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THE OPPORTUNITIES AND THREATS OF TURNING AIRPORTS INTO HUBS

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ABSTRACT

This paper examines the opportunities and threats which arise when turning origin/destination airports into hubs. The analysis focuses on market development trends, competitive structures—especially in the light of airline network strategies and the growing rivalry between airports—and finally the potential financial impacts for the airport, including both investment efforts and the financial results from hub operations. We argue that in most cases a decision against converting a traditional origin/destination airport into a major transfer point is preferable to the transformation into a hub.

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INTRODUCTION

The hub-and-spoke concept has remained a dominant characteristic of most scheduled airline networks since its introduction in the late 1970s, particularly for carriers integrated in global airline alliances.[1] As a consequence, airports facilitating airline hub functions were able to increase their air traffic volumes significantly. Even though the market entry of low cost carriers has recently re-strengthened point-to-point links between non-hub airports,[2] Hub airports still dominate the global ranking of airports in all traffic categories (passengers, air cargo, aircraft movements).

Driven by the competitive pressure on (formerly) protected national carriers to adapt to an increasingly competitive market environment, the hub-and-spoke-system became a typical companion of the trend towards a liberalization of air transport. Consequently, hub-and-spoke networks are still increasing their geographic coverage now reaching more newly industrialized countries. The general character of hub airports has changed due to the fact that the total traffic figures of these countries are usually significantly lower than current focal hub-and-spoke markets like North America and Central Europe. The carriers operating from hubs are smaller (in terms of passengers transported, fleet size, etc.) compared to the traditional hub carriers in first world countries. Furthermore, the global airline alliances—oneworld, SkyTeam and Star Alliance—have only partly sought co-operation or membership by carriers from developing countries. These carriers are either not yet able to guarantee the alliances' quality requirements, or the respective national markets are already well served by existing alliance members. Therefore, at present fully functioning alliance hubs are a rarity in these regions.

As part of the political process to liberalize the national aviation systems, governments of developing countries should consider two closely interlinked aspects: the future competitiveness of the national carriers as well as the operational and economic capabilities of the countries' airports. The predominant centralization of the administrative and economic processes in these countries is also reflected in the structure of their national airport systems. The capital city airport is generally the operational base of the national carrier and the main gateway to international destinations, bundling the services of foreign airlines to and from this country. Consequently, it is normally the largest national airport in terms of air traffic handled. Integrated national aviation policies have to take this exposed function into account. A

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[1] On the importance of hubs for airlines and their marketing efforts see Dennis, 1991.

[2] For a detailed analysis of the impact of low cost carriers on the development of airports see Dresner, Lin and Windle, 1996.

liberalization policy offers the opportunity of enhancing the airports' capacity and performance as well as improving their market position.

As the investment for this transition often exceeds the governments' resources, privatizing the airport offers the achievement of international airport quality standards within a manageable timeframe. However, the market position of the airport on the supply side in terms of destinations, frequencies and airlines offered, can only be influenced indirectly by the airport.

In the context of a long-term airport strategy governments often define a hub function as the key functional target for the central national airport. This expectation, which is often part of the airport privatization tender documents, has to be reflected in the light of the different stakeholders' individual targets. As the airport only facilitates but does not operate the hub system, the importance of the airlines' role becomes obvious. The question remains, whether this expectation is a valuable target for the airport as well.

This paper analyzes the effects a hub function has on central capital airports in newly industrialized countries. We assume that airport operators strive towards achieving business success, whether the operating company is privatized or still remains under state ownership. For the purpose of this paper, the argument focuses on the passenger market segment. However, most of the aspects are also applicable to the air cargo business.

THE IMPLICATIONS OF AN AIRPORT FUNCTION: ORIGIN/DESTINATION AIRPORT VERSUS HUB AIRPORT

In general, airports can be divided into two categories in commercial aviation: origin/destination (O&D) airports and hub airports. In the following chapter we will show why this strict separation does not reflect the full picture, since airports have to pass various evolutionary stages or development phases between being one of those two kinds of airports. To allow for this discussion, we first briefly discuss the typical characteristics of the traditionally distinguished airport types.

The role of O&D airports is mainly defined as to act as the gateway to their region, offering an attractive point of entrance for visitors and a reliable point of departure for locals on their way abroad. O&D airports always require a sound traffic demand to allow for efficient and profitable operations. Connection traffic is of minor importance for these airports: Consequently, their infrastructure does not provide specific transfer facilities, and the national carrier has not established coordinated flight arrivals and departures to facilitate passenger itineraries which are not necessarily related to the respective airport region. Any transfer traffic at such airports is mainly limited to connecting small domestic airports with the international services and vice versa. O&D airports are the fundament of any

point-to-point air transport. Their focus is not to provide the more complex transfer operations, which are to a certain extent independent from the airport's location.

Airlines that have restructured their network on the basis of the hub-and-spoke concept choose one airport—the hub—as their central point of transfer. Flights originating at the various cities in the carrier's network (spoke airports) are consolidated and passengers wanting to travel between this airline's non-hub airports are transferred within a specified timeframe. Thus, instead of providing a large number of direct connections between cities in the network, a far larger number of indirect connections with a transfer stop at the hub can be provided.[3]

In this system, a so-called *bank* can ideally be defined by a wave of flight arrivals at the hub from numerous spoke airports during a limited timeframe. All aircraft utilized are on ground for a certain period of time to allow for the transit of passengers between flights. The airport's specific minimum connecting time (MCT) defines the minimum period necessary to allow transfers from all arrivals to all departures and thus to ensure the full coverage of potential passenger itineraries.[4] Once all transfers have been finalized, the aircraft leave the hub again within a limited period of time causing a second wave: the flight departures.

This strict separation between hubs and O&D airports cannot reflect the whole range of airport functions in airline networks. On the one hand, like O&D airports, all hubs offer direct connections especially for the local passengers, leaving from the airport without using feeder flights. On the other hand, many O&D airports are trying to establish an initial hub position by attracting airlines and promoting transfers

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[3] The International Civil Aviation Organization uses the following definition for transit and direct transit passengers: "Direct transit passengers: Passengers who continue their journey on a flight having the same flight number as the flight on which they arrived. Passengers in direct transit are counted only once. Other transit passengers and stop-over passengers are counted twice: once as embarked passengers and once as disembarked passengers." See ICAO Air Transport Reporting Form, Airport Traffic, Form I. Based on this definition, IATA is also referring to transit passengers in their airport charges manual. A more common definition, different from this official, approach names the other transit passengers as transfer passengers. See for example Doganis (2002), p. 339. In this paper, we follow the latter definition to avoid confusion with discussions in other papers.

