

A model for measuring Airport competitiveness: The case of Zurich Airport

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This paper focuses on hub airport competition for airlines and for transfer traffic but not for origin – destination passengers. There is an ongoing discussion about airport competitiveness and factors used to measure and compare competitiveness of airports. The question raised addresses whether the competitiveness of airports can objectively be compared and which implications can be derived with respect to the case of Zurich Airport, the hub of Switzerland. Therefore, the authors develop a comprehensive model of airport competitiveness based on five main factors: environmental factors, demand factors, managerial factors, facility factors and service factors. To assess its competitiveness, Zurich Airport is compared with seven European competitors for transfer traffic. Among eight airports Zurich Airport is ranked fifth. The most competitive airport thereof turned out to be Schiphol, followed by Paris CDG, London Heathrow and Frankfurt. The results show that the competitiveness of Zurich Airport is inhibited through the strict regulations for capacity extensions, operation hours and the regulations regarding noise. As growth at Zurich Airport is limited due to capacity restrictions, it is questionable if the airport will be competitive in the future.

KEYWORDS: airport, competitiveness, Zurich, regulation, capacity.

CLASSIFICATION: Airport Management

1. Introduction

In the recent years, airports were mostly seen as natural monopolies, and thus the topic of airport competitiveness has typically not received much attention in literature and research. However, Graham describes how the traditional view of airports as natural monopolies has been increasingly questioned. Airport commercialisation and airline liberalisation were the main drivers of this change (Graham, 2010).

Hsin Lin (2006) argues that the growth of hub-and spoke networks has increased the competition between hub airports in many areas in the world, especially in Europe and Asia. The reason is that network carriers use the hub airports as points of intersections of their international hub-and spoke network. That leads to the result that competition among network carriers also entails competition among their hub airports. Following this argument, the most important competitors of a hub airport are the airports that are being used as hubs by the competitor network carriers of a hub airport's carrier (Rürup & Reichart, 2014).

But there is also a second kind of competition between hub airports. It is due to an increasing number of multi-hub carriers such as Scandinavian Airlines or Lufthansa. They decided to operate more than one hub. That gives these airlines the option, at the margin, to switch between airports, and also to increase their bargaining power over the airports (Bush & Starkie, 2014). Because Swiss Airlines, the main carrier at Zurich Airport, is part of Lufthansa, Zurich Airport competes with the other hubs in the "Lufthansa family". Also, totally new hubs have appeared in the landscape. Istanbul Ataturk and Middle Eastern hubs have increased the competition for European hub airports even more (Bush & Starkie, 2014).

Many studies concentrate only on the home passenger market and the competition among airports in the same catchment area. This work, however, mainly focuses on the competition among airports in different catchment areas. It is certain that Zurich Airport competes with airports in the same catchment area such as Basel Airport or even the airport in Geneva, even though Basel and Geneva Airport are no hub airports. But Zurich Airport as a middle-sized hub in Europe also competes with other hubs within Europe, because hub airports compete against other hubs for connecting traffic and not only local passengers (Fröhlich & Niemeier, 2011). That is to say that we focus on the competition of airports for airlines.

After having explained that airports cannot be seen as natural monopolies in a market without competition any more, another important question arises: *How can the competitiveness of hub airports be compared and which implications can be derived for the success of Zurich Airport?*

In order to compare the competitiveness of hub airports we elaborate a framework that we apply to the example of Zürich Airport and seven competitors for transfer traffic: Paris CDG, Munich, Frankfurt, Vienna, Istanbul Ataturk, London Heathrow and Amsterdam.

Despite initial enjoyment about the opening of Zurich Airport in 1948 in Kloten, the first complaints about noise emissions already came along in the 1950s with the operation of jet aircrafts. Attempts of Zurich Airport to reduce noise emissions through optimized departure and arrival routes and technical development in the area of jet engines were mostly compensated by the increase in air traffic.

After the failure of the inter-country treaty between Germany and Switzerland in 2003, the airport had to change its departure and arrival routes significantly; Germany heavily limited the north-approaches to Zurich airport in the morning and evening hours. Thus, an increased number of east-approaches on runway 28/10 and the introduction of south-approaches on runway 34/16 led to a dramatic increase in noise emissions for the surroundings of the airport (Gfeller, 2006). The noise problematic at Zurich Airport has led to the result that Zurich has the strictest curfews among all its competitors in Europe and also the current and expected costs for noise compensations and abatement are very high (Intraplan, 2015).

