Simulation-based Capacity Analysis for a future Airport

Extended – Abstract

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1 Introduction

Nowadays the main airports throughout the world are suffering because their capacity are getting close to saturation due to the air traffic which is still increasing besides the economic crisis and oil prices[11]. These levels of high saturation can be perceived as more and more aircrafts put in holding trajectories, lack of gates when they have landed and increasing delays in airside or terminal sections in the airport. Several options appear for alleviating the congestion problem in the airports of the main capitals of the world. One of the solutions some airports are evaluating is what is known as Multi-airport Systems.

1.1 MULTI-AIRPORT SYSTEMS

A multi-airport system is the set of significant airports that serve commercial transport in a metropolitan region, without regard to ownership or political control of the individual airports[4]. The main characteristics of these kinds of systems are:

- They focus on commercial aviation.
- They focus in a metropolitan region rather than a city.
- They are market-oriented thus they leave aside the ownership of the airports.
- Normally there is one main airport with secondary ones that relieve traffic from it.

The case of London, New York, San Francisco are just some of examples of regions that use airport systems for managing the air traffic. Other European capitals such as Amsterdam is struggling nowadays for changing the management model from a single airport to a system of airports in order to accommodate hub-related and non-hub related growth of aviation in the Netherlands[10].

adfa, p. 1, 2011.

1.2 SCHIPHOL AND THE DUTCH REGION.

Schiphol currently performs 423,000 operations which corresponds to an 83% of saturation considering the declared capacity of 510,000 ATM[9]. For all these reasons the national government is interested in developing a system of airports that serve for the purpose of the region. The airports involved in the forthcoming project are Schiphol (as the main one), Rotterdam (already saturated with business, VFR and charter traffic)[10], Eindhoven which currently has only some low-cost-carriers and Lelystad which currently is not serving any commercial ones. Figure 1 illustrates the sitation of the Dutch region.

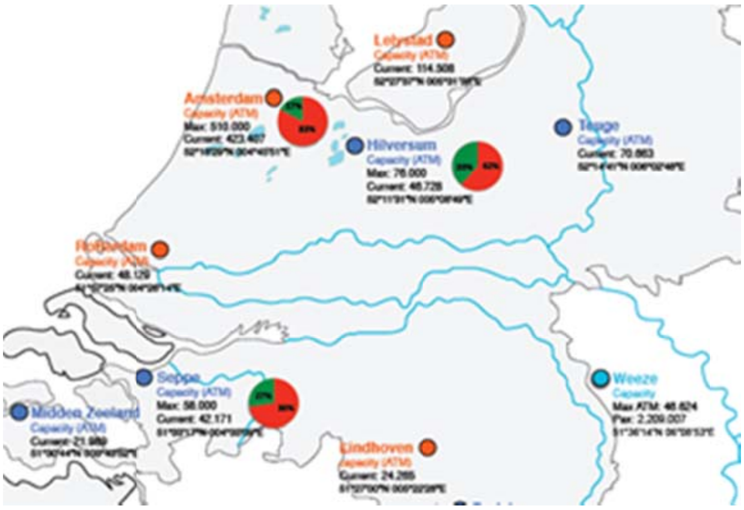

Figure 1. The situation of North Holland

2 Simulation for evaluating future capacity

The case of Lelystad airport is interesting since the local government has claimed that they are not able to foreseen what would be the performance and which kind of traffic should be diverted to which airport in order to alleviate the traffic burden on Schiphol airport. To this end simulation techniques seem to be the right ones for assessing the future performance of the airport once the traffic has been diverted.

2.1 Simulation Assumptions

Simulation is a technique that allows to evaluate actual systems or systems that are under development; the methodology is well known and it has the capacity for solving operational problems in different fields where stochasticity is a key component [1,7,6].There are also some analytical approaches to calculate the performance of a future airport [5] but the problem with these analytical models is that they are based on average values of the future traffic of the airport under study thus making static assumptions. Furthermore these assumptions are based on operation profiles that are already established thus they are not useful for assessing the performance of a future airport in an accurate way.