[4] The MCT depends on the necessary processes involved in the transfer of passengers and their luggage. These not only include pertinent security checks of passengers and bags changing aircraft at the hub, but also immigration or customs. Furthermore, depending on the airport's dimensions, a considerable amount of time is needed for the passengers to reach their departure gate and for the handling and sorting of their luggage.

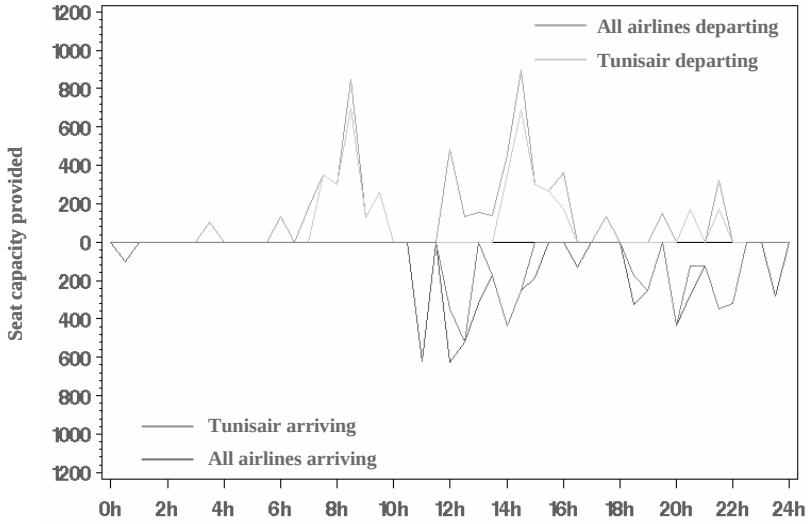
Our discussion of the various airport and hub types is based on an analysis of current capacity supply profiles of selected airports being typical representatives of their respective types. These profiles show the available arriving and departing seat capacity both for the entire airport analyzed as well as for its hub airline or the strongest airline at the airport, respectively. The following charts show this profile for a typical day. On the x axis the hours of the day are shown, the y axis gives the available number of seats provided at any given time. Negative volumes represent capacities arriving at the airport, positive values are capacities departing from the airport.

The charts have been derived through an analysis of the official flight schedule data for each airport for calendar week 10, 2006. In this process, the entire published flight schedule data including departure and arrival times as well as the available capacity per flight and the operating airlines has been analysed and clustered into 48 time periods of 30 minutes. This has resulted in the reflected total capacity supply in each interval.

Origin/Destination (O&D) Airports

Tunis-Carthage Airport (TUN) is an example for the first airport category, the typical O&D airport.

Figure 1. Typical capacity supply profile of an O&D airport: Tunis-Carthage Airport (TUN), Tunis, Tunisia



Note. Based on airline schedule data (calendar week 10, 2006), OAG 2006

Tunis-Carthage Airport is the home base of Tunisian national carrier Tunisair. The airline is concentrating its entire network on its home base. This is not only reflected in the fact that almost the entire aircraft fleet employed is parked at Tunis overnight, resulting in significant departing capacities in the early morning hours and large capacities returning in the evening. Tunisair focuses on destinations which can be reached within approximately 2.5 hours flying time, which leads to a certain accumulation of flight activity during midday, when the entire fleet returns to Tunis before leaving again for the second rotations of the day.

Other airlines than Tunisair have significantly lower market shares at the airport. Since most carriers operate routes of a similar stage length as Tunisair, but originate at the flag carrier's destinations—mainly in Europe—most of their flights arrive in the morning and return around noon.

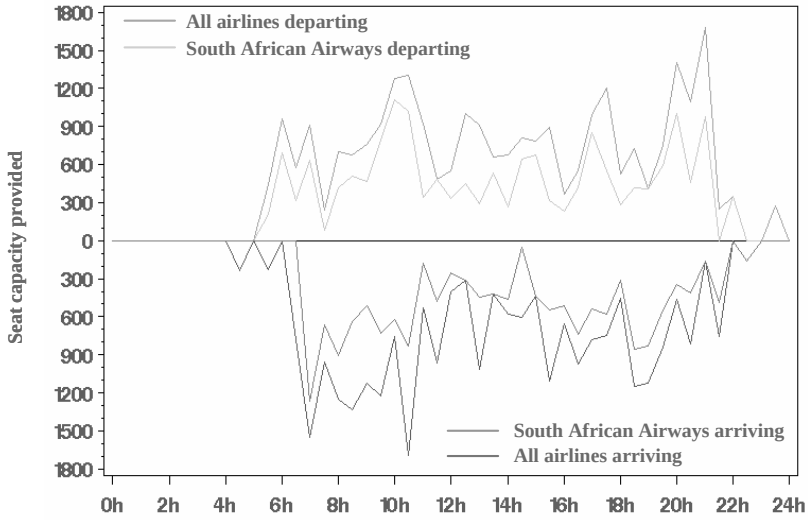
Besides these peaks, no major variations can be observed regarding the available capacity during the day. The capacities offered are usually in line with the demand experienced at the respective airport.

The operational patterns of the airport as a whole and of Tunisair as the most important airline in terms of total seat capacity per day in Tunis do not show a clear indication of intended hub operations. These would be reflected by a stringent wave structure.

O&D airports with first hub characteristics

An example for an airport showing first hub characteristics is Johannesburg International Airport (JNB) in South Africa. Its major home base carrier South African Airways accounts for a significant share of the overall airport operations, but does not reach a clear dominance regarding the entire traffic at its base airport. Nevertheless major capacity demand differences between the peak utilization and the off-peak periods occur at Johannesburg. South African Airways only dominates the morning peak, the evening capacity peak is the result of several international airlines arriving and departing. The limited overall share of the home base carrier is also a result of the competition by other carriers in the liberalized domestic aviation market with its strong O&D traffic.