Airports play a key role for the attractiveness of business locations. Transportation hubs are necessary to foster commerce activities and to satisfy the commuting needs of modern day population, but unfortunately they also cause numerous damages such as air-pollution and noise. Sari says that noise is the most significant factor to affect the growth of air transportation in the world (Sari, Ozkurt, Akdag, Kutukoglu, & Gurarslan, 2014). This leads to a trade-off between growth and damage to population. International companies depend highly on frequent and good international connections. In Switzerland, about 180'00 workplaces depend on the aviation sector and the aviation sector produces an added value of 28 billion Swiss Francs (Economiesuisse, 2011). The question is if Zurich can cope with the competition with other hub airports in Europe and is able to offer the necessary connectivity to the city of Zurich and the whole of Switzerland.

2. Literature

2.1 Increasing Competition between Hub Airports

Air transport used to be one of the most regulated and nationally controlled industries in the world. (Debbage, 1994). But in the 1970ies started an era of deregulation of international air-transport that lead to the creation of low-cost airlines and international airline alliances (Wittmer & Müller, 2009). Barrett (2000) says that this deregulation made also possible the entry of new passenger airports in the aviation market and that the increased competition led to a higher efficiency of airports and airlines. D'Alfonso et al. argue that the competition between airports in Europe has increased on several levels: The deregulations have not only led to more competition but also decreased average fares, increased frequency and new routes services (D'Alfonso, Jiang, & Bracaglia, 2015).

To sum it up three major changes are driving the competitive constraints for airports: more choices for passengers, more footloose airlines and more active responses from airports. Bush and Starkie (2014) add another driver of competitiveness - transfer choice of passengers. However, airports are still too often regarded as 'monopoly infrastructure providers'. For policy makers it is hard to catch up with the fast changing aviation market (ICAO, 2013).

2.2 Measuring Airport Competitiveness

According to Rürup and Reichart (2014) a company in the aviation sector is only competitive if it is able to increase its market share or can at least maintain it. They say that the intensity of competition is higher, the bigger the share of transfer passengers. Transfer passengers in general have a larger choice of different route options where to change airplanes.

Park (1997) makes an analysis of major airports in Asia using fuzzy linguistic approaches. His approach is one of the most comprehensive – he analyzes the airports' competitiveness based on eight different factors (Park, 1997). In his article "*An analysis for the competitive strength of Asian major airports*", Park (2003) makes an analysis of the competitive strength of Asian major airports.

Yeo, Wang, and Chou (2013) argue that to measure a concept such as competitiveness is more suited to use a qualitative than quantitative methodologies because the values of the criteria are often very imprecise. Yeo et al. compare a list of 15 criteria that influence the competitiveness of airports such as the airport access modes, environmental sustainability, regulation policy and more (2013).

Grancay evaluates competitiveness of airports and establishes an Airport competitiveness index (Grancay, 2009). One of the main factors in his model is the infrastructure. He argues that there are two kinds of infrastructures: ground infrastructure and airport infrastructure. The airport infrastructure consists of taxiways, runways, ramps, terminals and other facilities in direct control of the airport. The second part, the ground infrastructure consists of the road and rail network connecting the airport to the metropolitan areas in the region (Grancay, 2009).

Cui, Kuang, Wu, and Li (2013) argue that airport competitiveness has multidimensional and complex characteristics. The major factors in their model are the regional influence, the own strength, and the market condition (Cui et al., 2013). Quite a different approach have Oum, Yu, and Fu (2003). They compare 50 major airports and focus more on productivity than on competitiveness (Oum et al., 2003).

Burghouwt and Veldhuis (2006) argue that to measure the connectivity in hub-and spoke networks it has to be taken in consideration both direct and indirect connections (Burghouwt & Veldhuis, 2006). They say that the three large global alliances choose one or two hubs at each continent to function as primary intercontinental gateways. Other hubs fulfil secondary, regionally oriented

roles. In another article of 2009 Burghouwt et al. measure the competitive position of primary airports in the Asia-Pacific rim (Burghouwt, de Wit, Veldhuis, & Matsumoto, 2009). Another contribution about Asia is from Lee and Yang (2003), which shows options to improve airport competitiveness using a regional cluster model. Factors that influence competitiveness are the market potential of the surrounding area, the possibility of expansion and the airport charges (Lee & Yang, 2003).

Teraji and Morimoto (2014) focus on price competition between airports and on their effect on airline networks. In their model the airline can choose between two models of its network configuration: point-to-point or hub-and-spoke. The airports can only compete for airport charges (Teraji & Morimoto, 2014). Hsin Lin (2006) focuses on the economic effects of the non-price competition between the hubs. Hsin assesses the trade-off situation between the length of the connecting time and the consumption opportunities of the passengers at the airports (Hsin Lin, 2006). On the one hand the connecting time at has a negative effect on the transfer passengers, simply because they have to wait longer. Thus the airports and airlines have incentives to minimize the connection times for their passengers. On the other hand shortening the length of the connecting times decreases the passengers' opportunities for consumption and this leads to a reduction of the airport's revenues from its concession activities (Hsin Lin, 2006).

