Airport Observatory Working Group 1

Task 1c: Define functional requirements of capacity assessment tools

1. Introduction.

This document provides an summary of the work undertaken to define the functional requirements of capacity assessment tools, as part of Task 1c of Working Group 1 of the Airport Observatory (Ref 1).

The objective of this task was to provide a set of key functional requirements that are important for assessment and declaration of runway capacity. Stakeholders will be able to compare existing methodologies against these requirements or use them as the basis for developing a new tool or methodology. It was ***not*** the objective of this Task to produce a single methodology for runway capacity assessment that will then be enforced across Europe.

Background information on this area was provided via presentations and discussions at the first two WG1 meetings (Refs 2 and 3). Subsequently, a sub-group was created to review the requirements in detail and met for a full day on September 9th (ref 4).

This paper summarises the output of the group so far and suggested next steps.

2. Study Results

2.1 Overview

There were three aspects to this task:

1. Develop a definition of airport capacity and identify the scope of any airport capacity assessment methodologies.
2. Identify common elements to be included in a Functional Specification for airport capacity assessment.
3. Identify next steps

2.2 Develop a definition of airport capacity and identify the scope of any runway capacity assessment methodologies

The objective of this task was to identify a common definition of airport capacity and then identify which areas should be included within any airport capacity methodology.

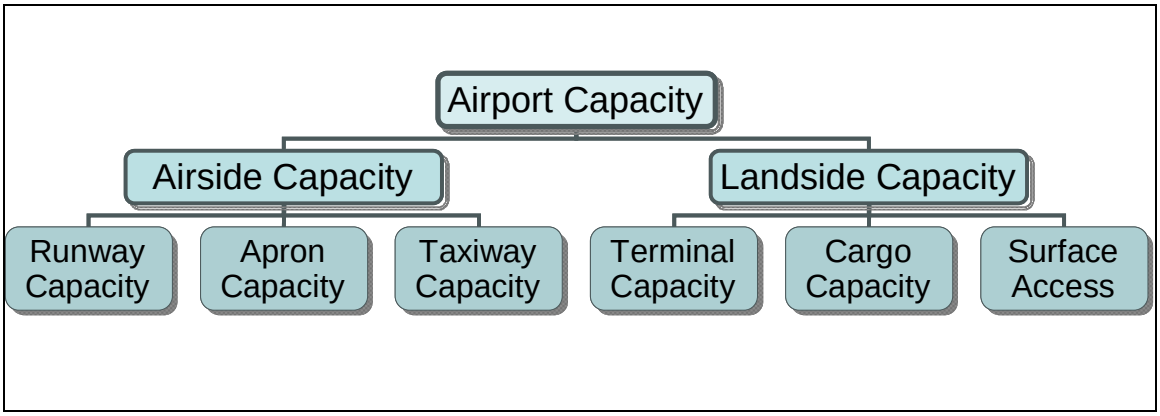
A brief literature survey identified many different definitions that cover all aspects of airport capacity (these are included in Annex 1). Clearly, a more in-depth review would find many more. The objective of the tasks was primarily to list the various definitions, but an attempt was made to identify one definition that could be taken forward.

The following definition is proposed as the most appropriate:

> "*The ability of a component of the airport to accommodate aircraft. It is commonly expressed in operations (arrivals and departures) per unit of time, typically in operations per hour."*

The advantage of this definition is the aspect of "component", which means it can be applied across for each area of the airport.

This led to a discussion of the "scope" of this study, and what should be included. The following diagram presents a hierarchy, starting with overall airport capacity, and then splitting this into the different airside and landside components.



The diagram indicates three elements to each of the airside and landside components. As a first output from this tasks, it was agreed that "functional requirements" should be reviewed for each of these six components.

2.3 Determine key aspects of each methodology

Having determined the scope of the functional requirements, namely the six components, the objective was to identify the factors that "*should ideally"* be included in any assessment of capacity.

At this stage, the list of factors for each component is not proposed as exhaustive, but should be seen as a checklist for the undertaking of a capacity assessment. Depending on the status of the airport (e.g. coordinated or schedule facilitated), some or all of the factors may be taken into account, but all should at least be considered.