Figure 2. Typical capacity supply profile of an O&D airport with first hub characteristics: Johannesburg International Airport (JNB), Johannesburg, South Africa

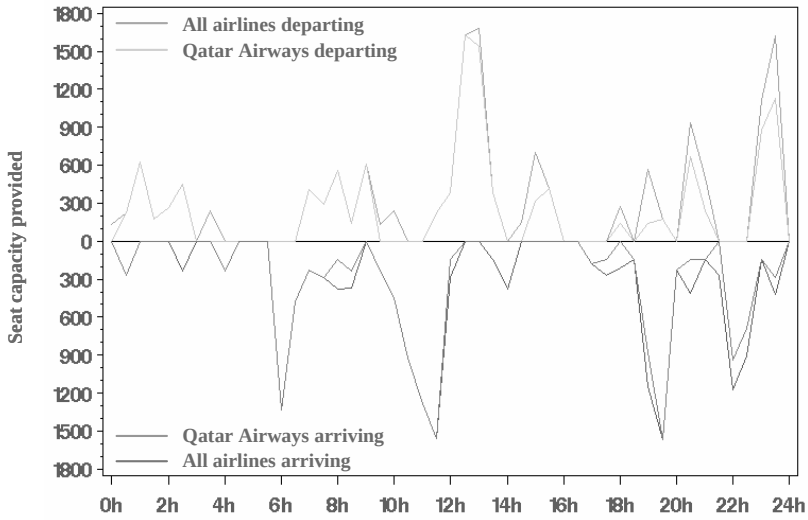


Note. Based on airline schedule data (calendar week 10, 2006), OAG 2006

Long-haul transfer hub airports

Compared especially to the first example of Tunis-Carthage, but to a large extent also to the Johannesburg example airports mainly serving long-haul routes represent a different typology in terms of their traffic pattern. Those routes tend to be served at a lower daily frequency than short- to mid-haul routes and also depend on a number of specific long-haul travel parameters (time differences, night curfews, passenger departure/arrival time preferences, etc.). This results in an overall far more condensed operational pattern at the airports. These also show longer connecting times between the waves to allow the processing of the large number of passengers and their luggage. Typical examples for such airports are the new hub airports arising in the Middle East, which are the home bases of carriers strictly focusing on long-haul flights and competing for connecting traffic.

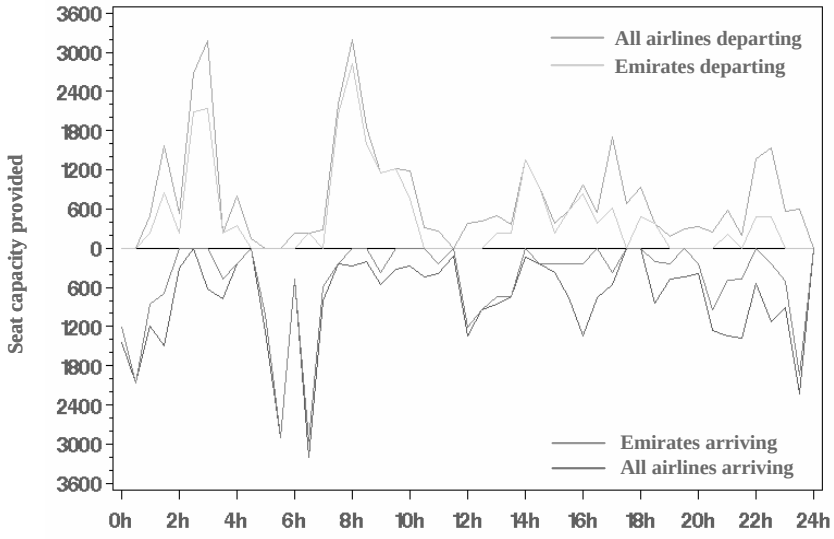
Figure 3. Typical capacity supply profile of a long-haul transfer hub airport: Doha Airport (DOH), Doha, Qatar



Note. Based on airline schedule data (calendar week 10, 2006), OAG 2006

Qatar Airways, the home base operator at the Airport of Doha (DOH), accounts for almost the entire traffic at the airport, creating a strong dependence of the airport on the national carrier. Due to the airline's strategy of serving and connecting mainly long-haul flights, there are only two peaks during the day, with the one close to midnight being absolutely dominant. This pattern results in extremely high capacity requirements during the hub bank period, while substantially less handling capacities are needed for the rest of the day. A very similar picture with even higher traffic volumes can be seen at Dubai Airport (DXB) with its home base carrier Emirates.

Figure 4. Typical capacity supply profile of a long-haul transfer hub airport: Dubai Airport (DXB), Dubai, United Arab Emirates



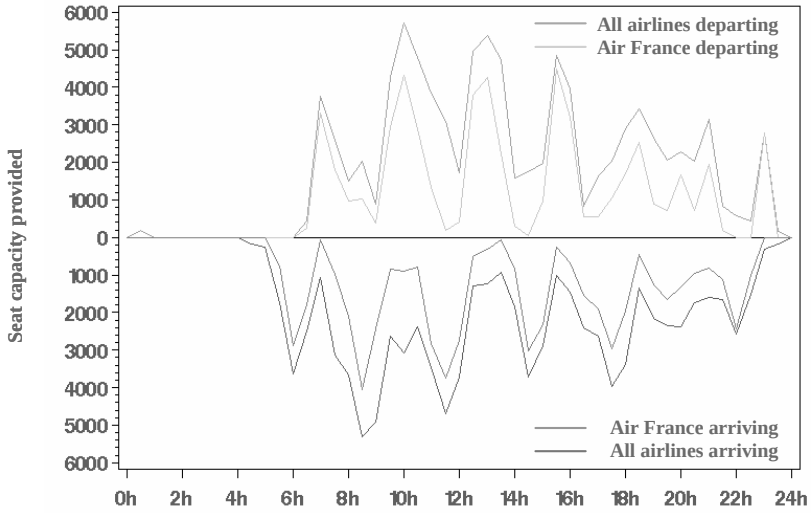
Note. Based on airline schedule data (calendar week 10, 2006), OAG 2006

Hub airports of the Doha or Dubai type experience a daily traffic distribution leading to a highly utilized infrastructure only during the peaks. During the remaining time, a major share of the capacity provided remains under-utilized. Such a situation cannot be achieved by smaller airports, which do not have a major home base operator or have not established a strong competitive position as a transfer point.

Mature hub airports

At well-established hub airports a strong home base carrier operates several banks—up to 5 or 6 waves during the day-time, taking a total time of about 1.5-2.0 hours each. This leads to a situation in which the single peak periods follow each other at close intervals and thus generate a relatively stable level of infrastructure utilization, interrupted only by short periods of lower traffic loads. It has to be realized that even within the group of fully developed hub airports differences in the operational patterns and thus in the degree of infrastructure utilization can be observed. Paris-Charles de Gaulle (CDG) is a typical example of a mature hub airport with a combination of short- and long-haul traffic.

