ACI EUROPE POSITION PAPER

Airport Capacity

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ACI EUROPE
AIRPORTS COUNCIL INTERNATIONAL

Introduction

Airport capacity is a crucial component in the overall performance of the aviation system and the ability of airports to serve passengers and optimise their travel experience. With demand for air transport predicted to continue growing in the coming decades, it is essential that airports are able to accommodate growth in a sustainable manner but also to ensure smooth and punctual journeys as well as a route offering which satisfies passenger demand.

The availability of airport capacity not only matters because it dictates the ability of airports, as part of the air transport system, to respond to passenger demand, but also allows airports to face the challenges presented by adverse weather conditions or en-route restrictions, such as lack of ATC staff in parts of the Network. Furthermore, ensuring the provision of adequate airport capacity allows for entry by new airlines and increases of frequency, generating the conditions for more airline competition. The level of airline competition is a significant determinant of air fares on a route.[1]

In many cases, the provision of adequate capacity at airports can be done through infrastructure or system development, which tend to imply significant investment. However, continued effort to optimise the use of existing capacity will allow airports to postpone these significant investments in physical infrastructure or systems, and therefore avoid increases in airport charges to fund such investments.

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1. https://www.icf.com/resources/reports-and-research/2018/identifying-the-drivers-of-air-fares

The capacity provided by the airport system is determined by multiple factors, many of which are not directly within an airport operator's control. Ensuring that these factors are addressed in an optimal manner, through integrated operations and collaborative decision-making, is key in ensuring that airport capacity is best used and even optimised when possible.

The following paper shall set out how airports may best achieve improvements in the use of available capacity within the airport system and, although it is a stand-alone document, is supplemented by the **ACI EUROPE Position Paper on Airspace & ATM**, the **ACI EUROPE Position Paper on Airport Slot Allocation** as well as the **ACI EUROPE Guidelines for Passenger Services at European** Airports. These three elements of the airport system have a direct impact on the overall system's performance.

Istanbul Airport / IST

What determines airport capacity?

Numerous factors combine to determine an airport platform's capacity. The available capacity is maximised when each factor is put to use at its optimal level, bearing in mind that increasing capacity in one area can decrease capacity elsewhere, thus reducing the overall effectiveness (e.g. increasing runway throughput without appropriate apron capacity or an efficient turnaround process).

In addition, the airport capacity can be divided into nominal and peak capacity. Off-peak or nominal periods are needed to recover from over-demand during peak times (e.g. in case of delays).

Runway

Physical runway capacity is one of the key descriptors of airport capacity, and is determined by a number of criteria, which often intersect with other elements of capacity including airspace capacity. These include:

- The number of runways in use, their location, their use in different weather conditions, the design of exits and taxiways, etc.,
- In-trail separation of aircraft - how closely aircraft can be spaced one after another when approaching the runway,
- Lateral separation, especially in bad weather, between aircraft approaching the same airport on parallel runways,
- Whether multiple runways may be operated independently of one another,
- The sequencing and separation of departing and landing aircraft on runways that intersect,
- The sequencing of departing and arriving aircraft on a single runway,
- The sequencing of aircraft approaching airports located in close proximity to one another, where one aircraft must

cross the path of another aircraft landing at a nearby airport (see also airspace capacity below),

- The presence of obstacles that limit the use of runways according to the aircraft performance, especially for very large aircraft,
- Aircraft mix operating at the airport (aircraft wake vortex categories which determine the spacing of aircraft approaching and departing the runway, runway occupancy time, separation standards, approach speeds…),
- Weather conditions (visibility, ceiling, wind direction and speed, precipitation, low temperatures…),
- The condition of the runway due to weather, and the negative effect on aircraft performance (reducing airport capacity / throughput),
- Equipment (type of navaids provided, ATC equipment…),
- Level of ATC staffing, etc.,
- Percentage of arrivals versus departures within a given period of time and how this percentage changes during the day (i.e. Hub in, Balanced, hub out waves).

Apron

The size of an airport's apron and the number of stands required to handle a number of aircraft within a given period of time determine apron/stand capacity. Again, annual throughput and peak capacity are decisive while the apron/stand capacity is further influenced by elements such as the turnaround times and the mix of aircraft operating at the airport. Ideally, the mix of stands available matches the capacity requirements of the mix of aircraft operating at the airport.

