Summary

This International airport capacity benchmark compares the current capacity of 24 European airports as hubs and as business locations, as well as examining the developments as a result of expansion plans.

By comparing the capacities of various international airports, a clearer picture will emerge of the possibilities for developing Schiphol Airport, as compared to its competitors. Airports that still have a lot of room to expand will find it easier to remain competitive than airports with little or no room for growth.

Table S.1 lists the airports compared in this benchmark report.

Table S.1
Airports compared in this benchmark report

No.	Airport name	IATA code	No.	Airport name	IATA code
1	Schiphol Airport	AMS	14	London Stansted	STN
2	London Heathrow	LHR	15	London Gatwick	LGW
3	Frankfurt	FRA	16	Istanbul Ataturk	IST
4	Paris Charles de Gaulle	CDG	17	Rome Fiumicino	FCO
5	Munich	MUC	18	Helsinki	HEL
6	Milan Malpensa	MXP	19	Charleroi	CRL
7	Zurich	ZRH	20	Düsseldorf	DUS
8	Vienna	VIE	21	Weeze (Niederrhein)	NRN
9	Copenhagen	CPH	22	Luxembourg	LUX
10	Madrid	MAD	23	Cologne	CGN
11	Brussels (Zaventem)	BRU	24	Liège	LGG
12	Barcelona	BCN			
13	Manchester	MAN	25	Dubai	DXB

Dubai Airport was included in the benchmark study because both the airport and its home carrier Emirates are pursuing an explicit strategy to develop Dubai into a 'super hub'. This could lead to substantial competition in the Europe-Asia market.

Recent developments in the aviation sector have thrown a new light on the ongoing debate about capacity and capacity expansion. Until recently, it appeared that Schiphol, which currently has 450,000 aircraft movements per year, would soon find it very difficult to handle the increased traffic demands. Therefore, options were established for expanding capacity. However, it is now clear that a period of decline in the amount of traffic will temporarily interrupt the airport's growth. As a consequence, the feeling that capacity expansion was urgent has decreased.

Nevertheless, it is realistic to assume that the demand for air travel will increase once again – together with the associated need for airport

capacity – in the medium to long term. Then, Schiphol's competitive position compared to other airports will again become an issue. This benchmark report provides information for the assessment of that competitive position.

Airports as hubs
Airports serve as hubs where airside and landside traffic converge and exchanges occur between the various transport systems. This report will focus on the capacity issues in relation to airside traffic. Airside capacity is determined not only by the number of runways, but also by the capacity of the terminals and the Air Traffic Management (ATM) system. It can be defined in terms of the maximum number of aircraft movements that the airport can handle within a given amount of time (hour/year). The runway system as a whole, the ATM system and the terminals are the factors that combine to determine airside capacity.

It is often difficult to consider the airport's physical capacity separately from the constraints of environmental measures taken to regulate noise levels at the airport and in the surrounding area. The benchmark is therefore based on two key pieces of data provided by the airports themselves (declared capacity): the annual capacity and the peak hour capacity. Both indicators take into account the policy on capacity and, in particular, the restrictions imposed by noise regulations.

Traffic and transport volume
The airport's role as a hub is measured in terms of the number of aircraft movements, passenger numbers and cargo volume. In the graphs S.1 to S.3, the airports are ranked in terms of these indicators, from highest to lowest.

Schiphol, Charles de Gaulle, Heathrow and Frankfurt can be classified as multifunctional hub airports that handle large volumes of both passengers and cargo. Luxembourg, Cologne and Liège are typical examples of cargo-dominated airports that handle relatively few or no passengers at all. Brussels, Charleroi, Düsseldorf and Weeze (Niederrhein) are the most important airports for Dutch passengers located just across the Dutch border.

In terms of aircraft movements and passenger transport, Schiphol is Europe's fifth largest airport. It is the third largest in terms of cargo volume. The figures demonstrate that the relationship between passenger volume and aircraft movements is not linear. For example, Heathrow has 68,000 fewer aircraft movements than Charles de Gaulle, but it handles nearly 8 million more passengers. This is due to differences in the average aircraft size and the type of aircraft (passenger aircraft, full freighters and 'combis').