Figure 5: Typical capacity supply profile of a mature hub airport: Paris–Charles de Gaulle (CDG), Paris, France



Source: Based on airline schedule data (calendar week 10, 2006), OAG 2006

Paris-Charles de Gaulle is one of the largest hub airports in Europe, being the home base of the French national airline Air France. It is also one of the very few large European hub airports still providing sufficient space for further expansion. The operational pattern shown in figure 5 reflects the typical traffic situation for a highly frequented hub airport. There are five very sharp peaks almost equally distributed over the day, with large capacities arriving at the airport and departing shortly afterwards. In the evening, there are only two minor additional peaks. These are not as strong as the first peaks, but can still be well recognized. The home base operator, Air France not only operates the majority of the shown aircraft capacities and thus dominates the overall development of the airport. Air France also determines the traffic peak pattern with its supply.

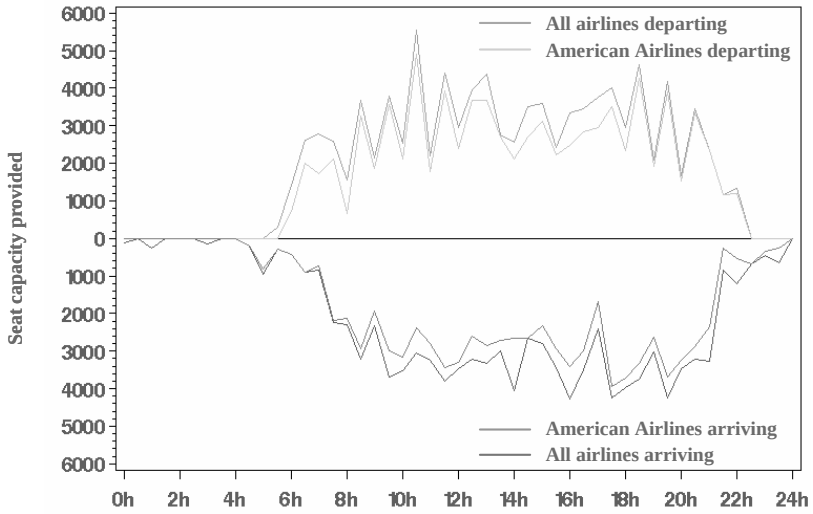
Hub airports with de-peaking strategy / Rolling hubs

Dallas/Fort Worth (DFW) reflects a further evolutionary stage of hub airports with a so-called rolling hub structure.

Similar to Paris, a single airline, in this case American Airlines, clearly dominates the overall air traffic supply. Apparently this is mainly done using a hub concept, but based on a total of about eight waves per day. Due to the high number of wave operations, only minor variations between the peaks and the short off-peak periods occur. This is the result of a de-peaking concept, which tries to reduce extreme peaks and increases the permanent

utilization of the airport. At large airports, this is possible by moving flights to less congested times, resulting in a more even distribution over the day. In the case of Dallas/Fort Worth this is accompanied by coordinating eastbound and westbound waves allowing fast and reliable connections for transcontinental traffic. Furthermore, along with the increasing number of flights the number of connections to most destinations has increased as well. This allows for transferring from one incoming flight to several outgoing flights, which leads to an erosion of the clear wave structures and eases the peaks.

Figure 6. Typical capacity supply profile of a rolling hub airport with de-peaking strategy: Dallas/Fort Worth Airport (DFW), Dallas, Texas, USA



Source: Based on airline schedule data (calendar week 10, 2006), OAG 2006

Before such a change in the operational pattern is possible, a hub needs to reach a certain development stage. Only well-established hub airports, which serve a large variety of markets and extremely large passenger volumes, show as high a number of waves as the examples given. Usually, these hubs serve both short- and long-haul flights as well as continental and intercontinental traffic.

The hub airport's evolutionary stages

Summarizing the results of these analyses a total of five different airport types can be distinguished. The first is the traditional O&D airport, serving its region without a clearly observable hub transfer service pattern (e.g., Tunis-Carthage). The second airport type only partly targets transfer traffic

flows, but has a home base operator operating only one bank in the morning. This peak might be accompanied by a second peak in the evening, resulting from the same-time operation of several international carriers (e.g., Johannesburg).

The first clearly identifiable hub airport type describes airports with strong home base operators focusing on the transfer of passengers between long-haul flights. These airports experience one or two banks per day, resulting in strong peaks and relatively stable, but significantly lower traffic volumes over the day (e.g., Doha and Dubai). Finally, a fully developed hub airport combines multiple waves over the day, in which short- to medium-haul flights are connect with long-haul flights and vice versa. There are two possible development stages. The first can be observed at large hubs still offering open capacity reserves, showing substantially lower traffic in the off-peak periods (e.g., Paris–Charles de Gaulle). The other is the category of congested mega-hubs, at which the airlines have already started to introduce de-peaking to lower the peak utilization by rescheduling flights into off-peak times, resulting in a balance in the use of infrastructure (e.g., Dallas/Fort Worth).

These evolutionary stages of airport development can be identified at every airport worldwide. Even though airports are increasingly active in developing their own business by attracting airlines through various means of airport marketing and air service development,[5] it has to be realized, that airports do not provide hub operations themselves. It is—and will remain—the airline that decides whether to establish hub operations at a given location. Any initiative of an airport driven transfer strategy remains at a very low level, because airports can only cover a minor share of the financial risk of providing air services. Thus, for any functional development an airport is highly dependent on its most important customers—the airlines—particularly the home base operator. Therefore providing facilities at an airport, which are designed to facilitate hub operations is always a risky endeavour, opening great opportunities as well as risks for the success of the airport. As long as the hub operations of the home airline flourish, the airport will also prosper, due to the constantly growing traffic volumes. Should there be major changes in the carrier's network strategy or should the airline go bankrupt, this situation can pose a threat to the airport.

Recent examples of the discontinuation of a positive traffic development at hub airports have emphasized the risk the dependency on one carrier bears for an airport. The airport operation is increasingly at risk, the more specialized the hub function, the lower the share of the local O&D traffic and the higher the passenger share of the hub carrier.

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[5] See, for example, Jarach (2005).

