gamma t^2 \quad (2)$$

For both equations, μ_t is traffic, t is time (normally in years), and α, β and γ are constants [3].

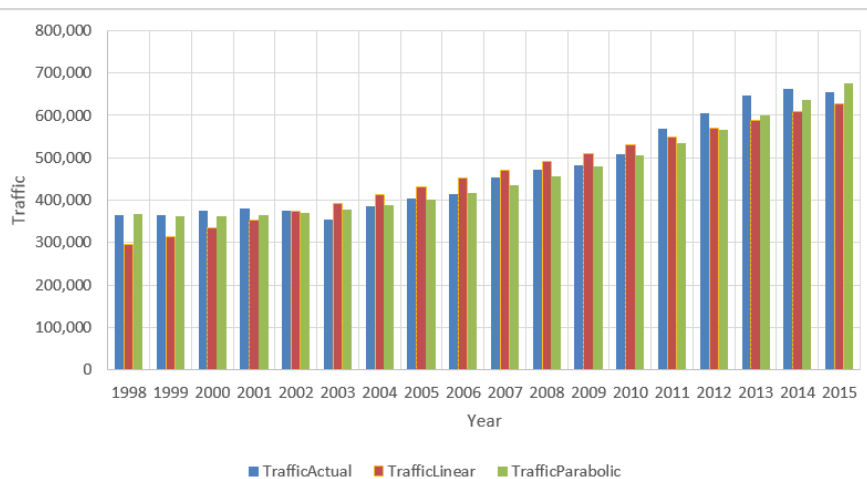


Figure 1 Singapore 18 years Air Traffic.

4. RESULTS AND DISCUSSION

Figure 1 shows the relationship between time (t) and traffic (μ_t) for Singapore air traffic from 1998 to 2015. By using 18 years of air traffic data the following relationships were obtained:

- For the linear trend,

$$\mu_t = 470,700 + 104,500t \quad (3)$$

Where 470,700 is the intercept, and 104,500 is the gradient.

current traffic and the red aircraft are additional aircraft.

Figure 4 shows the Singapore air traffic in 2030 based on 6%. The green aircraft represent the current traffic and the red aircraft are additional aircraft.

Based on 3% growth rate, this study brings top 3 city pairs out of 5. This study estimates that WSSS-WMKK has 203 aircraft movements per day, WSSS-WIII has 196 aircraft movements per day and WSSS-VHHH 115 aircraft movements per day in

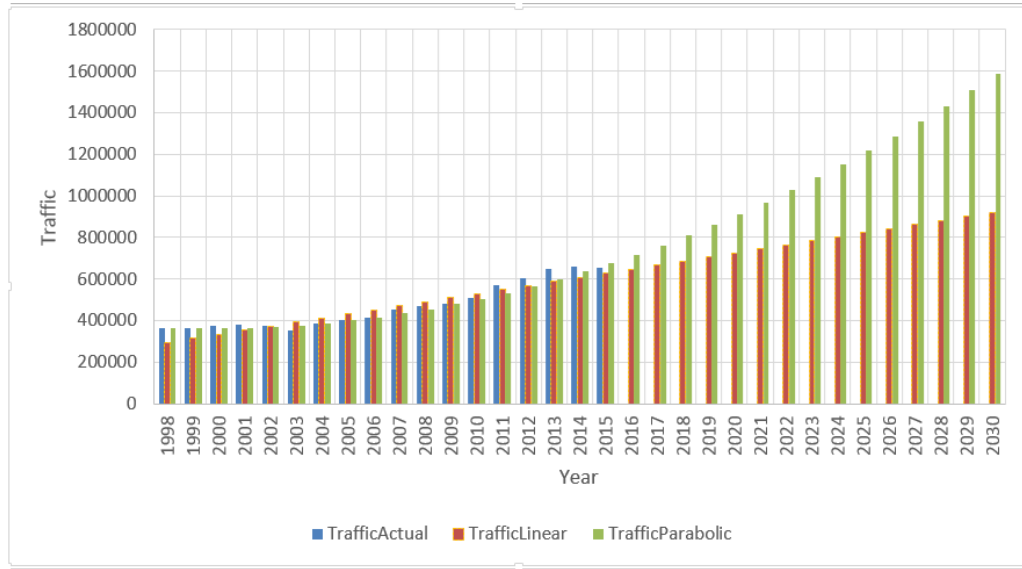


Figure 2 Singapore Air Traffic Forecast for next 15 years

- For the parabolic trend,

$$\mu_t = 37,940 \left(\left(\frac{T-2007}{5.339} \right)^2 \right) + 104,500 \left(\frac{T-2007}{5.339} \right) + 434,800 \quad (4)$$

Where 37,940 is the intercept, 104,500 and 434,800 are the coefficients respectively. 2,007 is the mean and 5.339 is the standard deviation.