Figure S.1
Number of aircraft movements by airport in 2007

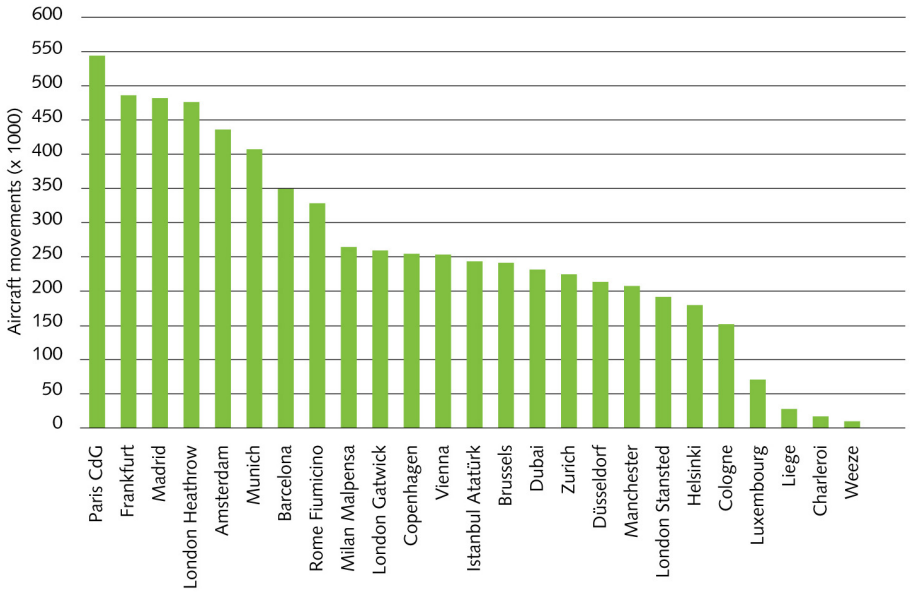


Figure S.2
Number of domestic, transit and international passengers by airport in 2007. (Transit passengers have a layover at the airport in question, but do not change planes. At most airports, these passengers account for less than 0.5 percent of the total.)

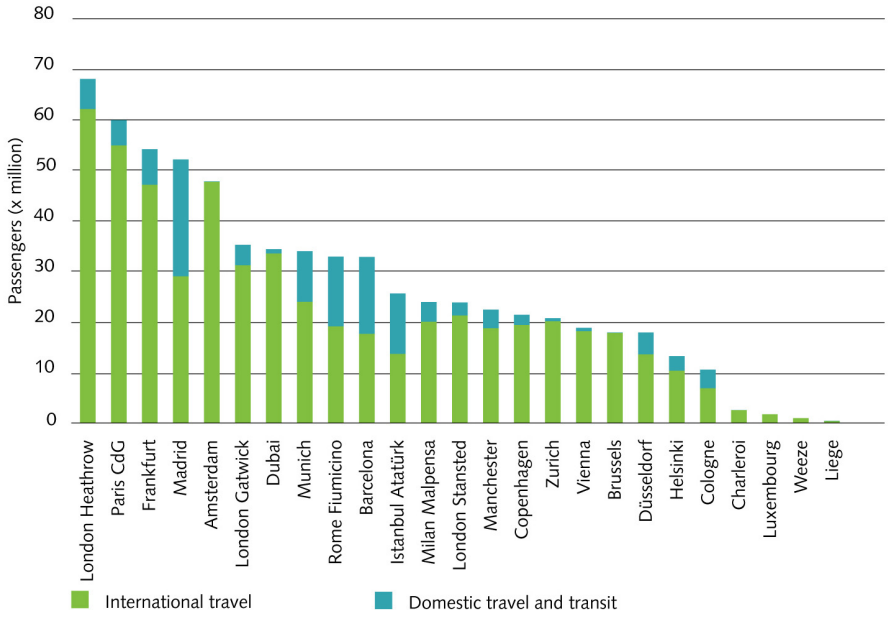
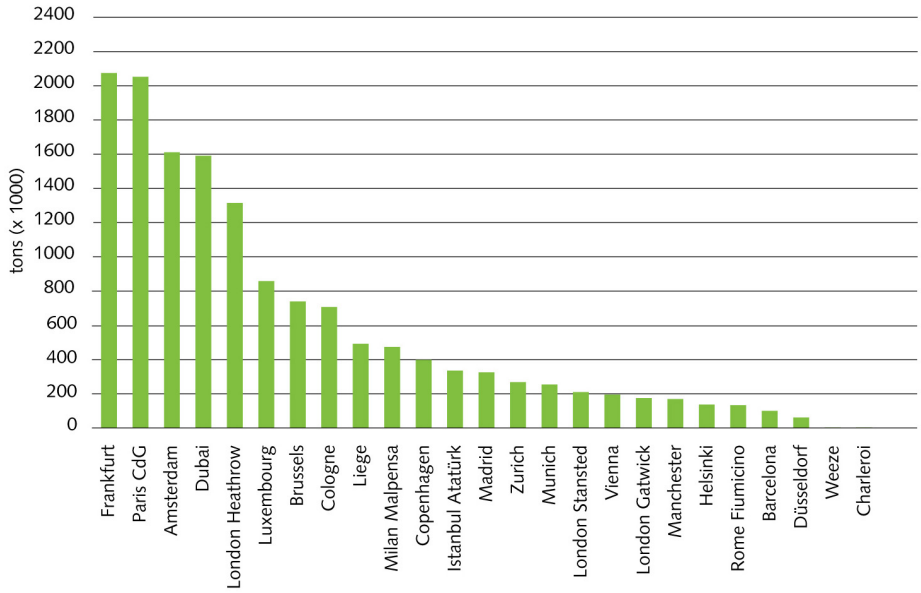