Especially during crisis periods—which are experienced quite frequently in the volatile aviation industry—airlines have to react by significant cost-cutting measures at short notice. Airports can suffer substantially from this situation if a multi-hub carrier decides to scale down its network. A remarkable example was the closure of American Airlines' hub at Raleigh/Durham Airport, North Carolina, in 1995. Airport facilities highly specialized for the hub function lost their main mission, leaving the airport with over-dimensioned, under-utilized facilities generating high fixed costs.

Zurich and Brussels airports have experienced similar situations as a consequence of their respective hub carriers' financial instability. Both have constructed major hub terminals for their home base carriers, Swissair and Sabena. After the terrorist attacks of September 11, 2001, both carriers went bankrupt within weeks. By that time the construction works were already at an advanced stage. As a consequence, both airports had to finalize the facilities, continuing to invest substantial amounts in their terminals. To limit further losses resulting from the lack of traffic, both airports decided to close down the completed facilities to at least save operational costs for the time being. Thus, the terminals were not used until a sufficient number of other carriers had taken the opportunity to fill the gaps left by the former hub carriers at least by serving the strong passenger O&D demand at the two cities. Parts of the older terminals were closed after the new facilities opened. Both airports lost their specific hub status and a high share of connecting traffic, but the O&D demand was still served.

COMPETITIVE ASPECTS OF HUB DEVELOPMENT

To evaluate the implications of hub operations on an airport from an economic or financial perspective, first the underlying basis for any hub development needs to be analyzed. Due to the main characteristics of any hub—established and operated by an airline, but requiring major investments and operational changes from the chosen airport as infrastructure and service provider—the goals of both parties involved should be discussed when establishing a hub. While the goals are identical or at least complimentary in some regards, there are some contradicting targets, which need to be dealt with—even though for both parties the main goal of course is a maximization of traffic and revenues.

For the airline, network attractiveness is achieved by providing as many connections between as many airports as possible at an efficient and profitable level at the lowest achievable cost base. Before the late 1970s the standard operational pattern was to link two airports with direct services, thus providing non-stop services even on routes offering only a comparably low demand. The result of this strategy is the need for a very large aircraft

fleet to be able to serve all relevant routes. Furthermore, this fleet must consist either of aircraft with very different capacities to serve every market adequately, or low seat load factors on some routes and an under-satisfied demand on other markets have to be accepted. Both approaches result in high direct costs by operating an inflexible and inadequate aircraft fleet or by accounting for high opportunity costs caused by not serving existing demands. Either strategy has proved to be a sub-optimal business model.[6] Therefore, airlines have started consolidating traffic flows at single points, their hubs, to be able to offer flights with a high demand using larger aircraft at lower per seat costs while still serving other destinations with direct flights. Along with these operational targets another goal is of course to establish a strong customer position with the hub airport, enabling the airline to negotiate discounts or other benefits.

A major disadvantage of the hub concept from the passengers' point of view is the transfer procedure itself. Passengers have to change aircraft at an airport they did not intend going to and by doing so they need even more time to reach their final destination compared to direct services. To minimize total travel times as far as possible, airlines need to reduce the time required for transferring at their hub. In the global distribution systems (GDS), itineraries are always ranked by elapsed travel time. Therefore, airlines with inefficient hubs requiring long connecting times are ranked relatively low in the GDS. Since approximately 90% of all bookings are made from the first screen of the GDS, such a constellation results in substantial competitive disadvantages and thus translates into a direct loss of revenues.

For an airline a hub is not only the transfer point of its passengers. Besides the in-flight service it is the best place to cater to their customers' other service requirements. The hub airport is always the ideal location to offer dedicated additional services to the high value passengers, namely frequent travellers, business and first class passengers. These range from lounges and special assistance services to dedicated terminals and transport services between the terminal and the aircraft—either with dedicated buses or even luxury limousines.

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[6] While this statement is valid for the traditional network carriers whose target is to serve a wide portfolio of destinations, regions and passengers, low cost carriers strictly adapt to the point-to-point network structure. Establishing and operating a hub-and-spoke network is a very complex and costly issue, whereas low cost carriers are strictly focusing on reducing costs. This is achieved by many different means, including network simplicity. Transit opportunities are not offered to the passengers, there is no time coordination between the single flights. Thus, the following discussions exclude the low cost market segment, even though these carriers are taking over an increasing share of the market. They do not play a relevant role in hub development.

While for the airline the main target is to offer a high product quality at the hub at low costs, for the airport operator the goals differ significantly. The common goals of both parties are passenger services, customer loyalty as well as an overall efficient and thus cost reducing operation. At the same time, the targets of operating profitably and maximizing revenues for the airport require completely different approaches in the context of hub development. Airlines endeavour to keep their passengers on the ground for as short a time period as possible, which is counterproductive to the airports' target to maximize retail revenues, as passengers hurrying to their connecting flight do not have sufficient time to allow for extensive shopping.

Furthermore, airports naturally strive for a continuously high utilization of their infrastructure. Airports are increasingly reluctant to discount charges for the hub airline and show a growing interest in attracting other airline customers to exploit the available business opportunities. The exclusivity targeted by the hub carrier is of course not supported by such a strategy.

Several additional arguments have a high impact on an airline's hub choice and development. Driven by the still rather regulated aviation system the main hub of any carrier can only be located in its home country—resulting from the availability of traffic rights which usually depend on the carriers' nationalities. Thus, any country without a strong national carrier faces severe difficulties in establishing a strong hub.

Apart from regulative and political reasons various additional influences have an impact on a successful hub development. The first is the airport's geographic location. If a hub is intended to bring any advantage to the passengers, who ultimately decide on the hub operations' success, a major factor is the lowest possible total travel time even when using the hub. This requires a hub location as close to the direct line between origin and destination as possible to minimize the flying time for feeder flights.[7] Distant locations, far from the main routes, are considered disadvantageous and cannot be compensated by other competitive means. In this respect it is important to distinguish between intercontinental hubs and continental hubs. Continental hubs located far away from the heart of the continent tend to be suboptimal, for intercontinental hubs the position close to the most utilized intercontinental routes is the main decision factor.

Topographic aspects generally add to the geographical arguments in evaluating the hub potential of an airport. Airport locations significantly above sea level surrounded by mountains or experiencing extremely high

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[7] A network simulation model like applied by Berechman and de Wit (1996) for the deregulated European market can contribute to the theoretical choice of the hub location. However, this approach is of limited value for most developing countries as the system of bilateral air service agreements restricts the free choice of routes served by the airlines.

temperatures bear operational disadvantages especially for long-haul flights, since all these features might result in payload restrictions or similar operational limitations for the airlines. While these aspects are also relevant for certain direct flights, for example, flights between Europe and certain South American destinations, they can be accepted for single flights. If a complete hub operation has to be set up under such restrictions, negative operational factors lead to an overall situation that is not suited to handling the complexity of an airport hub operation.