Apron/stand capacity can be a limiting factor when aircraft operators upgrade aircraft types or fleet mix which, in some cases, is done fairly rapidly. However, the construction or modification of aircraft stands can be a longer process.

Terminal

Terminal size is not dictated by annual capacity but rather depends on both annual passenger throughput and anticipated peak hour flows, and may be a limiting factor on airport capacity. In order to allow the efficient movement of passengers through touchpoints within an airport terminal, the passenger processing capacity of these touchpoints is decisive. Examples of touchpoints include security checkpoints, border control, boarding gates, baggage sortation system, or check-in desks. The terminal design and configuration, and appropriate signage and wayfinding, therefore have an impact on capacity through both the space available as well as the assurance of a smooth passenger flow through the terminal. Limitations on any one of these touchpoints can have a significant impact on the overall airport capacity. Landside accessibility (car parking, access roads, public transport connections) may also have an impact.

Amsterdam Airport Schiphol / AMS

Airspace

Airport capacity is influenced by the capacity of the airspace surrounding an airport, in particular the capacity of the Terminal Manoeuvring Area (TMA) - a designated area of controlled airspace surrounding an airport. The main purpose of the TMA is to connect the airport approach or departure routes with the en-route structure of the upper airspace. However, the capacity of the TMA depends on a number of factors such as the design of arrival and departure routes to and from an airport or the configuration and interfaces between two or more TMAs serving individual airports in the same portion of airspace.

The sequencing of aircraft approaching airports located in close proximity to one another, where one aircraft must cross the path of another aircraft landing at a nearby airport, particularly impacts the capacity of these airports. Further examples of factors influencing TMA capacity could be military or other airfields located in the area surrounding an airport or restrictions regarding the overflight of residential areas for noise reasons. The availability of divergent standard instrument departures (SIDs) and the impact of any noise mitigation by way of aircraft departure routing can also affect capacity.

Lisbon Airport / LIS

What is the capacity problem?

According to the 2018 EUROCONTROL Challenges of Growth report, demand for air traffic in Europe is expected to grow by at least 53% by 2040 compared to 2017 levels. While EUROCONTROL's predictions imply a slower rate of growth compared to the 20 years up to 2008, and the report notes a planned 16% increase in capacity between 111 European airports, it is predicted that by 2040 there will be 1.5 million more flights in demand than can be accommodated, equating to 8% of demand and 160 million passengers. At least 16 European airports will be operating at near full capacity for most of the day, compared to 6 in Summer 2016.

The expansion of physical airport capacity is the most obvious means of increasing overall airport capacity but often requires governmental and public approval, which is presently a long and difficult process in Europe. The lack of available space, environmental concerns and the impact on neighbouring communities makes such a solution often physically and politically complicated. These same political and environmental concerns are equally having an increased impact on the usage of available capacity, through actions such as requiring changes to approach or departure routes due to noise or the implementation of more stringent night ban regulations.

Additionally, investment into capacity expansion must be financed. Because airport infrastructure often comes in relatively large amounts compared to the asset base, it may result in short-term increases in airport charges or pre-financing of the infrastructure, which are then lowered as the new capacity is in use. As a result, airlines will frequently oppose any investment that increases costs. Airlines have a short-term focus on costs in the next season, while an airport, in order to serve its passengers, has a longer-term focus. Opposition to investment is especially strong if an airline will see that capacity used by competitors, since air fares are determined by competition on a route. Hence, in jurisdictions

where economic regulation gives more power to airlines, there is an additional regulatory hindrance to capacity expansion.

Airports' ability to maximise their capacity on the ground is also impacted by the capacity crunch in the air, where a shortage of ATM capacity has led to record delays and underlines the necessity of achieving the implementation of a Single European Sky. The implementation of new ATM technology and procedures offer promising advances in runway throughput, but require investment and a holistic view incorporating airspace and physical airport capacity in order to deliver the most benefits.

Finally, airport capacity may also be optimised through slot allocation, however the slot allocation process in Europe, as governed by Regulation 95/93, requires reform in order to ensure better use of available capacity and avoid undesired behaviours by airlines such as slot baby-sitting for example.