3. Research Approach

3.1 Framework to measure Airport Competitiveness

Our framework to measure competitiveness of airports has similarities with the model developed by Park (2003). This model appears to be the most comprehensive and convincing that can be found in the literature review. Other models focused on certain factors of competitiveness such as profitability, or price-competition, but Park's model is much more comprehensive; It is based on five main factors: Spatial factors, demand factors, managerial factors, facility factors and service factors and each of these factors consists of so-called sub factors. The methodology he uses is very different from most other authors. The method of ranking and weighting of many different factors is quite unique for comparing airport competitiveness. It is based on the multiple criteria decision-making (MCDM) technique. Unfortunately, the article by Yongwha Park presents some major flaws: Firstly there are mistakes in some of the tables. In "Table 1 Degree of importance of each of the five core factors" Park (2003) it seems that Park slipped the total score of the "service factor" (63) with the total score of "demand factor" (85). Secondly, Park does not explain why he has chosen which sub factor for his model. Also, he does not explain well how he measures and calculates which factor.

Although we consider Park's model very convincing our model is quite different from Parks: In our model, we altered certain factors such as Parks spatial factor, which we changed with an environmental factor. We also changed nearly all sub factors to be able to include aspects that are highly important for airport competitiveness and to leave out other factors that do not have a big influence. For example, we added the delay at the airports but excluded the terminal space per passenger from the service factor. Figure 1 shows are new model with all factors and sub factors. To choose our factors we conducted an expert interview¹ and an extensive literature review, to see if there exists empirical evidence on the influence of the factors for airport competitiveness. In the following subchapters each factor and their sub factors are explained shortly.