Figure S.3
Cargo volume by airport in 2007



Annual capacity
The competitiveness of a given airport in the future depends on the initial situation, i.e. the current volume, as well as on the degree to which the airline network development can be facilitated by means of free capacity. Important indicators for this are the total number of available slots and the difference with the number of slots already in use (i.e. residual capacity). Table S.2 ranks the airports according to these indicators.

Airports that still have a lot of room to expand will find it easier to remain competitive than airports with little or no room for growth. The impact on relative competitiveness will depend on local market conditions, the strategies of the airlines, airports and governments and the degree to which airport networks complement each other. Just because an airport has the resources to expand considerably does not necessarily mean it will become a major competitor.

Based on the figures shown above and below, the following conclusions can be drawn about Schiphol:

- Schiphol was Europe's fifth largest airport in terms of aircraft movements (436,000) in 2007.
- In 2007, Schiphol was tenth as regards the number of available slots (450,000).
- Based on the current system, Schiphol's ability to expand is comparatively limited. Schiphol ranks 22nd amongst the airports with the most residual capacity.

Implementation of the 'Alders recommendations' (*Aldersadvies*, a report compiled by a committee chaired by Hans Alders) in the medium term will allow Schiphol to increase its capacity to 510,000 aircraft movements by 2020. This will also change Schiphol's ranking in respect of both indicators. If the capacity of the other airports remains

runway, which is expected to become operational when the 2011 winter timetable takes effect. Expansion of the terminals is also underway. This will increase the airport's capacity to approximately 700,000 aircraft movements and 88 million passengers. In terms of available slots, Frankfurt Airport will then rank second. This seems to be unfavourable for Schiphol's competiveness, as Frankfurt is Lufthansa's base and Lufthansa is part of the Star Alliance - a key competitor of the Sky Team alliance, which includes the Air France – KLM group. What might be favourable for Schiphol is that permission for the expansion was granted on condition that the runway will be closed at night and that the total number of nighttime flights would be reduced. Airlines are currently contesting this condition in court.

- With 482,000 aircraft movements, Madrid is Europe's third largest airport and it ranks second in terms of available slots (631,000). Two new runways are planned, but it is still unknown how much this will help airport capacity. What sets Madrid apart is the large proportion of domestic passengers, who account for about 44 percent of a total of 52 million (see figure S.2). In terms of international passengers only, Madrid ranks sixth in Europe. However, the airport's international segment is growing rapidly. The airport is also seeing a decline in the number of domestic passengers caused by the new high speed rail link between Madrid and Barcelona. The result is more residual capacity, which may be used for more international flights in the future.

- With 476,000 aircraft movements, Heathrow is Europe's fourth largest airport and it ranks ninth in terms of available slots (489,000). In the coming years, Heathrow will have very little room for growth, particularly now that the number of available slots has been reduced to 480,000 since the opening of the fifth terminal in 2008. The airport has received permission from the British government to build a third runway. Because of its location in relation to the existing airport, the new runway will be subject to strict noise and environmental regulations. The runway is not expected to be finished until 2020 due to the numerous procedures that have to be completed. Once the runway is complete, Heathrow's capacity will increase to 605,000 aircraft movements. Provided that the use of noisy aircraft is phased out, the new system could allow for 702,000 aircraft movements by 2030. All else remaining equal, Heathrow would then be fourth and third, respectively, in terms of the number of available slots.

- With 407,000 aircraft movements, Munich is Europe's sixth largest airport and it also ranks sixth in terms of available slots (520,000). Although the airport still has considerable room to grow, preparations are underway for the construction of a third runway. One of the terminals will also be expanded. It is not known how many new slots will be created by the expansion, but it is estimated that Munich will be able to accommodate about 67 million passengers.