Madrid-Barajas Adolfo Suárez Airport / MAD

Making best use of existing capacity

With so many factors influencing an airport's capacity, it is essential to find the right mix and to squeeze the most out of each determinant, in a way which optimises capacity to meet current and future demand. The right mix will depend on numerous local and network-wide factors, and as mentioned above the effect of addressing one capacity driver on the constraints provided by others must always be considered. In this context, airports wishing to optimise the use of available capacity may consider the following points.

Physical infrastructure

Not only does the number of stands and their size impact capacity, the handling of the aircraft requires a number of vehicles and equipment that need to be nearby the stands or which require easy access to the stands and the terminal so as to carry passengers, baggage and goods to and from the aircraft. To reduce the number or the size of the vehicles and the environmental impact, the apron parking stands can be equipped with centralised systems (GPU, PCA, VDGS, refuelling points, boarding bridges). Another solution would be equipment pooling by ground handling service providers, which has proven to de-clutter apron areas. All of the elements combined enable better management and use of stand capacity, giving better control over the turnaround process and thus contributing to the number of movements which an airport can handle in a given period.

Within the terminal, a range of new technologies permit the automation of some processes so as to reduce the number of operators, reduce the processing time at critical touchpoints and maximise the use of available space (e.g. automatic border controls, self-check-in desks, self-boarding gates, biometric controls). This can increase the number of passengers served and increase throughput, again contributing to the optimal use of the

available capacity of the airport and the overall number of flights and passengers which may be served[2]

ATM technology and procedures

The separation applied by ATC for approach and departure can change runway throughput significantly and is affected by the aircraft size mix. Procedures and technologies can increase the capacity of the TMA (e.g. Performance Based Navigation, RECAT, Time-Based Separation, Trombones).

Optimising existing capacity is supported by technologies and procedures developed in the Single European Sky ATM Research Programme (SESAR). According to the 2018 Challenges of Growth report, SESAR solutions offer the potential to reduce the capacity gap by 28% by 2040. Available options include, RECAT-EU, time-based separation, arrival and departure management (AMAN/DMAN), separation optimisation and data-link.

However, it should be determined on a case-by-case basis whether the developed technologies and procedures actually have a positive impact on capacity and efficiency of individual airports. A one-size-fits-all approach, with mandatory implementation, is likely to worsen the situation as the funding required for physical capacity expansion would be allocated to the implementation of technologies and procedures that may not necessarily benefit the individual airport's capacity and efficiency. While some airports are held up as examples of capacity optimisation which others should replicate, in many cases their good performance is due to a combination of unique factors. This can include geographical situation, the airport-ANSP relationship, runway configuration and usage mode, descent procedures and the mix of aircraft in use

2. See Chapter 7 of the ACI EUROPE Guidelines for Passenger Services at European Airports (2nd edition) for further details.

at the airport which directly affects runway occupancy time and separation on approach.

Moreover, taking a network-wide view to capacity constraints is necessary so as to ensure that changes to the airspace network (including airports) are considered as a whole, and the effects or impacts of increases or bottlenecks in one part of the network are identified across the entire network. However, network capacity should not come at the expense of local capacity. Trade-offs are required in order to ensure that airports may continue to serve passengers in the optimal manner.

Airport and ANSP relationship

Establishing a solid relationship between the airport operator and the ANSP, both on an operational and management level, is one of the key factors for success in ensuring the best use of system capacity. The partners should seek to establish a common vision and goals on a local level, ideally based around optimal delivery of services to airspace users and ultimately passengers.

This common vision should include strategic alignment on issues such as forecast growth, current and forecast capacity, route and procedure developments, required staffing levels, common infrastructure or system developments. Ideally a document detailing this common vision should be developed and agreed between the ANSP and airport operator.

Depending on the legal framework as well as organisational setup, the relationship between the two organisations can be either informal, for example based on a memorandum of understanding, or formal, for example based on a letter of agreement or formal contract. In the case of a formal agreement, the airport operator should also consider establishing formal Key Performance Indicators (KPIs) or an Service Level Agreement (SLA) that will provide a basis for monitoring the performance of the ANSP within the airport system.

