Journal of Air Transport Management 46 (2015) 40–48

Contents lists available at ScienceDirect

Journal of Air Transport Management

journal homepage: www.elsevier.com/locate/jairtraman

Is increasing aircraft size common practice of airlines at congested airports?

Peter Berster, Marc C. Gelhausen*, Dieter Wilken

German Aerospace Center (DLR), Institute of Air Transport and Airport Research, Linder Hoehe, 51147 Cologne, Germany

ARTICLE INFO

Article history:
Available online 7 April 2015

Keywords:
Airport capacity
Airport utilisation
Airport congestion
Average seat capacity
Causal factors of average seat capacity development

ABSTRACT

If the overall demand for air transport grows, but additional airport capacity is not available at congested airports, we could assume that airlines will offer flights with more seats in order to cope with the demand. An analysis of frequency and average seat capacity developments at congested, and not yet congested airports, has shown that the hypothesis of bigger aircraft being used in congested situations is valid in most instances, although not at all airports. The objective of this paper is to report on an analysis of the development of average seat capacity at congested airports, in contrast to the situation at not yet congested airports, and to find out the reasons for airlines increasing the number of seats at congested airports, by means of a statistical model using variables including the degree of airport congestion and average flight distance.

1. Introduction

Capacity constraints analysis of the global airport system has shown that in 2008 only a small number of airports were congested, including important airports such as London Heathrow, New York La Guardia and Paris Charles de Gaulle. Overall, 10 airports were identified as highly capacity critical airports (Gelhausen et al., 2013):

- San Diego (SAN),
- Shanghai (SHA),
- Shenzhen (SZX),
- London Heathrow (LHR),
- Mexico City (MEX),
- New York La Guardia (LGA),
- Barcelona (BCN),
- Charlotte (CLT),
- Frankfurt/Main (FRA), and
- Paris Charles de Gaulle (CDG).

These airports have high peak-hour traffic volumes and values of the so-called capacity utilisation index (CUI) of more than70.[1] These 10 airports handle about 6% of all flights worldwide, which indicates that the great majority of flights operate under unconstrained conditions. According to the market forecasts of the aircraft manufacturers and international organizations such as ICAO, we have to assume that the number of flights will increase in the future, although probably not as much as passenger traffic measured in revenue passenger kilometres (RPK). However, given a long-term growth rate of around 5% for traffic development (Airbus, 2010; Boeing, 2012; Teyssier, 2010), a growth rate of 3% for the flight volume does not seem implausible (ICAO, 2005; ICAO, 2012; Eurocontrol, 2008). Therefore, the number of flights will grow by about 30–40% in 10 years. Airport capacity analysis has demonstrated that traffic conditions at airports, which were still favourable in 2008, will soon deteriorate since many more airports will suffer from bottleneck situations. The majority of flights in the airport network worldwide will be affected by capacity constraints.

The impact of capacity constraints on flight activities can be mitigated by capacity enhancing measures, such as new runways, or demand management measures. Investment options, such as new infrastructure, are increasingly subject to public opposition, especially in Europe, since the residents in the vicinity of airports are against higher levels of noise pollution due to increased aircraft movements. Interconnecting high-speed and regional

* Corresponding author.
E-mail address: Marc.Gelhausen@dlr.de (M.C. Gelhausen).

[1] Capacity utilisation index is defined by the ratio of average daytime hourly flight volume and the 5% peak hour volume in 2010 for each airport.

http://dx.doi.org/10.1016/j.jairtraman.2015.03.012
0969-6997/

trains with airports is another investment option that relieves the pressure on short distance flights. However, this solution is also becoming more opposed by the affected population. In the meantime, demand management is gaining more acceptance as an alternative or a complementary measure to capacity expansion and enhancement through reorganizing traffic patterns. The following provides a brief discussion of some potential demand management approaches:

- Pricing schemes, for example, peak-period pricing or congestion pricing. However, such pricing schemes are often difficult to realise effectively due to price regulations imposed on the airports (e.g., Charlton, 2009).
- Using off-peak times more intensively: at hub airports this is only feasible to a small degree, since inbound and outbound flights are generally closely coordinated (e.g., Button, 2002).
- Based on technological progress, changing air traffic control (ATC) rules in order to augment the throughput of aircraft movements: this measure will raise capacity probably to a degree which corresponds to the traffic growth of just a few years.
- Substitution of short-distance air travel by high-speed trains: this measure is only effective for short-haul routes between areas of dense population like Europe and is of limited potential to mitigate congestion at airports.
- Diverting traffic to less congested airports: is often contradictory to the demands of passengers and hub operations (e.g., Dennis, 1994).
- Using aircraft with a higher seat capacity: this may lead to additional congestion at terminals or on the apron.