Because of the attention that Weeze (Niederrhein) and Dubai are receiving in discussions about Schiphol's future, the developments at these two airports are briefly described below:

- Weeze (Niederrhein) is located in Germany only a few kilometres from the Dutch border in the Nijmegen-Venlo-Duisburg 'triangle'. At present, the airport occupies a relatively modest position in the sector, ranking 24th in terms of aircraft movements (9000) in 2007. However, the airport is growing rapidly and processed 1.5 million passengers in 2008 – nearly twice as many as in 2007. Furthermore, Weeze has the potential to handle a relatively large number of aircraft movements (268,000). If the airport takes advantage of this potential, the current terminal capacity (2.5 million passengers) will in any event be a limiting factor. Another constraint is that the airport does not have a permit to handle aircraft with a take-off weight exceeding 340 tons. This means that large commercial airliners such as the Boeing 747-400 cannot take off or land there.

- With slightly fewer aircraft movements than Brussels, Dubai is currently not considered a very large airport either. However, it has the potential to grow into a super hub with 788,000 available slots. There are also plans to build a new airport nearby with even more capacity. One of the cornerstones of Dubai's strategy is to become a hub for intercontinental traffic between Europe and Asia. If the airport and the home carrier Emirates achieve this goal, there will be a definite impact on European hubs. However, it is unclear how recent changes in the economic situation will affect the airport's future development as a hub.

Peak hour capacity
Peak hour capacity is one indicator that is especially relevant to airports with hub networks. Often, hub networks are largely dependent upon passengers who connect to other flights. In many cases, it is crucial that the waves of inbound and outbound flights are handled relatively quickly to provide these transfer passengers with the best possible service. The maximum peak hour capacities now and in the future are shown in Figure S.4 for each airport.

With regard to peak hour capacity, Schiphol and Charles de Gaulle share the top position: both can accommodate a maximum of 112 aircraft movements per hour. With 96 aircraft movements, Madrid Barajas ranks third, followed by Munich with 90 aircraft movements. For airports of their size, Heathrow and Frankfurt have relatively low peak hour capacities of 87 and 82 aircraft movements per hour, respectively.

By 2020, these six airports will all have a peak hour capacity of 120 aircraft movements per hour, if all expansion and utilisation plans are implemented. As a result, the leading home carriers in the alliances competing with SkyTeam will be able to exploite a dual-hub system at

constant, Schiphol will rank eighth in terms of available slots and 18th in terms of residual capacity.

Tabel S.2
List of European airports by available slots and residual capacity

Rank	IATA code	Available slots (x 1000) in 2007	IATA code	Residual capacity in slots (x 1000) in 2007	Residual capacity as a percentage
1	CDG	705	HEL	317	64%
2	MAD	631	NRN	268	97%
3	BCN	561	CPH	259	50%
4	FCO	557	FCO	229	41%
5	FRA	539	CRL	225	93%
6	MUC	520	BCN	212	38%
7	CPH	513	VIE	181	42%
8	HEL	496	BRU	175	42%
9	LHR	489	MXP	169	39%
10	AMS	450	ZRH	163	42%
11	VIE	434	CDG	161	23%
12	MXP	433	MAN	149	24%
13	BRU	416	MAD	149	42%
14	ZRH	387	LUX	116	62%
15	MAN	356	MUC	113	22%
16	IST	333	LGG	90	27%
17	LGW	291	IST	90	77%
18	NRN	277	STN	71	27%
19	DUS	263	FRA	53	10%
20	STN	262	DUS	50	19%
21	CRL	241	LGW	32	11%
22	LUX	186	AMS	14	3%
23	LGG	117	LHR	13	3%
24	CGN	-	CGN	-	-
	DXB	788	DXB	557	71%