Slot allocation

The slot regime encompasses all regulatory provisions impacting declared capacity and the allocation of slots. It is clear that an efficient slot regime would result in a better use of existing capacity, for instance, through the possibility to apply local rules at airports that could for instance favour larger aircraft, or through the introduction of a slot reservation system. Such a system would incentivise airlines to hand back their slots in time (before the slot return date) in order to allow the swift reallocation of the slots to other carriers.

A proposal of the European Commission for a new Regulation on common rules for the allocation of slots at European Union airports has been in the EU legislative process in Council and the European Parliament since 2011, and show little sign of progressing. A revived initiative to modernise the outdated Regulation 95/93 is required in order to ensure better use of available capacity through optimum slot performance.

Pricing

The pricing of the airport services (landing charges and passenger service charges) can be modulated or differentiated to send the correct economic signals. Pricing is a powerful tool and motivation to incentivise desired behaviours, in this case the optimal use of the airport's capacity by its users. Economic regulation should not constrain an airport from using differentiated prices, modulations or offering incentive and rebates, as long as they are not discriminatory between comparable conditions of users. The use of these pricing strategies will allow an airport to incentivise users to better use the capacity.

Community relations

In many cases the local political pressure on airports, in particular due to noise and to a lesser extent air pollution, can be a hindrance to the physical development of the airport platform or to any changes that may be proposed to the operating regime (e.g. operating hours, departure or arrival routes). Developing a strong community relations programme whereby local stakeholder groups and community leaders are integrated into discussions on the usage and further development of the airport can lead to a better understanding by affected parties and reduce the pressure exerted on the airport system. In this context, airports should ensure adequate public consultation processes are applied for key aspects of the airport's development, such as master planning or airspace reconfiguration.

Heathrow Airport / LHR

Zurich Airport / ZRH

Unlocking latent capacity

The next step beyond making optimum use of an airport's existing capacity is to find ways to tap into extra capacity which may be released through successful implementation of methods such as those outlined above. By intelligently combining different capacity-optimisation measures, airports may not only ensure that their operations are as efficient as possible within existing constraints, but may also create additional capacity in which additional aircraft movements may be accommodated. This can result, for instance, from a combination of ATM procedures and system upgrades to increase runway throughput, the creation of new rapid exit taxiways and aircraft stands, and additional terminal capacity.

In order to successfully do this, all stakeholders operating at an airport need to be involved. Otherwise, each stakeholder determining or contributing to airport capacity will try to optimise capacity within its domain. This would be suboptimal for the entire airport system as, for example runway capacity may not be aligned to terminal capacity nor to apron/stand capacity. Additionally, the actual capacity of the different capacity drivers mentioned above is usually not determined by a single stakeholder but results from the efficient interaction of the different stakeholders involved, for example the processing capacity of border control is ultimately decided by border police or customs.

Therefore, effective coordination of the different stakeholders determining or contributing to airport capacity is required. The airport operator, ATC, ground handling service providers, pilots, police and customs all have an important role in the airport system performance in terms of punctuality, flow and resilience. This should include both strategic and tactical alignment based on extensive information sharing through an integrated airport operations plan (AOP) and Collaborative Decision Making.

These processes should be implemented in the interest of the connectivity of people and goods both locally and through a modernised airspace network as well as to balance the demand and the capacity available also in contingency situations.

Improved collaboration and communication on an airport wide level is expressed through the Ground Coordinator concept and in its most complete form is embodied in the Airport Operations Centre (APOC), although for smaller airports there might be alternatives to a fully-fledged APOC. The consolidated execution of the AOP, that makes predictable passenger journeys possible, may happen through physical or virtual operations centres where the common goal and the focus on the end user supersedes individual stakeholder/company interests.

It must be borne in mind that the declared capacity of an airport, which in particular influences the slot coordination process, is not necessarily the same as the airport's true operating capacity. As the capacity of an airport is subject to constraints which reduce actual capacity, if capacity is declared at too high a level then these factors can combine to cause a build-up of delays and congestion.

Therefore, when new capacity at an airport is made available, the airport's declared capacity may increase, thus unlocking new arrival and departure slots (in the case of slot coordinated airports). However, in such circumstances it is essential for the airport to declare its new capacity at a level which can be managed in the peak traffic periods. It may be appropriate in such circumstances to release the new capacity gradually across several seasons.