Strengthening the high-speed network between large urban agglomerations is a measure used to ease the pressure on airports and reduce the level of unaccommodated demand at congested hub airports. The continued improvement of the high-speed train network in Europe will lead to a reduction in demand for air travel, and consequently the number of flights by 0.6% in Europe by 2035, depending on the efforts taken by the member countries (Eurocontrol, 2013). High-speed trains have had significant impacts for some city-pairs. For example, with the opening of the ICE train service between Cologne main station and Frankfurt airport (a distance of 177 km, travelled in 70 min), air services between Cologne and Frankfurt airport were discontinued. Since the opening of the Madrid-Barcelona high-speed service in 2008, 40% of the traffic between those two cities was captured by the high-speed train service (European Commission, 2010). Nevertheless, as a measure to mitigate airport congestion, high-speed trains are only of limited value, typically because it is limited to short- to medium-distance continental travel. Indeed, high-speed train access at an airport tends to reduce short-haul feeder flights, but also increases the catchment area of an airport at the trip origin or destination, respectively (Gelhausen et al., 2008).

Diverting traffic to less congested airports and a “division of work” between various airports in a metropolitan area is not optimal from the view of hub operations (Dennis, 1994), but this measure is employed quite frequently. In many cases, traffic distribution among the airports in a particular metropolitan area is historically set, such as the cases of Paris Orly and Charles de Gaulle in Paris or Haneda and Narita in Tokyo. Other examples include Frankfurt and Munich, London Heathrow and Gatwick, New York JFK and La Guardia, as well as the airports of Rio de Janeiro and Sao Paulo. Often, the “newer” airport in the area has a longer runway system and focuses on long-haul international traffic, whereas the “older” airport handles more short-haul domestic/continental traffic. This is reflected by the average stage length of flights to/from these airports. For example, average stage length of flights is 3010 km at London Heathrow and 1668 km at London Gatwick (OAG, 2012). Of course, the extent of differences in stage length varies, but is consistent throughout. Congestion is typically quite high at both types of airports, but not necessarily at the same level. For example, congestion at New York La Guardia is considerably higher than at New York JFK (CUI value of 0.76 at LGA vs. 0.67 at JFK).

Diverting traffic to secondary airports becomes less attractive if the secondary airport is too far away from the origins of demand, as the examples of London Stansted and London Luton show: these airports are mainly served by low-cost and charter carriers but not by British Airways. Despite the distance between the airports, Frankfurt and Munich are a different story, as both airports have a strong catchment area. Nevertheless, Lufthansa has started to relocate international flights from Munich back to Frankfurt, after the opening of the fourth runway at Frankfurt airport.

Using bigger aircraft and aircraft with a higher seat density are measures that airlines use to varying degrees depending on factors such as the level of airport congestion, fleet, network structure, competition with other airlines, etc. This paper focuses on this measure and reports on a statistical analysis regarding the development of average aircraft size, i.e., the number of seats per flight at constrained and unconstrained airports worldwide, as well as in world regions. A model has been developed that relates average aircraft seat capacity to causal factors, such as the degree of airport congestion and average flight distance. The results indicate that airport capacity is primarily constrained by the airside, especially the runway system, and not the landside, i.e. the terminal ground access, etc. This stems from the fact that, in many cases, the most critical element of airport capacity is the runway system, since airport expansion planning often requires the involvement of the public, who are most likely to oppose to new runways to protect their neighbourhood against increased noise emissions (Wilken et al., 2011).

The paper is organised as follows: Chapter 2 describes the methodology for the selection of constrained and unconstrained airports to be included in the analysis. Chapter 3 analyses the development of average seat capacity at capacity constrained airports versus unconstrained airports from a global perspective and from the point of view of different world regions. Chapter 4 takes a look at airport-specific developments of average seat capacity. Chapter 5 addresses factors that lead to increasing average seat capacity per flight, and an econometric model of average seat capacity, along with some sensitivity analyses follow in Chapter 6. The paper finally concludes with a brief summary and some conclusions.

2. Selection of sample constrained and unconstrained airports

A working hypothesis at the outset of the analysis was: airlines that want to serve a growing market increase their capacity by offering more seats on existing routes, as well as new routes (ICAO, 2008). At congested airports, airlines would do so by deploying bigger aircraft and at uncongested airports they would first increase the number of flights. Capacity constraints would hinder airlines from increasing frequencies, whereas at airports with a capacity surplus, airlines would prefer to offer more flights in order to better comply with the needs of travellers, in particular, the needs of business travellers.

Our analysis of the development of the average seat capacity of flights offered should then differentiate between congested and uncongested airports; however, it would not necessarily have to include all airports worldwide. The global air traffic network consists of several thousand airports, most of which handle only small