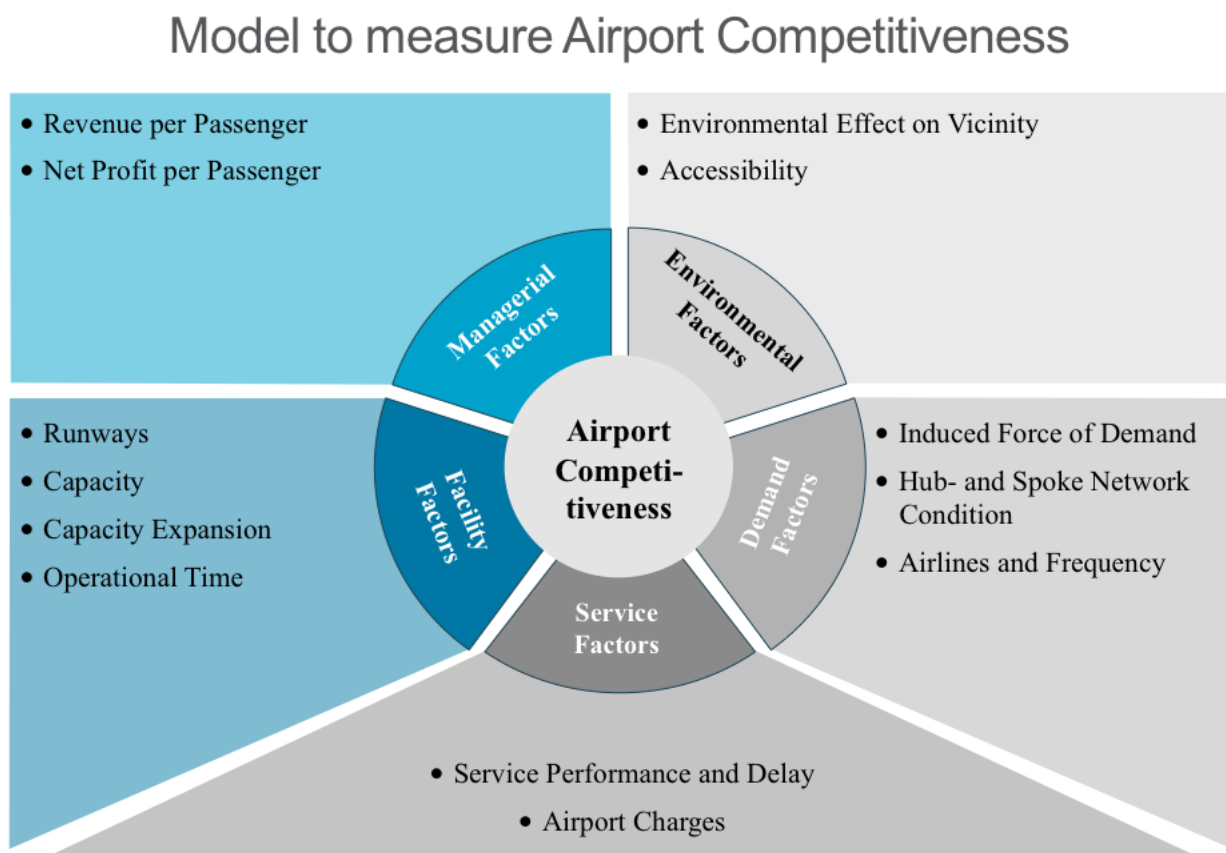


Figure 1 Framework to compare airport competitiveness

¹ The expert interview was conducted with Felix Keller: "Head of Regulatory Affairs" of Zurich Airport.

3.1.1 Environmental Factors

The environmental factor is measured using the two sub-factors environmental effect on vicinity society and accessibility to the airport. To measure the environmental effects of an airport on its vicinity society we have measured the current and expected costs of noise abatement and compensations if paid by the airport.² According to Sari et al. noise is the most significant factor to impede the development of air transportation in the world (Sari et al., 2014). Firstly the costs for mitigation and compensation of aircraft noise are an important cost driver for airport charges and thus also ticket prices and secondly the noise can be a reason to reduce the operational hours of an airport and hinder infrastructure projects.

The sub-factor accessibility consists of two main parts: the distance to the city centre (linear distance) of the next adjacent city and the connection by public transportation, which is measured by the number of buses and trains per year per passenger.³ Conventz and Thierstein (2011) argue that it is crucial for airports to be close to the city centres because that means that the airport is closer to its customers. So we ranked the airport closest to the city centre first and the one furthest away was ranked last.

3.1.2 Demand Factors

The demand factor consists of three sub-factors: the number of airlines and frequency, the hub-and-spoke network condition and the induced force of demand.⁴ The sub-factor number of airlines and frequency also contains the number of destinations that were served with more than five flights per week at each airport. Although, in recent years, airlines are more ‘footloose’ and have gained bargaining power in their negotiations with airports, they face high costs when switching airports. And these costs are even higher for airlines with a hub or base at a given airport (Wiltshire, 2013). The sub-factor induced force of demand consists of the purchasing power and the travel behaviour. The purchasing power was measured with the GDP per capita of the countries where the airports are situated.⁵ This is a very important factor as the passengers’ preference to travel from their local airport is very strong (Wiltshire, 2017). It was found that for every 1% increase in distance the likelihood of passengers flying from a certain airport decreases by 4% (Wiltshire, 2013). To compare the travel behaviour an additional factor called “willingness to fly” was added. It is the numbers of passenger boarding and exiting a plane in a year per inhabitant of a country. The hub-

² For AMS, MUC, FRA, VIE und ZRH the data is based on the report of Intraplan (2015), for CDG, LHR, FRA on data from the UK Civil Aviation Authority (2014) and for IST from a report by Boeing (2015).

³ To measure the number of public transport connections we were able to use “verkehrsmittelvergleich.de/at” for VIE, MUC, CDG, FRA and AMS. ZRH offers a statistic about the number of buses and trains in Zahlen und Fakten (Zürich Flughafen, 2015). For IST we counted all the bus connections according to the airports homepage and for LHR we had to make an estimation based on the share of public transport, number of buses, trains and subways that connect it to the surrounding area.

⁴ The data about the number of airlines, frequency and the hub-and-spoke network condition is taken from the airports official websites.

⁵ For the GDP we used the numbers from the World Bank (2015).

and spoke network condition is based on two components: 1) the index DJ^6 , which measures the feeder routes at an airport and 2) the number of long-haul flights per week for each airport. The average rank of these two components results in the sub-factor hub-and spoke network condition.

3.1.3 Service Factors

The service factor consists of the two sub-factors service and delay performance and the airport charges. The factor service and delay performance consists of two more parts: the Skytrax 2015 World Airport Awards and the departure delays at each airport. For the delay performance the average of the January 2016 and June 2013 on-time flights at each airport were used.⁷ For the airport charges we have compared the airport charges for an Airbus 330-300 at each airport according to the (Intraplan, 2015).

Although our framework compares the competitiveness of airports from the view of competition for airlines, it is still important what the passengers think of the airports as they might not want to board or have a stop-over at an airport that offers poor quality services and long delays. That is why we included the Skytrax World Airport Awards that is based on a customer survey about the services offered at an airport.