In addition to this, all **drivers of airport capacity are usually further impacted by operating procedures and regulations**, for example, due to noise considerations, special approach and departure procedures or airspace design requirements, limitations to runway use, night curfews. The variability of passenger, aircraft flow throughout the day, week and season produces peaks

and troughs of activity at many airports, as does the airlines requirements for hub and spoke operations with minimum connect times.

As a result, declared airport capacity is usually much lower than actual operated airport capacity. Nonetheless, advances in managing the numerous constraints above mean that extra capacity can be still be created out of the existing system, by allowing airports to declare higher levels of capacity than before.

Frankfurt Airport / FRA

Dealing with capacity shocks

Situations such as adverse weather, network incidents, delay build-up etc. all constitute contingencies which can have immediate, negative impacts on capacity. Airports must be able to accommodate the temporary reductions in capacity in such situations, as well as the return to normal operations thereafter. The number of stands must be suitable for the contingencies that an airport can reasonably expect to face, while schedules need to be resilient enough to accommodate such events. Adverse weather conditions or a reduction of runway capacity in arrival or departure may increase the turnaround time, which can affect other airports in case of diversion as well as through reactionary delays, therefore impacting capacity utilisation.

A key part of minimising the gap between 'normal' operating capacity and deteriorated capacity in adverse circumstances, and closing it once the situation returns to normal, is integrated operations management. Collaboration, coordination and consolidation between the airport stakeholders ensures clear lines of communication, a common view on how capacity is being utilised and where it may be available, and optimises the speed of recovery after contingencies. An integrated view of the real-time and predicted situation at an airport, established through an APOC, gives clarity over the capacity situation, expected shortfalls during the day, and enables a coordinated response in order to overcome contingencies and re-establish 'normal' operations.

Munich International Airport / MUC

The way forward

The capacity crunch in Europe's aviation system demands action now. As outlined above, there are multiple factors at play in determining an airport's capacity and its potential for being increased, which must be considered carefully, and in their entirety, when deciding on the appropriate actions for each airport.

Furthermore, a network-wide view of capacity measures will ensure that the overall network capacity is balanced and optimised. There can only be so much capacity on the ground as there is in the air, and vice-versa, yet while airport measures can influence the network, the network has a direct impact on the airport.

Given the number of stakeholders determining or contributing to airport capacity and the risk of inefficiencies, **the Ground Coordinator is the optimum, comprehensive operating model for efficiency and capacity management at airports.**

Moreover, the Ground Coordinator is not only relevant at a local level, but offers the opportunity for the Network Manager to have a single point of contact for each major airport – thus contributing to an improved overall network performance. If the Network Manager is to adopt a role of Capacity Manager for the entire network, then integration between the Airport Operations Plan and Network Operations Plan (NOP) will enable a strategic, holistic approach to capacity management. Both serve the same goal: on-time connectivity for people and goods.

There is no hierarchy between the two, and successful consolidation of AOP and NOP will be a function of the successful implementation of Collaborative Decision Making. Moreover, the Airport Collaborative Decision Making concept is being gradually augmented to that of Total Airport Management, which takes the coordination process landside and beyond, considering even aspects of the entire passenger journeys to the airport and

through the airport system. Greater coordination allows better overall management and predictability, thus giving greater control over the use of airport capacity.

Successful implementation of the Ground Coordinator concept led by the airport operator needs to involve the different partners in a collaborative spirit, to carefully manage the potential conflicting interests and to avoid a negative impact on competition between different partners. **All airport operators are invited to participate in extending uptake and implementation of the Ground Coordinator concept.**

Airports must be at the centre of initiatives to develop the capacity of the air transport system, working in close coordination with all other operational stakeholders. This includes development of physical airport capacity, slot allocation rules, research and development of technological solutions and processes to increase runway throughput, development of TMA capacity, its interfacing with the airspace network, and overall ATM reform. The Ground Coordinator concept, and related concepts such as A-CDM, APOC and Total Airport Management, are integral in the airport taking ownership of its capacity management, and therefore should be promoted and entrenched in the running of Europe's airports.

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