Besides the operational aspects discussed, competition issues have developed as the most crucial influential factors in turning O&D airports into hubs.[8] The decision to realize this development is usually driven by three main targets. First, the airport targets at developing a preferred position in the greater region, achieving the status of largest facility in the market and the focal point of future air transport development. Particularly economic expectations are the main drivers of such a strategy. Second, air transport generates economic development and trade flows. The hub for the region has a potential position to become the most important trade centre at which the trade and travel routes of the region meet. This creates opportunities for an increasing economic development of the airport's surrounding area—for example, in the form of logistics parks or a free trade zone—and of course for the airport itself.[9] Third, the political dimension of having a hub airport is one of the most important development drivers, since it is expected to give the country and thus the government a leading role in the region.

All these expectations are closely related to the original hub function. Increasing air traffic, as related to a hub development, implies new revenues and commercial potential for an airport operator. Additionally, the economic impact of air transportation on a country's industry, trade and tourism are well proven. Furthermore, the political dimension of becoming the trade centre of a region should not be underestimated. This constellation's core problem is that the benefits expected by developing a hub are far too promising to be ignored by any airport in a region without a dominant airport. Thus, usually several O&D airports try to take over the leader's position at the same time. This directly results in intense competition between several relatively weak candidates, often ignoring the operational aspects discussed above. This type of situation can currently be observed in Central South America with airports like Lima, Bogotá, Guayaquil and Caracas all competing to become a main hub for the continent. While all four airports are trying to attract more traffic and to support transfer structures,

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[8] A deeper discussion of the effects of liberalization developments on airports in the European Union can be found in Barrett (2000) or Starkie (2002).

[9] For an evaluation of the economic welfare effects of airports, especially in the case of their development by airline alliances, see Park, 1997.

they compete intensively by improving, expanding and marketing their airport infrastructure. None of them have strong interregional home base operators able to support such a development so far.

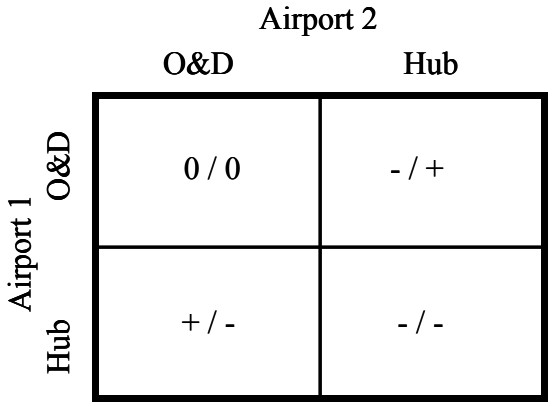
A similar kind of competition can be observed in other parts of the world, even between larger airports such as Kuala Lumpur and Singapore, both competing for the same transfer market, or several airports in the Pearl River Delta, including Hong Kong and Guangzhou.

Besides adding to their own, existing infrastructure by undertaking multi-million or even multi-billion dollar investments, the competing airports use every other available means of competition as well. These range from reducing overall landing fees and handling charges for all airlines, to special marketing and incentive programs for selected airlines, which for example introduce intercontinental services or establish transfer-focused operations. Besides the direct financial impact on the airport's performance, which will be discussed in the following, the dramatic competitive aspects should be regarded as well, creating a situation in which deregulation might lead to destructive competition.

The competitive dynamics of such a constellation can be shown with simple theoretical considerations. Two airports with the choice between establishing a hub or not, can be presented in a simple, two-dimensional matrix. For both airports, this matrix allows the choice of either an O&D or a hub function.

Now consider a move by any one airport towards establishing a hub. There will be a competitive reply by the other airport, resulting in reduced revenues for both airports as well as high investment and operational costs. We assume that in the case of no change for both airports (both remain O&D airports) the business performance will not change for the two players. If now any one of the two players chooses to become a hub, this will have two impacts. On the one hand, this will lead to an improved economic situation for the active player, taking advantage of the new market position. On the other hand the competitor will lose traffic and thus experience negative impacts. Therefore both players will strive for the position as the first mover, since a position as the only hub is preferential to remaining an O&D airport. This results in a situation in which both parties establish hub operations at high costs, competing at a level which eliminates the positive effects for both. The situation for the remaining O&D airport is even in danger of a further deterioration as other airlines might shift long-range direct flights to the hub airport and only operate spoke feeder flights to the O&D airport.

Figure 7. Result matrix for hub considerations



O&D = origin/destination airport

In this simple scenario an overall positive outcome (following any change) is impossible. Furthermore, the financial risks in setting up a hub operation are neglected irrespective of new competitive patterns. In the following, this financial perspective is discussed more closely.

FINANCIAL IMPLICATIONS OF A HUB STRUCTURE FOR AIRPORTS

Hub operations are specifically characterized by an extremely intensive utilization of airport infrastructure in a short period of time. The underlying concept of providing a high number of transfer opportunities to a multitude of destinations leads to significant operational peaks for all elements of the airport and the aviation infrastructure at the hub location. Air traffic control capacities have to satisfy these demands. Furthermore, runway and taxiway systems, apron space, fuel farm reservoirs, passenger terminals and cargo facilities have to be provided in line with demand. This may also result in further requirements for landside facilities such as the access roads to the airport, depending on the share of passengers using the transfer airport as an origin or destination airport. This leads to the problem of significant capital investments in infrastructure, which is only utilized during the peak times.

In 2004, the member airports of Airport Council International together spent about US$ 30 billion in infrastructure projects.[10] This figure underlines the high investment costs needed for the upgrading of existing airports to

[10] See Airport Council International (2005).

cope with the traffic developments and to prepare the airports for the future. Of course, the measures taken and the costs of such development projects differ significantly depending on the location of the existing airport, its current size and the objective of the project. Nevertheless, any terminal construction or even building a new airport to replace the existing facilities—usually because the current airport cannot be developed further at its present location—requires substantial investments. The following table gives some examples for recent new terminal or airport development projects in different parts of the world. The significantly higher investment costs for projects focusing on hub facilities compared to destination airport facilities are apparent.