3.1.4 Managerial Factors

The managerial factor has the two sub-factors net profit per passenger and revenue per passenger. To have a better comparison the revenues, profits and also passenger numbers for two years (2013/2014) were used.⁸ We use these two factors to measure the profitability of the airports. We think it is important to measure the airports profitability, as in the long run an airport is only competitive if it is able to create profits. And profits are crucial for new investments such as new airport infrastructure.

Different than Park (2003) we did not include the type of airport operation (public or private) in our model, because the effect of privatization on airport competitiveness is not at all clear. For example Forsyth (1984) argues that “selling a government firm makes no difference to the competitive environment it operates; ownership and competitive structure are separate issues”. Liebert and Niemeier (2013) conclude that the effect of privatization is quite controversial. While

⁶ $DJ = (F^a_w + rF^b_w) + (N^g_c + rN^h_c)$

F^a_w is the rank of flight frequency per week in 2000 km air-route range; rF^b_w is the frequency rate rank within a 2000-kilometer air route range out of total frequency; N^g_c is the number rank of air route connecting cities within a 2000-kilometer distance; rN^h_c is the number rate rank within 2000-kilometer distance out of total connecting cities)

⁷ The data is from a Flightstats (2013) for June 2013 and from the Airport delay tool of Flightstats (2016) for January 2016.

⁸ The data is based on the public annual reports from the airports.

some studies found a positive effect of privatization on factors such as cost-efficiency others found no improvement.

3.1.5 Facility Factors

The facility factor consists out of four sub-factors: capacity, capacity expansion, operational time and runways. The capacity of the airports is measured as current and planned air movements per hour⁹. The capacity expansion is measured as the possibility of a future expansion.¹⁰ To compare the airports operational times we cannot just use the hours an airport allows for flight movements, because the restrictions are much more complicated. There are many different restrictions at an airport that differ in their severity. The strictest regulation is a comprehensive curfew, followed by fixed limits of slots or air movements, noise load quota or noise quota, the closure of certain runways at night, the limited use of noise aircraft or limits to deviations from airways (Wubben & Busink, 2004). The airport with the longest operational hours and the least regulations was ranked first, the one with the strictest regulations last.

For the measurement of the number of runways we made three “sub-rankings”, of which we took the average ranks and ranked them again. One “sub-ranking”, is the number of runways, the second is the number of runways suitable for intercontinental flights (longer than 3000 meters) and the third the existence of a parallel landing system.¹¹

3.2 Weighting of the framework factors

To find out the importance (or weight) of each factor in the framework we first calculated the weight for each sub factor. For this experts were asked to give a weight of importance for airport competitiveness for each sub factor. A weight of 5 means high importance for airport competitiveness, whereas a weight of 1 means low importance. For the weighting 19 experts were interviewed: The respondents were from airlines, airports, civil aviation authorities and other organizations from the aviation industry. To calculate the average weight for each sub factor the sum of the weights were divided by the number of answers received for each sub factor. The following figure shows the weighting of the sub factors.

⁹ The data is based on the Intraplan (2015) report.

¹⁰ The Intraplan (2015) report divided the airport expansions projects of European airports in three categories that we used for our framework: Category 1 (current capacity allows for future growth), category 2 (current capacity does not allow future growth but new capacity is in construction or planned) and category 3 (no future growth in sight due to lack of capacity). We ranked the category 1 airports as first and category 3 airports as last in the ranking.

¹¹ The data is based on the Intraplan (2015) report.

	Respondents																				
Sub-factor	Airlines			Airports												Regulators			Other		Sub factor weight
	Helvetic	Swiss	Avianca	MUC	IST	FRA	ZRH AM* PG	ZRH AM* LA	ZRH AM* NG	ZRH AM* RH	ZRH AM* SW	ZRH AM* IW	ZRH AM* TB	ZRH Regulatory Affairs	BRN	FOCA	CAA	Slot Coordination Switzerland	Swiss Aerodromes Association	Sum of the weights divided by number of answers	
Environmental effect on vicinity	5	1	4	2	1	1	2	3	1	3	2	2	1	2	4	3	3	2	2,5	2,34	
Accessibility	5	4	5	3	5	4	4	4	3	4	3	2	2	3	3	3	4	4	5	3,68	
Number of airlines and frequency	4	4	2	5	5	5	5	4	5	4	5	4	5	4	5	5	4	3	n.a.	4,33	
Hub-and spoke network	4	5	2	4	4	5	5	3	5	5	5	4	5	3	4	5	4	n.a.	n.a.	4,24	
Induced force of demand	4	5	3	5	4	4	5	5	4	4	3	3	1	4	3	3	3	4	5	3,79	
Service performance	3	4	4	3	3	1	2	3	3	4	4	1	3	2	5	4	3	4	5	3,21	
Airport charges	4	5	5	5	3	2	2	2	2	3	3	2	2	1	5	4	3	3	5	3,21	
Revenue per passenger	4	5	5	4	3	4	3	1	3	4	2	3	1	3	3	5	4	n.a.	5	3,44	
Profit per passenger	5	5	3	4	3	5	4	2	4	4	2	3	1	5	3	5	3	n.a.	5	3,67	
Runways	2	5	2	4	5	5	2	4	2	4	4	4	4	4	5	2	3	4	5	3,68	
Capacity	4	5	4	5	5	5	5	5	3	4	5	4	2	5	5	5	4	4	5	4,42	
Capacity expansion	4	5	5	5	5	5	5	4	4	5	4	4	3	4	3	4	4	5	4	4,32	
Airport operational time	5	4	2	5	5	3	4	4	3	5	5	5	4	4	5	5	3	5	5	4,26	