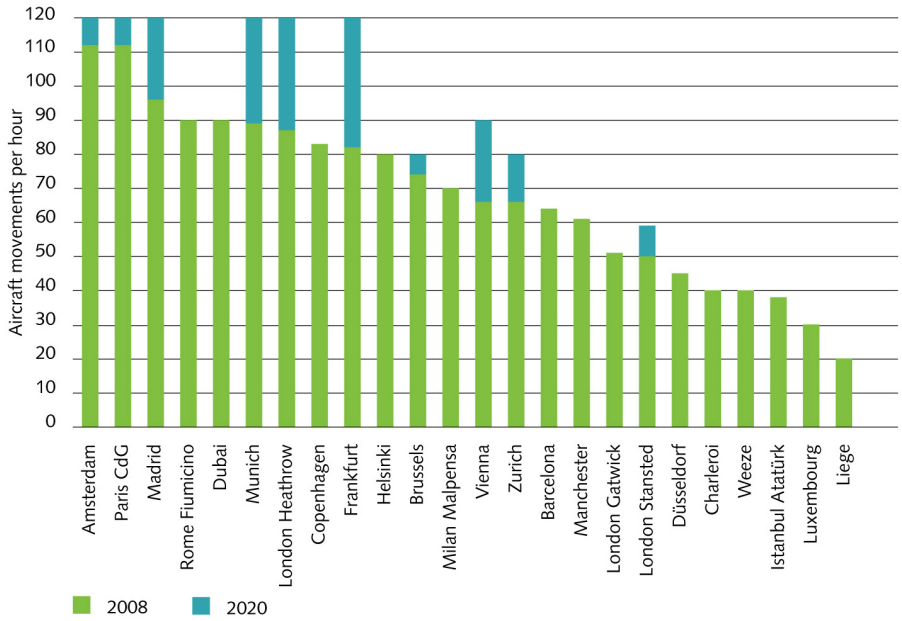
Competing airports have plans to expand their capacity. The most significant developments at Schiphol's top five competitors are as follows:

- Charles de Gaulle is the largest European airport both in terms of its current number of aircraft movements (544,000) and available slots (705,000). No plans have been reported to increase the number of slots any further. However, terminal capacity will be increased in the period from 2009 to 2012, in order to process more passengers. Although Charles de Gaulle and Schiphol are competitors, each airport acquired an eight percent interest in the other in 2008 with a view to improving the competitiveness of the two airports within the Air France - KLM dual-hub system.

- With 486,000 aircraft movements, Frankfurt is Europe's second largest airport and it ranks fifth in terms of available slots (539,000). Frankfurt Airport has begun construction of a fourth

airports with a peak hour capacity that is about the same as that of SkyTeam's hubs.

Geef kop
Current and future peak hour capacity



The maximum peak hour capacity cannot always be achieved in practice, mostly due to weather conditions. Of all the airports included in the benchmark study, Schiphol is impacted most by the weather. Poor visibility due to fog or low clouds is the problem in about half of these cases. In 2004, the average peak hour capacity at Schiphol for inbound flights under less than ideal weather conditions was about 35 percent lower than under optimum weather conditions. At Charles de Gaulle, the percentage is about the same. When weather is a limiting factor, the peak hour capacity at the competing airports is similar.

There is great variation amongst the airports as regards the utilisation of peak hour capacity. Various figures relating to the utilisation and the average residual capacity per hour are given for Schiphol and its five greatest competitors in table S.3.

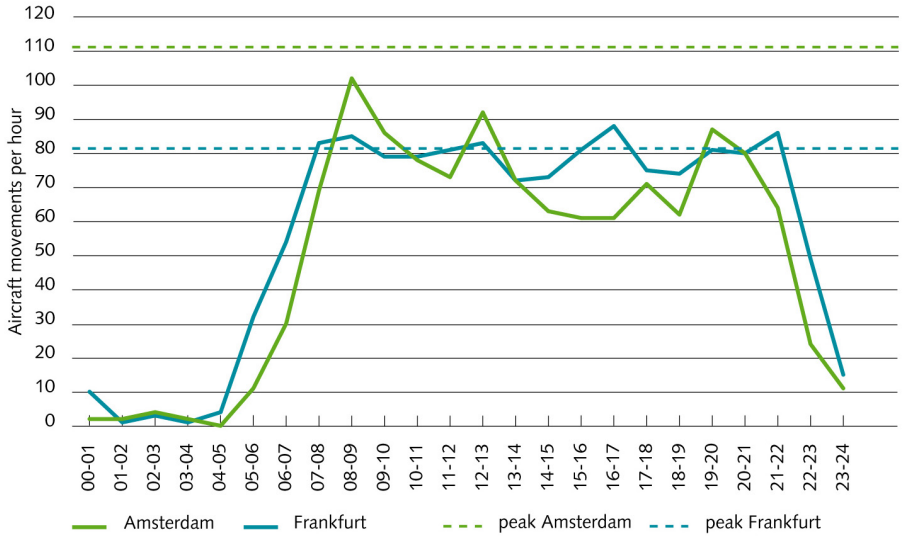
Table S.3
Utilisation and average residual capacity per hour