Due to the aforementioned problems simulation models appear to suit the characteristics needed to evaluate in a close-to-reality way the performance and help in the design of a future facility.

For the development of the model there are operative restrictions that are known beforehand and that can implemented in the model. Other restrictions and characteristics should be assumed and other are developed taking into account historical data. The following table presents the three type of assumptions made for the model [3].

Table 1. Technical restrictions for the simulation model of Lelystad Airport

Separation Minima between aircraft:		
A-A (Arrivals-Arrivals)		
Leading aircraft	Trailing aircraft	Separation distance (nmi)
Heavy	Heavy	4 nmi
	Large	5 nmi
	Small	6 nmi
Large	Heavy	3 nmi
	Large	3 nmi
	Small	4 nmi
Small	Heavy	3 nmi
	Large	3 nmi
	Small	3 nmi
A-D (Arrivals-Departures)	Clearance for takeoff run of the trailing departure is granted after the preceding landing id clear of the runway	
D-D (Departures-Departures)		
Leading aircraft	Trailing aircraft	Separation time (s)
Heavy	Heavy	90 s
	Large	120 s
	Small	120 s
Large	Heavy	60 s
	Large	60 s
	Smal	60 s
Small	Heavy	45 s
	Large	45 s
	Small	45 s
D-A (Departures-Arrivals)	The trailing arrival on final approach must be at least 2nmi from runway when departing	

	aircraft begins its takeoff run, and cannot touch down until departing aircraft is clear of the runway.
Operational time:	Lelystad airport is open from 8:00 to 21:00 (mon-fri), and from 9:00 to 19:00 (sat-sun).
Weather Limits:	
Cross Wind	<= 37 km/h
Cross Wind when runway surface is wet	<= 24 km/h
Visibility:	
For Approach	>= 750 m
For Takeoff	>= 250 m

Table 2. Historical Data and modeler assumptions

Historical Data	
Data for wind, visibility and precipitations have been gathered and analized for the region during 2013. Distribution curves have been generated based on the data.	
The flight schedule of one week of 2013 has been taken and assumed that is the same during the year.	
Modeler Assumptions	
Length of runway:	The length of runway is 2100m and not the current 1250 m since the government will expand it the coming years.
Taxiways:	The number of exits and the type of exits it has been assumed as three 90° exitways. In some scenarios it has been tested the usage of different exitways (e.g. high speed).
Mix of aircraft:	It has been assumed that the aircrafts hosted by the airport will be mostly LCC (A-320 or B-737).
Noise:	It has been assumed that there will be no noise limits.
General Aviation:	General Aviation Activity doesn’t affect the runway usage.
Aircraft routes in the Airspace:	Aircraft routes allowed to fly to and from Lelystad.
Airspace Sector in which Aircrafts fly:	There aren’t restrictions in the Airspace sectors in which Aircraft fly.

The model has been developed using a DES simulation software and the mentioned restrictions have been implemented taking into account the future developments and also the weather of the region where the future airport will be developed. Figure 2 illustrates the developed model.

Figure 2. Snap Shot of the Airport Model

3 Scenarios and Results

IN CASE OF BEING ACCEPTED THE CORRESPONDENT RESULTS AND SCENARIOS WILL BE ADDED AND DESCRIBED IN THIS SECTION.

4 Conclusions

It has been presented the model of a future airport; in particular the regional airport of Lelystad will be expanded in the coming years for relieve Schiphol airport from the congestion it is currently suffering. The model was developed taking information from the current traffic in Schiphol and evaluating the conditions at which it will operate in the future. Some scenarios were developed in order to get insight about the kind of traffic that should fit in the future characteristics of the airport. There are more restrictions that must be taken into account but the simulation model will serve as an initial step to have an intelligent design and perform a better decision-making process once the time to divert the traffic from Schiphol to the regional airports approaches.

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