Table 1: Sub factor weights¹²

In the next step we calculated the weights of the five main factors, which we call “factor weight” shown in Table 2. The “factor weight” is the average of the weights of its sub factors. For example the factor weight of the environmental factor is constituted by the average of the weights of its two sub factors, the environmental effect on vicinity and accessibility. For the final weighting of the ranks we multiplied the rank for each of the five factors with the factor weights.

Factor	Weight
Environmental Factor	3,0132
Service Factor	3,2105
Managerial Factor	3,5556
Demand Factor	4,1194
Facility Factor	4,1711

Table 2: Factor weights

¹² * AM stands for the Aviation Marketing Department of Zürich Airport.

4. Analysis and Results

In the analysis we used three steps of a multi-decision criteria model (MDCM) method: The first step is the ranking of each sub-factor. If a sub-factor consists of more than one component, the average of the ranks is taken and then ranked again. The ranks for each sub factor can be found in Table 3 where all results are summarized. In the second step, the five main factors (environmental, demand, service, managerial and facility) are ranked, which is then called total rank (TR). The total ranks of each of the five factors consist of the average of the ranks of its sub factors. The following graph shows the total ranks (without weighting) of the five main factors.

	Environmental	Demand	Service	Managerial	Facility
AMS	1	1	1	5	2
CDG	8	2	7	1	1
FRA	6	3	8	4	3
IST	5	8	5	8	3
LHR	3	3	6	1	7
MUC	7	5	2	7	5
VIE	2	6	4	6	6
ZRH	3	6	2	3	8

Figure 2: Total ranks

In the third step of the MDCM method the total ranks are multiplied with the weight of each factor (“factor weights”) leading to the total weighted ranks (TWR). The following figure explains TWR mathematically.

$$\begin{aligned}
 \text{TWR} &= \text{TR} \cdot W \text{ (Factor Weights)} \\
 &= \text{TR} \cdot [W\text{-Environ.} \quad W\text{-Demand} \quad W\text{-Service} \quad W\text{-Managerial} \quad W\text{-Facility}] \\
 &= \text{TR} \cdot [3,013 \quad 4,119 \quad 3,210 \quad 3,556 \quad 4,171052]
 \end{aligned}$$

Figure 3. Formula to Calculate the Total Weighted Ranks

The aggregated sum of the total weighted ranks of each airport results in the ‘sum total weighted ranks’ (STWR).

$STWR = TWR \text{ Environ. Factor} + TWR \text{ Demand Factor} + TWR \text{ Service Factor} + TWR \text{ Managerial Factor} + TWR \text{ Facility Factor}$

If ranked again, we get the final rank and therefore the final result of the whole analysis. The first part of the following figure shows the TWRs for each airport for each factor. These are then aggregated into the sum total weighted ranks shown in the middle part of the figure. And finally the third part of the figure shows the final ranks, which is the final result of applying our model to the eight airports. We obtained this final rank by ranking the STWRs again, where the lowest STWR results in the highest final rank and the highest STWR in the lowest final rank – Istanbul Ataturk in this case.

	Environmental	Demand	Service	Managerial	Facility	Sum total weighted rank	Final rank
AMS	3,01	4,12	3,21	17,8	8,34	AMS 36,5	AMS 1
CDG	24,1	8,24	22,5	3,56	4,17	CDG 62,5	CDG 2
FRA	18,1	12,4	25,7	14,2	12,5	FRA 82,9	LHR 3
IST	15,1	33,0	16,1	28,4	12,5	IST 105	FRA 4
LHR	9,04	12,4	19,3	3,56	29,2	LHR 73,4	ZRH 5
MUC	21,1	20,6	6,42	24,9	20,9	MUC 93,9	VIE 6
VIE	6,03	24,7	12,8	21,3	25,0	VIE 89,9	MUC 7
ZRH	9,04	24,7	6,42	10,7	33,4	ZRH 84,2	IST 8