Number of aircraft movements still possible during busiest hour		Average residual capacity between 06:00 and 22:00 hrs (aircraft movements/hour)		Number of aircraft movements possible during busiest hour in 2020		Average future residual capacity between 06:00 and 22:00 hrs (aircraft movements/hour)	
AMS	10	AMS	40	LHR	35	AMS	48
MAD	7	CDG	23	FRA	32	MAD	46
LHR	2	MAD	22	MAD	31	MUC	45
CDG	-1	MUC	14	MUC	28	FRA	42
MUC	-3	LHR	7	AMS	18	LHR	40
FRA	-6	FRA	4	CDG	7	CDG	31

As shown above, Schiphol, Madrid and Heathrow still have the capacity to accommodate additional aircraft movements during the busiest hour of the day, while Charles de Gaulle, Munich and Frankfurt do not. At the latter three airports, the number of flights handled during the busiest hour in practice even exceeds the peak hour capacity reported to Eurocontrol.

Frankfurt and Heathrow operate at 100% capacity almost all day. That means that there is generally little flexibility for accommodating additional flights, which explains why these airports are under such pressure to expand their capacity. Schiphol has the most residual capacity. In figure S.5, the number of aircraft movements per hour at Schiphol is compared to the number at Frankfurt Airport. The figures demonstrate that Schiphol is not yet utilising all of its capacity, except during the morning peak hour. However, the current environmental regulations allow little room for manoeuvre - the airport has nearly reached its annual capacity. Once the Alders recommendations have been implemented, it will be possible to add aircraft movements throughout the entire day, except at night: slightly fewer aircraft movements will be allowed at night compared to the current situation.

Figure S.5
Number of aircraft movements per hour in 2007



If the aforementioned airports have a peak hour capacity of 120 aircraft movements per hour by 2020, there will be much more flexibility, particularly at Heathrow and Frankfurt. The increased capacity might cause a shift from a relatively even distribution of flights throughout the day to a pattern with more peaks.

Conclusion
In future, Schiphol will have a lower annual residual capacity than its competitors. Whether Schiphol will then remain an attractive hub will depend, among other things, on how Schiphol and other airports utilise the available capacity in terms of the number and type of destinations and the frequency of flights. Schiphol Airport, the largest airlines and

the Dutch government are pursuing a policy of selective development in order to encourage non-hub-dependent traffic to develop elsewhere. This will require an increase in capacity at regional airports. Schiphol's position will also depend to a significant extent on the development of demand over time at the various airports and the strategies adopted by the airports, airlines and governments as regards network development at the airports concerned. Therefore, detailed analyses of the development of demand, networks and strategies at other airports must be carried out in order to predict Schiphol's relative competitive position. Analyses of this kind go beyond the scope of this benchmark report. For the sake of illustration, a number of figures relating to the nature and scope of the current airport networks compared to those at Schiphol have been included in the database for this benchmark report.

The European airports included in the benchmark study handled a total of approximately 6.3 million aircraft movements in 2007. The total residual capacity at these airports was about 3.2 million aircraft movements, or about 50 percent. Whether that is enough to accommodate the increasing demand will depend on how quickly demand picks up and how it then develops. Eurocontrol scenarios show that demand for aircraft movements in 2020 will grow by 40 percent in the lowest scenario and 60 percent in the highest. The expectation is that future capacity demand and supply will not be in balance with each other geographically. Some airports in the benchmark are currently not popular or less popular, but do have considerable capacity for growth. It is possible that these airports will get an overflow function in the event of impending shortages at popular airports.

Airports as business locations

In recent decades, airports have gradually broadened their range of activities. Originally, they functioned mainly as hubs, but today airports and the surrounding areas can increasingly be considered autonomous economic zones that sometimes even have social significance. The development of offices, shopping centres, meeting rooms and other facilities has transformed airports into places that are important for both passengers and non-passengers.

The airport's role as a business location has two aspects. One aspect is the degree to which the airport is a *factor* in the business' choice of location in addition to other factors such as the tax climate, average level of education, etc. The second aspect is the degree to which the airport and the surrounding area provide *a location* for businesses related to the airport, including international businesses.