As observed in Figure 1, there is a gap between the linear graph and actual traffic graph, while the parabolic graph is fairly accurate except at the mid of 2010 to 2014.

Figure 2 shows the extrapolation of air traffic using both linear and parabolic trends, up to 2030. Using the linear trend, the average annual growth rate was 3% and the amount of traffic was estimated to be 920,878 by 2030. The R-Square for this study is 0.8877.

For the parabolic trend, the average annual growth rate was 6% and the amount of traffic was estimated to be 1,589,076 by 2030. The R-Square for this study is 0.9752.

Figure 3 shows the Singapore air traffic in 2030 based on 3%. The green aircraft represent the

2030.

Based on 6% growth rate, this study brings top 3 city pairs out of 5.

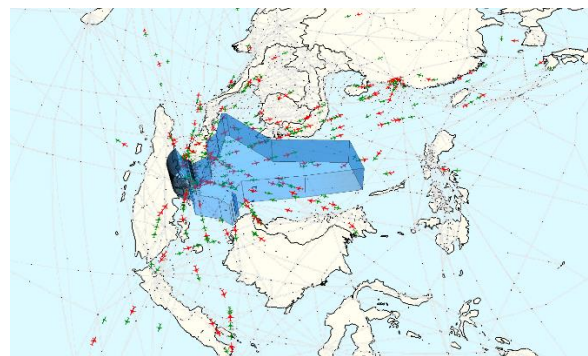


Fig.3. Singapore Air Traffic in 2030 based on 3% growth rate

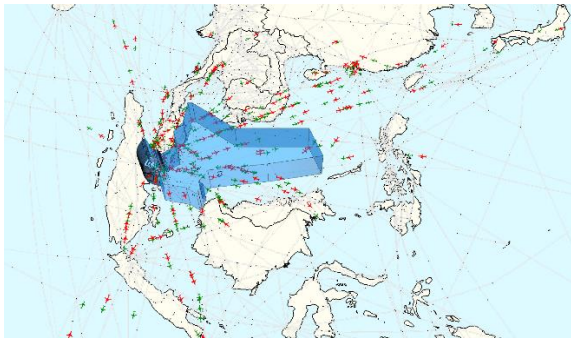


Fig.4. Singapore Air Traffic in 2030 based on 6% growth rate

This study estimates that WSSS-WMKK has 286 aircraft movements per day, WSSS-WIII has 264 aircraft movements per day and WSSS-VHHH 152 aircraft movements per day in 2030.



Fig.5. City Pair between WSSS_WMKK

Figure 5 shows the city pair scenario between Singapore Changi Airport (WSSS) and Kuala Lumpur International Airport (WMKK).

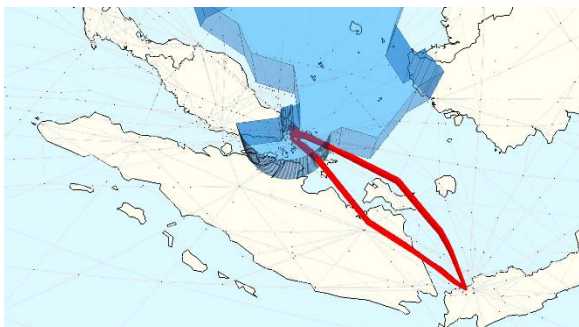


Fig.6. City Pair between WSSS_WIII

Figure 6 shows the city pair scenario between Singapore Changi Airport (WSSS) and Soekarno-Hatta International Airport (WIII).

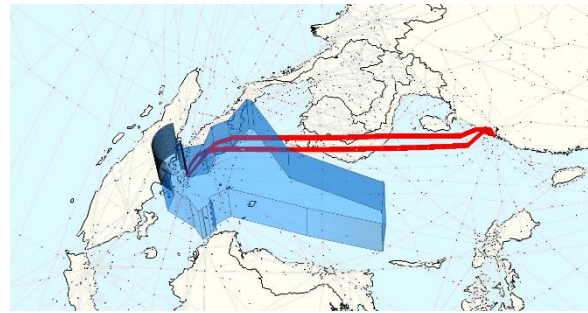


Fig.7. City Pair between WSSS_VHHH

Figure 7 shows the city pair scenario between Singapore Changi Airport (WSSS) and Hong Kong International Airport (VHHH).

CONCLUSIONS AND FUTURE WORK

The trend projection method was used to predict the air traffic growth rate and amount of traffic for Singapore in the next 15 years. Future work could target research of other methodologies to predict the traffic growth rate and traffic amount.

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