Table 1. Investment costs for airport expansion or development projects, 2006

Airport	Investment Cost	Kind of Project	Hub focus?
Munich, Germany	US$ 1.8 billion	New terminal including apron	Yes
Frankfurt, Germany	US$ 4.1 billion	New terminal including new runway	Yes
Lima, Peru	US$ 1.2 billion	Terminal expansion	Yes
Manila, Philippines	US$ 650 million	New terminal	Limited
Bangalore, India	US$ 180 million	Greenfield airport	Limited
Guayaquil, Ecuador	US$ 250 million	Greenfield airport	No
Ouagadougou, Burkina Faso	US$ 230 million	Greenfield airport	No

Source: own depiction

In addition to the facilities required for successful hub operations, major investments also have to be made into the mobile equipment such as passenger stairways or trucks and, of course, in qualified personnel to operate and handle the airport, the aircraft and the passengers and goods. In addition to the sheer air traffic volumes to be handled during the peaks, transfer operations require special processes and technical installations, for example, a central baggage handling and sorting system or dedicated, separate transfer areas for the passengers, who in many cases are not allowed to mix with departing or arriving passengers before reaching their respective departure gates. The larger the hub operations, the more complex processes, systems or terminal areas. These factors lead to high investments and rising operational costs. Operational costs include salaries for additional staff, the maintenance costs for facilities and equipment, energy costs, insurance costs and a multitude of further cost-related items.

For a financial evaluation of the advantages of hub operations both the start-up investments as well as the operational costs need to be considered in detail. All these items have to be regarded as fixed costs. It is neither

possible to operate the terminal and other infrastructure units only during the peak periods, nor to have the necessary staff available only for selected hours of the day. Therefore any under-utilization of the airport leads to an inefficient use of the available resources. Significant opportunity costs are incurred, where the money spent on providing over-capacities could otherwise be used for alternative business developments.

A major underlying problem of hub operations are the different, diverging interests of the various partners involved. Airlines following a hub-and-spoke network strategy focus all their planning and operation on the minimization of the aircraft time on the ground and the maximization of the number of connections offered during this time. Successful operations at their hub require as little time as possible. Utilizing the airport off the waves is comparably unattractive for the respective airline, despite a limited number of direct connections only serving local O&D traffic. At the same time, reducing costs is a main driver for all business decisions. Keeping operating costs and of course airport charges to a minimum is a top priority.

For airports on the other hand, hub operations result in a far more complex and difficult situation. Airlines pay for the use of the provided infrastructure and services offered by the means of landing fees or passenger service charges. Thus, the costs incurred during the off-peak times through maintaining the peak-time capacities have to be covered by other means—sufficiently higher charges during the peak-times to subsidize off-peak periods are usually not accepted by the airlines. This effect, combined with a continuous attempt to lower the common aviation charges has led to the rising importance of non-aeronautical revenues for airport operators.[11] While general assumptions claim that about 50% of total revenues at airport companies are already generated though non-aeronautical, commercial activities, the share aviation revenues account for is expected to further decrease over the next years. Even today, large airports such as Los Angeles International, San Francisco International, Frankfurt or Munich already earn between one-third and two-thirds of their revenues by non-aeronautical activities. Table 2 shows current revenue splits for a selection of international hub and non-hub airports as well as for several airports with only minor hub operations.

While the changing revenue structure shows that airports have learnt to diversify their business and started to develop a certain independence from the air traffic development at their facilities, the hidden threats to hub airports also become apparent. Obviously the revenues from landing fees and passenger service charges will rise with an increase in air traffic, which is the

[11] Francis, Fidato and Humphreys (2003) discuss the issue of airport revenues and the potential conflicts of interest along two case studies of low cost carriers and their impact on airports.

core of every hub operation. This general observation still leads to a purely positive evaluation of setting up hub operations, since these bring both air transport and passenger movements on a large scale. However, it does not directly reveal the competitive and operational downsides of such a traffic pattern as shown in the above table. Aeronautical revenues become less important when hub operations gain momentum, literally forcing the airport to compensate their high investment and operations costs with another non-aeronautical income.

Table 2. Revenue split for selected airport operators, 2006

Airport	Hub status?	Share of aeronautical revenues	Share of commercial revenues
Frankfurt International	Yes	40%	60%
Singapore Changi	Yes	< 40%	>60%
London Heathrow (BAA)	Yes	approx. 40%	approx. 60%
Los Angeles World Airports	Partly	62%*	38%
San Francisco International	Partly	67%	33%
Toronto	Partly	59%	41%
Hamburg	No	65%	35%
Stuttgart	No	67%	33%

* including building rentals
Source: own depiction

As discussed in the light of competitive aspects, in most regions of the world there are either well-established hub airports already holding a strong market position or there is a group of airports simultaneously competing for the preferred hub location. The quality of facilities and services provided as well as the charges due for the airlines are of major competitive importance. While the airports' services tend to increase in volume and quality, the charges are systematically lowered in an attempt to attract airlines. Therefore, the positive financial effect of additional traffic tends to be diminished by the competitive measures facilitating the traffic growth.

At the same time, former monopolies, for example, ground handling services are being increasingly liberalized, leading to greater or new competition for the airport operators even within their own operations. This again leads to the effect of being forced to reduce charges and to increase the service quality offered.

In total, the effects of hub operations which are originally regarded as positive aspects have to be re-evaluated as very limited or non-existent. This situation mainly applies to newly developing hub airports. Well-established

major hubs with an accordingly strong market and competitive positions have usually solved these problems.

In addition to the discussed leveraging effect two additional factors have to be closely regarded in evaluating the financial side of turning an airport into a hub: passenger charges and commercial revenues.

Passenger charges at airports are levied to compensate the airport for its services in the context of providing passenger and baggage handling, ranging from check-in services, security controls, and baggage screening to the transport of passengers and luggage to the aircraft. Since most of these activities take place on the landside of the terminal and thus before the passenger enters the airside, the complexity and volume of services for departing passengers are the highest. For transfer passengers, the most important target group of hub operations, the majority of these activities are not needed since they have already passed security, very often even immigration and customs before leaving their origin airport. Thus, the passenger service charges for transfer passengers are usually significantly lower than for departing passengers, which again reduces the financial benefits for the airport operator. The following table gives an impression of passenger service charges at selected airports worldwide for both departing and transfer passengers.