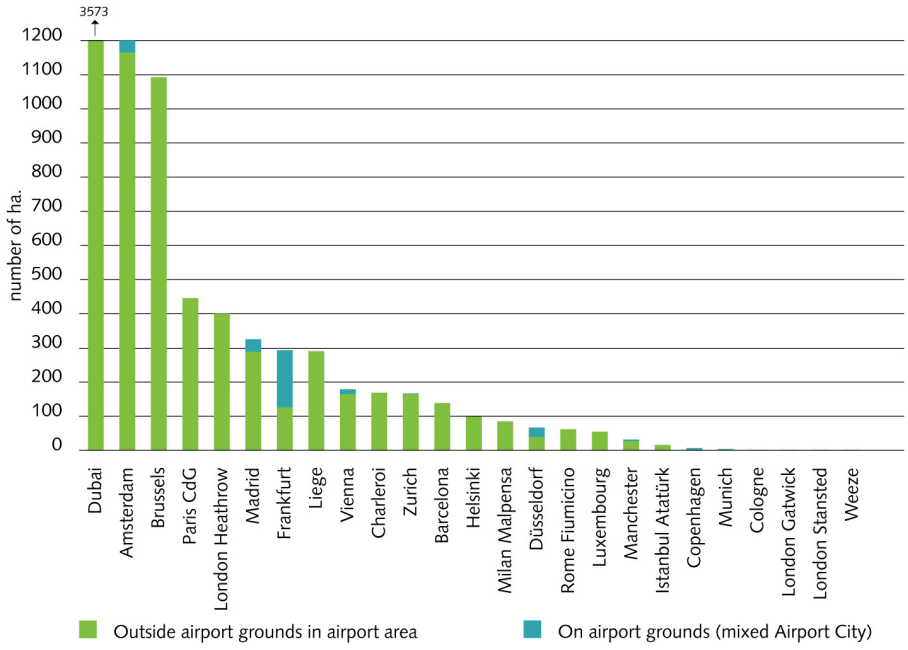
According to the Airport Spatial Development Committee, the roles of hub and business location have become more and more interdependent. On the one hand, the airport's role as a hub is strengthened when airport-related businesses establish branches in the region. On the other hand, a dynamic hub is vital to the economic development of the region, because businesses will then want to establish themselves within the general vicinity of the airport.

A good indicator of the airport's role as a *business location* is the amount of space used to accommodate airport-related businesses. This space can be located either on the airport site itself in a 'Mixed Airport City' (a mixture of businesses making use of the hub as a customer and businesses with other functions like retail, catering industry and transport), or outside the actual site but still within the airport area. For the purpose of the analyses, the airport area is defined as a 20 kilometre by 20 kilometre area around the airport.

The surface areas involved are given in Figure S.6. For the sake of comparison, not all of the Dubai surface area (3,573 hectares) is shown in the figure.

The largest areas dedicated to airport-related businesses (including offices and logistics activities) are found at Dubai, Schiphol and Brussels airport. Frankfurt, Schiphol, Madrid, Düsseldorf and Vienna are clear examples of airports with airport-related businesses on the actual site of the airport (Mixed Airport City).

Figure S.6
Amount of space used by airport-related businesses

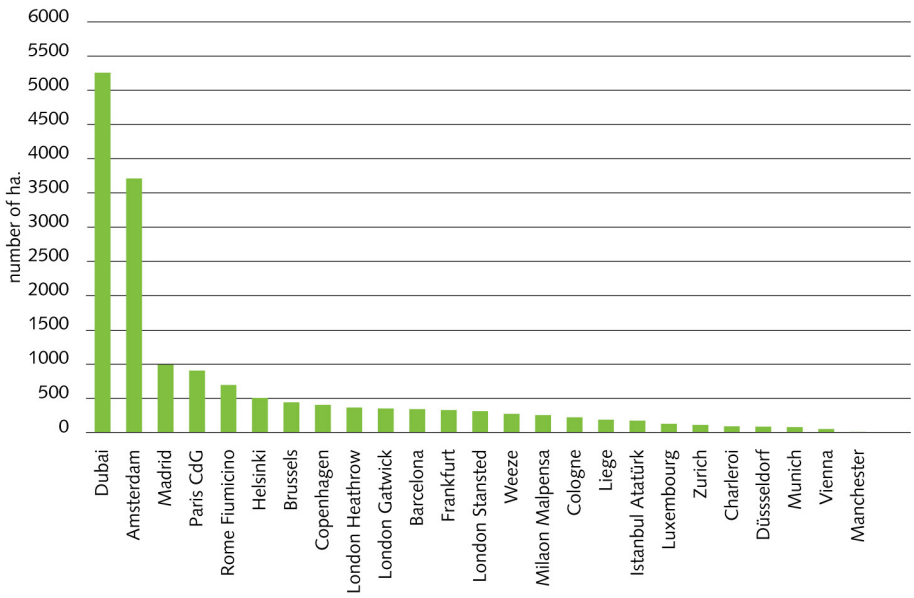


Some regions with airports pursue a clear strategy to expand the surface area available to airport-related businesses. The philosophy behind this strategy is that further development of 'airport corridors' (i.e. areas that link the airport to the existing urban region) can play an important role in the international competitiveness of metropolitan areas. The figures in Figure S.7 provide an indication of the potential for accommodating additional airport-related businesses. Dubai and Schiphol possess the greatest potential in this respect, with 5,257 and 3,709 hectares of available land, respectively.