In addition to the factors, some calculations were suggested that could be used to help understand the actual capacity of the component as well as the operational efficiency of the current operation. This latter aspect may help in understanding the potential "latent" capacity in any airport system. Again, the objective was to keep the calculations and the processes simple.

The factors and calculations for each of the six components are presented in the following tables.

AIRSIDE: RUNWAY CAPACITY		

FACTORS	• TMA capacity (SIDs and STARs etc)
	• Runway Occupancy Time
	• Runway configurations
	• Weather
	• Separations and spacing
	• Infrastructure
		• Environment, eg:
		  o Political
		  o Curfews
		• Noise preferential routes
		  o Traffic Mix:
		  o Aircraft types
		  o Arrivals vs. departures

CALCULATION	• Expressed in “movements per hour”
	• Operational analysis, to measure (for example):
	  o Operational efficiency, including aggregate measures of:
	  o Delay (exact definition to be determined)
	  § Punctuality	

AIRSIDE: APRON CAPACITY		

FACTORS	• Stands:
	  o Number
	  o Type (i.e. size)
	  o Remote vs. contact
	  o Push-back vs. forward
	• Traffic mix
		• Communication and coordination between stakeholders (e.g. A-CDM)
		• Equipment and infrastructure
		• Weather

CALCULATION	• Expressed in “movements per hour” • Operational analysis, to measure (for example): o Turn-around time	

AIRSIDE: TAXIWAY CAPACITY		

FACTORS	• Number of taxiways
	• Taxiway layout
	  o E.g. Alternative Parallel Taxiways
	• Number of exit and entry points to the runway
		• Taxiway management (ATC)
		• Complexity of taxi routings
		• Equipment
		  o Stop bars / lighting
		  o A-SMGCS

CALCULATION	• Expressed in "movements per hour"
	• Operational analysis, to measure (for example):
	  o Taxi-times:
	  § Of block to wheels up, or
	  § Off block to join holding point	

LANDSIDE: TERMINAL CAPACITY		
FACTORS	• Check-in capacity (number of counters) • Border control: arrival and departure • Schengen vs. non-Schengen (traffic mix) • Transfer capacity • Security capacity	• Number and size of terminals • Distance to gates • Remote vs. contact stands • Number of gates • Passenger flow efficiency (e.g. signage) • Baggage facilities
CALCULATION	• Expressed in passengers per year and passengers per hour • Capacity for the terminal a function of the capacity of the various components (e.g. check-in, security, border control) • Operational analysis, to enable a local assessment of the efficiency of each component	

Cargo capacity: The factors for the cargo capacity were beyond the scope of the experts within the sub-group (the representative for the cargo carrier was unable to attend). This should therefore be considered by cargo experts as part of the next steps. However, it would be expected that they should include an assessment of the capacity of both cargo handling facilities and of the cargo apron itself. Clearly, some appreciation of the difference between dedicated cargo airports, and those for which cargo is a small part of the operation should also be considered.

Expected to be measured in terms of tonnes per year and movements per year

Surface access: This aspect was included for completeness but was out of scope for this exercise. However, this is expected to be covered by WG3: inter-modality.

2.4 Next Steps

This short paper has summarised the work to date. The results were presented to the working group 1 on September 22nd (Ref 5) and approved for presentation to the Airport Observatory Plenary meeting, due to take place on November 4th.

If the approach and results to date are approved by Plenary, then the following next steps are proposed:

- Validate the functional requirements against the busiest airports.
- Develop the functional requirements for the cargo capacity.
- Continue to develop the functional requirements for all areas based upon the data obtained from States through the questionnaire on Airport capacity to be sent in early 2010.
- Develop a list of “valid” models and methodologies that should be used for airport capacity assessments.

Annex 1: Runway Capacity Definitions

The following are a selection of definitions of capacity obtained through a brief literature review.

1. Declared Runway Capacity: DGAC

All definitions are relative to a defined traffic structure (aircrafts, airlines, origins/destinations) when there is a continuous demand for service.