Table 3. Passenger service charges at selected airports, April 2005

Airport	Departing Passenger Charge	Transfer Passenger Charge	Reduction of Transfer versus Departure Charge
Frankfurt	€ 12.15 – € 17.10	€ 10.00	18% – 42%
Munich	€ 9.86 – € 12.08	€ 7.69 – € 9.42	22%
Düsseldorf	€ 9.90 – € 11.78	€ 8.80	11% – 25%
Paris–Charles de Gaulle	€ 4.19 – € 12.10	€ 3.64 – € 9.08	13% – 25%
Dubai	AED 30.00	None	100%
Doha	QAR 30.00	None	100%
Singapore	SGD 15.00	None	100%
USA international airports	USD 14.10	USD 14.10	0%
Tunisia	€ 4.50 – € 6.00	None	100%
Lima	USD 5.04 – USD 28.24	None	100%
Nairobi	USD 40.00	None	100%

Note: Data from *Airport and Air Navigation Charges,* by International Air Transport Association, April 2005.

The lower the aeronautical revenues, the more important the non-aeronautical revenues become for the healthy business development of any

airport operator. While there are almost unlimited opportunities for airports to generate commercial revenues, the most profitable activities are usually the operation of parking spaces, concessions and retail activities. Parking is only needed by departing and arriving passengers and thus does not offer significant revenue generation potentials for hub airports. The same applies to many concessionaires' businesses, for example, car rentals or currency exchange bureaus.

Retail activities are mainly used by passengers who have already passed the security line and are on the airside. Having reached that point, the passengers use the waiting time to entertain themselves with shopping or dining, for example. The retail business of airports therefore benefits from a maximum idle time for the passengers. This of course is the direct opposite of what an airline expects from its hub airport, that is, the shortest possible minimum connecting time. If the passengers have only a very limited time to change aircraft they do not have enough time or at least feel that they do not have enough time to take advantage of the commercial attractions at the airport. This leads to a situation in which increasing operational efficiency and speed of the hub operations cause a significant decrease in commercial revenues.

A final aspect with significant impact on the economic success of hub operations for an airport is the required terminal space. Hub operations process large numbers of passengers and baggage at the same time. To handle these traffic flows adequately, terminal areas free of hindrances or installations to disturb the traffic flow are needed, providing an efficient operation. However, due to the need to finance the hub development through non-aeronautical revenues, the commercial areas need to be as large as possible. Since these areas should not interfere with the operational processes, even more space is required leading to additional investments and operational costs.

The financial impacts of turning a destination airport into a hub airport should be evaluated very carefully in each individual case. Well-established hub airports have found ways to generate sufficient revenues from their hub operations, even though they need to provide large capacities. In the first step this requires very high investment costs for new hub airports which furthermore lead to significant operational costs once the facilities are in place. The more efficiently the processes at the airport can be designed and realized, the less the airport will earn with hub operations, making the financial result of the development a rather risky undertaking.

CONCLUSION

Hubs are the focal points of today's aviation business. The growing importance of low cost carriers and their network strategies have increased

the number of point-to-point services in most parts of the world. However, the concept of consolidating traffic at major airports will remain the dominant approach in the foreseeable future.[12] Therefore the general interest in achieving a hub status will continue to remain an attractive target.

Most global markets already have well-established hub airports, which have gained dominant positions for their respective niches e.g. hubs for regional services or in the intercontinental market. The differences between these hub types have to be taken into account in all evaluations of the opportunities for a successful airport development. There are only a few white spots left where so far no airport has been successful in taking over the leadership role. In regions like parts of South America, Africa or even South-East Asia, many airports intend to establish such a position.

Our arguments have shown the typical development stages of airports, growing from typical O&D airports into hub airports. We have also described the competitive reactions to the strategic decision to transform an airport into a hub by surrounding competitors and have pointed out the financial risks in this undertaking.

In summary the following factors evolve as the crucial decision points for such a development.

1. From a financial point of view, operating an efficient and reliable O&D airport is far more beneficial than setting up a hub airport. Hub facilities require large facilities, needing high investments and generating increased operating costs. At the same time, aviation charges, especially passenger service charges, tend to decrease for transfer traffic, forcing the airport to generate revenues from other sources. Commercial revenues tend to be difficult to improve, due to the very limited time transfer passengers spend in the terminal.
2. A suitable geographical location is a prerequisite for an airport being chosen by an airline as a transfer point. A home base operator is necessary, since no other carrier usually has sufficient market presence to operate a real hub at a foreign airport.[13] A hub needs to be situated at a location which does not result in major additional flying time for airlines and passengers.
3. Any airport trying to establish a hub has to face severe competition by surrounding airports that are not willing to lose market share to their

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[12] This development is supported by the introduction of very large new aircraft like the A380 and the B747-8. Nevertheless, there will be a growing market for direct services on routes with larger demand—the market for which the B787 and the A350 are designed for.

[13] One of the very few examples is the airport of Singapore, at which Qantas of Australia operates a type of hub operation, having co-ordinated all their flights between Europe and Australia to allow for transfers.

neighbour or to give up their own position as gateway to their region. Competition will most probably result in decreasing revenues due to reduced aviation charges.

4. Closely related to the hub status is a strong dependence of the airport on a single carrier. If this carrier takes the strategic decision to close or relocate the hub or if the hub airline goes bankrupt, the airport faces a severe economic threat, which leaves it with substantial problems and costs.

It is always a risky decision to promote a change of the current function of an airport into a hub facility. Economic and financial success can of course be achieved, but need a long and consistent development. During this phase, severe competition has to be fought, requiring sufficient financial reserves to cover that period. Even then there is no guarantee for success in the intended venture.

Airports working on establishing a hub position do not have to watch competition passively. The fields of airport marketing and air service development offer significant potential to support the airport's development. They mainly include promotion and incentive programs to attract carriers to expand existing services or to introduce new ones to the airport. Of course those measures cannot guarantee a successful hub development. The future always depends on the airlines' and their passengers' decisions.

As soon as the hub status has been achieved and becomes established, it remains promising from both the economic and political points of view. In contrast to the attractiveness of this situation for governments of newly industrializing countries, the demand for potential new hub airports is diminishing. Therefore, the financial and political risks of achieving the hub function increase. If a developing country's government decides to liberalize the national aviation market, airline and airport development should be co-ordinated. Regulatory requirements for potential airport investors to develop an airport into a hub are of limited value to both, the national economy and the investor. A stabile hub operation at these airports can only be achieved, when the national carrier based at the airport benefits financially from a hub-and-spoke network structure. If this situation can be realized, positive effects will be achieved for both the local aviation players and for the region.

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