Madrid and Charles de Gaulle are also expected to develop areas similar to airport corridors in the future. London Heathrow has little

opportunity to develop an airport corridor, because the airport is already almost entirely embedded in an urban area. Frankfurt and in particular Munich also have few possibilities to accommodate more businesses.

Figure S.7
Available space to accommodate more businesses by airport



Conclusion

Schiphol's prospects are favourable with regard to business accommodation. Of all the European airports, Schiphol has the most space available specifically for airport-related businesses within a 20 kilometre by 20 kilometre area. Schiphol also scores well in terms of its potential for further development of such sites. However, this does not mean that other airports necessarily have less space to accommodate airport-related businesses. It simply means that such businesses will be more dependent on the available space on other types of sites (either current or planned sites), which may be less attractive as regards access to the airport. Apart from that accessibility is requiring attention in relation to the airport's role as a hub. The additional traffic caused by business activity can interfere with accessibility, which in turn undermines the airport's attractiveness as a hub.

Policy on capacity

To add depth to the largely quantitative comparison provided, the benchmark study was expanded to include a comparison of the policy on capacity in the Netherlands with the policy in the surrounding countries. The comparison looks at historical development, legal contexts, procedures for expansion of capacity, relations with local residents and future plans. The results regarding future plans have already been summarised in the section on the airport's role as a hub.

In nearly all of the countries compared (the Netherlands, England, France, Germany, Belgium and Luxembourg), airport capacity for civil aviation was originally developed on sites that had previously been used mainly for military purposes. Once the aviation sector began to

expand and jet aeroplanes appeared, these sites were no longer sufficient. The jets were noisy, which presented a problem because the sites were often too close to existing buildings. In addition, there was little room for the airports to grow at some locations. Over time, many countries built new national airports at locations that seemed more suitable. As a result of increasing urbanisation, however, noise nuisance (and therefore the potential to expand) became an issue to a greater or lesser degree once again.

Due to European regulations, all of the countries studied have legislation in place for measuring and monitoring noise nuisance. The legislation limits capacity in one way or another in all of the countries, except in Luxembourg. In the Netherlands, the restrictions centre mainly on the annual capacity. In the other countries, the restrictions focus primarily on nighttime capacity: the number of flights is subject to a quota, which is sometimes based on certified noise levels per aircraft. The legislation imposes few if any restrictions during the day. London and Paris also have airport systems that operate according to statutory traffic distribution regulations governing the allotment of air traffic amongst the regulated airports.

There are no separate legal regulations governing airport planning. In all the countries, airport planning must take place in accordance with general spatial planning procedures at national, regional and local level. The main points of the various countries' procedures are quite similar. They require close interaction between the various levels of government, the airport authority, environmental, noise and/or spatial planning advisory committees, the local residents and other stakeholders. However, the exact interpretation of the procedures and the time allotted do vary from country to country. Additionally, some advisory bodies play a particularly prominent role. In France, for instance, a national noise authority, ACNUSA, plays a major role. There is no comparable body in any of the other countries.

In all the countries, the major airports have a precarious relationship with the local residents. All countries have large residents' organisations that fight for a better living environment. Consultation with residents' organisations is regulated by law in every country, except in Belgium and Luxembourg. However, Belgium does have a voluntary consultation forum. It is also the only country studied where the courts declared a residents' organisation to be the beneficiary of penalty payments for a breach of noise standards. According to the organisation, these penalties amount to some 60 million euros. However, the defendant has not yet paid the penalty and is contesting the matter in court.

Conclusion

In all surrounding countries, airport capacity policy is subject to the same sensitivities as those that exist in the Netherlands. All countries are faced with dilemmas relating to how the airport should fit in the surrounding area and have to deal with local residents' concerns about expansion of capacity. As a result, long administrative and legal

preparation is required before expansion can actually take place. The Netherlands is no exception. One interesting detail in the Netherlands is that discussions about expansion of capacity for the short and medium term centre mainly on expansion of the environmental capacity. In contrast, in other countries that are struggling with an acute shortage of capacity, the expansion of physical runway capacity is the main subject under discussion. Nevertheless, the planned physical expansion in those countries is subject to stricter environmental regulations than was previously the case.