Figure 3: Final ranking

Schiphol is the most competitive airport of the comparison and Istanbul Ataturk scores much lower than all the rest. Schiphol has the highest rank for three out of the five factors (environmental, demand and service), scores second for the facility factor and obtained a medium rank for the managerial factor. Schiphol has formidable accessibility, serves a catchment area with a high GDP, offers a well-developed hub- and spoke network, offers many destinations, relatively low airport charges and has a high capacity for future growth. Charles-de-Gaulle is second due to very high profits and revenues, good scores for its facilities and a large number of destinations and airlines that operate at the airport. However, Charles-de-Gaulle has low scores for its service performance, poor accessibility and high noise compensations.

London Heathrow is ranked third. Although the service is not as good as at most other airports from the comparison and the growth possibilities are very low due to capacity restrictions, it is still among the most competitive airports. Heathrow has high scores for demand, mainly due to its size and it is also highly profitable.

Frankfurt is the most competitive airport among the 'Lufthansa-family' hubs. The major constraints on its competitiveness are the high environmental effects on vicinity, high airport charges, the relatively low service performance and the short operational time. Due to its mediocre scores for facility, managerial and demand factors it is in the middle of the ranking for airport competitiveness. Close behind Frankfurt is Zurich Airport. The major strengths of Zurich airport are its good accessibility, a high GDP in the catchment area, high profitability and good service. However, it is only ranked fifth because its competitiveness is inhibited by factors that are rather fixed: The growth possibilities in Zurich are very low because the capacity can hardly be increased. Among the eight airports in the comparison Zurich airport has the shortest operational hours, the lowest current and expected capacity and the second worse runway system. In addition, Zurich has very high current and expected costs for noise abatement and compensations.

Summary of Factors and Weighting								
Spatial Factor	AMS	CDG	FRA	IST	LHR	MUC	VIE	ZRH
Environmental effect on vicinity	2	6	7	1	4	5	3	7
Accessibility	2	7	3	8	4	6	4	1
Average rank	2	6,5	5	4,5	4	5,5	3,5	4
Total rank	1	8	6	5	3	7	2	3
Total weighted rank (W-Environ. = 3,013157895)	3,01	24,1	18,1	15,1	9,04	21,1	6,03	9,04
Demand Factor	AMS	CDG	FRA	IST	LHR	MUC	VIE	ZRH
Number of airlines and frequency	4	1	3	5	2	6	7	8
Hub-and spoke network condition	1	1	3	5	5	3	7	8
Induced force of demand	2	7	5	8	4	5	3	1
Average rank	2,33	3	3,67	6	3,67	4,67	5,67	5,67
Total rank	1	2	3	8	3	5	6	6
Total weighted rank (W-Demand = 4,119367045)	4,12	8,24	12,4	33	12,4	20,6	24,7	24,7
Service Factor	AMS	CDG	FRA	IST	LHR	MUC	VIE	ZRH
Service and delay performance	2	7	6	8	3	1	3	3
Airport Charges	2	5	7	1	8	5	4	3
Average rank	2	6	6,5	4,5	5,5	3	3,5	3
Total rank	1	7	8	5	6	2	4	2
Total weighted rank (W-Service = 3,210526316)	3,21	22,5	25,7	16,1	19,3	6,42	12,8	6,42
Managerial Factor	AMS	CDG	FRA	IST	LHR	MUC	VIE	ZRH
Revenue per passener	7	2	3	8	1	5	6	4
Profit per passenger	4	2	5	7	3	8	6	1
Average rank	5,5	2	4	7,5	2	6,5	6	2,5
Total rank	5	1	4	8	1	7	6	3
Total weighted rank (W-Managerial = 3,555555556)	17,8	3,56	14,2	28,4	3,56	24,9	21,3	10,7
Facility Factor	AMS	CDG	FRA	IST	LHR	MUC	VIE	ZRH
Capacity	3	1	1	5	6	4	6	8
Capacity expansion	1	1	4	1	8	4	4	8
Operational time	4	3	6	1	5	6	2	8
Runways	1	3	2	6	4	4	8	7
Average rank	2,25	2	3,25	3,25	5,75	4,5	5	7,75
Total rank	2	1	3	3	7	5	6	8
Total weighted rank (W-Facility = 4,171052632)	8,34	4,17	12,5	12,5	29,2	20,9	25	33,4
	AMS	CDG	FRA	IST	LHR	MUC	VIE	ZRH
Sum total weighted rank	36,5	62,5	82,9	105	73,4	93,9	89,9	84,2
Final rank	1	2	4	8	3	7	6	5

Table 3: Summary final results

Ranked sixth is Vienna Airport, which has a similar profile as Zurich Airport. Vienna however, has also weaknesses in demand due to its small size and its facilities, but offers good services and scores well in the environmental factor. It has longer operational hours than Zurich and there is the possibility of future growth due to possible capacity expansions. But the profitability is not as high. The following table shows the ranks for each sub-factor and factor.