Theoretical Runway Capacity: Maximum runway flow, which can be achieved under ideal conditions regardless of level of service but in accordance with air navigation and airport operations rules. This capacity represents the maximum capacity of the runway.

Operational Runway Capacity: Maximum runway flow, which can be achieved over a sustained period of time, taking into account

- air navigation and airport operations rules;
- ATM and runway system management;
- Environmental constraints (noise, air pollution);
- and with an acceptable maximum delay for a limited period of time (quality level).

2. Declared Runway Capacity: NATS

Runway Capacity.

A certain level of delay is unavoidable if high runway utilisation is to be achieved. Therefore, the need for airport operators to balance throughput and delays has led to what is meant by runway capacity in the UK, and that is:

“the number of aircraft movements that may be scheduled to use a runway such that their average delay measured over a given period should not exceed a specified value, nor should the peak delay over the same period exceed a specified value”

Delays

Delays referred to in the definition of runway capacity are those which occur solely from congestion at the airport during busy periods. These are departure delays at the stand or at the holding point – or arrival delays in holding stacks – which arise from the need to ensure that all the aircraft wanting to use the runway at the same time are safely separated.

3. Declared Runway Capacity: definitions from various sources

The number of movements which can be handled in one hour.

The maximum number of aircraft that can be handled by a facility during a specified time period under conditions of continuous demand regardless of delay magnitude to aircraft, is called ultimate capacity (Hockaday and Kanafani, 1974)

Maximum throughput capacity (MTC) or saturation capacity indicates the average number of movements that can be performed on the runway system in 1h in the presence of continuous demand, while adhering to all the separation requirements imposed by the ATM system. (De Neufville & Odoni, 2003)

A measure of the maximum number of aircraft operations, which can be accommodated at the airport or airport component in an hour (US Federal Aviation Administration, Advisory Circular, AC 150/5060-5, 1983).

The ability of a component of the airfield to accommodate aircraft. It is expressed in operations (arrivals and departures) per unit of time, typically in operations per hour (Ashford and Wright, 1992).

4. Runway Capacity: EUROCONTROL

Unconstrained Runway Capacity

Maximum runway throughput, or flow rate, which can be achieved under ideal conditions (to be defined), regardless of level of service but in accordance with safety standards and recommendations

Sustained Runway Capacity

Maximum runway throughput, or flow rate, which can be achieved over a sustained period of time when aircraft operate under IFR, under specific traffic mix, in good weather conditions, with good ATM/runway system management, in accordance with safety standards and recommendations, and with an acceptable maximum delay for a limited period of time (to be defined locally)

Declared Capacity

Stated limiting capacity of the airport in aircraft movements per hour

5. Apron Capacity: DGAC

Theoretical Apron Capacity: Maximum number of aircraft that a fixed number of stands can accommodate during a specified period of time for optimum turnarounds when there is a continuous demand for service, in accordance with ground operation rules.

Operational Apron Capacity: Maximum number of aircraft that a fixed number of stands can accommodate during a specified sustained period of time, with local airline and airport operations, in accordance with ground operations rules.

6. Apron Capacity: EUROCONTROL

Unconstrained Apron Capacity

Maximum number of aircraft that a fixed number of stands can accommodate during a specified period of time for optimum turnarounds when there is a continuous demand for service, in accordance with safety standards and recommendations.

Sustained Apron Capacity

Maximum number of aircraft that a fixed number of stands can accommodate during a specified sustained period of time under specific traffic mix, with local airline and airport operations, with scheduled practices, and in accordance with safety standards and recommendations.

7. Taxiway Capacity: EUROCONTROL

Unconstrained Taxiway Capacity

Maximum taxiway system throughput, or flow rate, which can be achieved under ideal conditions (to be defined), regardless of level of service but in accordance with safety standards and recommendations.

Sustained Taxiway Capacity

Maximum taxiway system throughput, or flow rate, which can be achieved over a sustained period of time when aircraft operate under specific traffic mix, in good weather conditions, in accordance with safety standards and recommendations, existing taxiway system management, and with an acceptable maximum delay for a limited period of time (to be defined locally).