On the seventh rank is Munich, which might surprise many readers, as it offers the best customer service of the eight airports compared. Munich Airport got low scores in many areas of our competitiveness framework: The costs for noise compensations and abatement are rather high, Munich Airport's accessibility is comparably bad, being the airport furthest away from the city centre and having less bus and train connections than the other airports. The number of airlines present at the airport and the number of destinations served are lower than for five of the other airports. The airport charges are higher than at the other medium sized hubs. Furthermore, Munich has the second lowest numbers for profitability among the eight airports compared. Other points weakening its competitive position are the relative short operational hours at Munich Airport and the capacity shortages. All these factors contribute to the result that one of the most liked airports in Europe from the passenger point of view is second last in the ranking of competitiveness.

Also the result of the last Airport in the ranking - Istanbul Ataturk – might surprise many. As this airport has seen double-digit growth rates over the last years, one might think that it is highly competitive (TAVHL, 2015). However, the application of the framework for airport competitiveness suggests otherwise. The accessibility by public transport is the worst among all airports. The GDP in the catchment area is the lowest as well, which suggest a lower demand. The rank of Istanbul Ataturk in the Skytrax ranking is much lower than all the other airports and on top, the departure delays are very high. It also has the lowest scores for the managerial factor. But Istanbul also scores very high in certain areas: There are no costs for noise compensations and Istanbul has the lowest airport charges.

5. Conclusion

It is argued that the competitiveness of Zurich airport is inhibited due to the strict regulations in the area of environment, curfews and capacity expansion. We can clearly see that Zurich is not competitive in the area with most governmental influence such as environmental policies, curfews and capacity expansion. Another weak point in Zurich's competitiveness are its relatively high airport charges compared to other medium-sized hubs in Europe and especially to Istanbul Ataturk and hubs in the Middle East. On the other hand, Zurich Airport turned out to be very competitive in the area of accessibility, the demand in the catchment area, the services offered and the managerial factors, including profitability.

Since 1976 Zurich Airport operates with the same runways. In the five busiest hours at Zurich Airport the demand for slots is already higher than what can be offered and an evasion to other hours of the day is not possible with hubbing. Also, these capacity shortages are a big competitive impediment as other European hub airports have an independent parallel landing system (LUPO, 2016). Handing over more influence in the decision-making process of the major Swiss airports from the Cantons to the Federal Government could be a possibility to enable future growth in

Zurich. Enlargement projects could be more successful when decided on a national scale than on a cantonal one. A suggestion to foster the competitiveness of Zurich Airport could be to try to “lobby” for an increased federal control of Zurich Airport and lower the influence of the Canton of Zurich. This could best be done in cooperation with Swiss, the major airline in Zurich. This airport-airline cooperation could increase the airports bargaining power (Bush & Starkie, 2014). Increased federal competences could enable the airport to pursue new projects for capacity expansions and hopefully prevent any enlargements of the curfews. However, intents to increase the competences of the Government in Bern will have to cope with serious opposition from the Cantons most affected from the airport’s negative externalities (Gubler, 2015).

The possibility of growth showed to be a crucial part of hub airports competitiveness. Because growth at Zurich Airport is only possible to a very small extend it is questionable if the airport is able to fulfil its role to offer the necessary connectivity for the Zurich area and the whole of Switzerland also in the future. Although Zurich turned out to be more competitive than two other hubs of the ‘Lufthansa family’ these could become more competitive than Zurich as they increase capacities. The four largest hubs in Europe are far more competitive and it will be difficult for Zurich Airport to compete with these for transfer passengers. Also new competitors from Turkey and the Middle East will make it more difficult for Zurich Airport to compete for airlines. The number of transfer passengers in Zurich Airport is as low as it has not been for a long time and in 2015 it decreased by more than three percent (Wedl, 2016). In conclusion, it can be said that there is and there will remain a trade-off between further growth at Zurich Airport which would increase the region’s accessibility and hence its attractiveness as a business location on the one hand and the increased noise emissions in the area around the airport on the other hand. Eventually, this will be a political decision rather than an economic one.

Whether the competitiveness of airports can objectively be compared is not as clear, as it depends a lot on which factors we include in a model and of what different people consider to be a competitive airport and what not. The survey with the experts from the aviation industry has showed that the opinions differ a lot on which factors are how important for airport competitiveness.

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