



# Methodologies for the determination of Airport and ATC Sector Capacity

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transport

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# Overview

Air traffic management (ATM) involves ensuring the safe and efficient movement of aircraft through airspace and airports. Two critical components of ATM are airport capacity and ATC sector capacity. Determining these capacities is essential for optimizing the flow of air traffic, minimizing delays, and maintaining safety standards.

## ICAO Annex 11

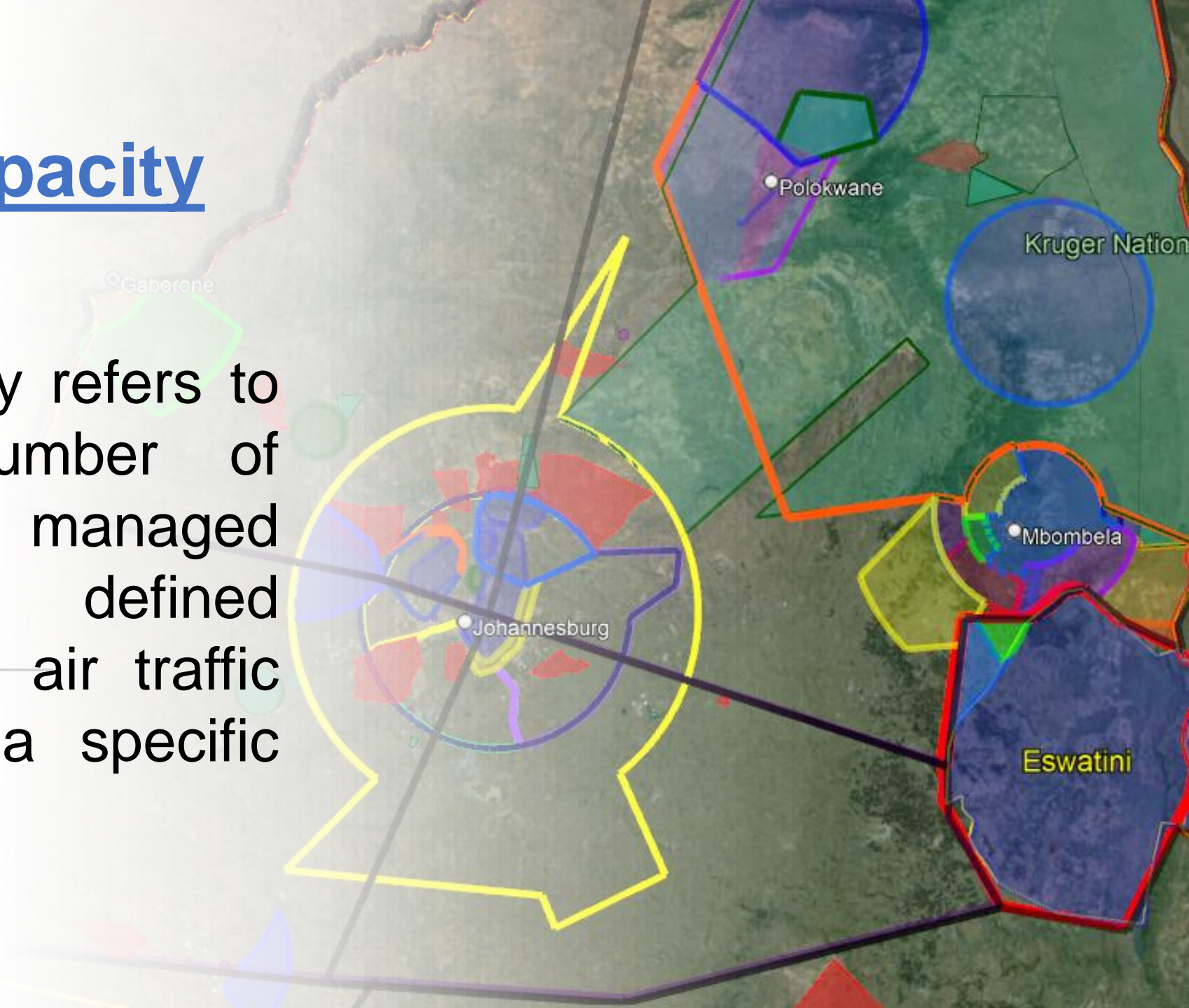
- Defines “declared capacity” as the measure of the ability of the ATC system or any of its subsystems or operating positions to provide service to aircraft during normal activities. It is expressed as the number of aircraft entering a specific portion of airspace in a given period of time, taking due account of weather, ATC unit configuration, available staff and equipment, and any other factor that may affect the workload of the controller responsible for the airspace.

## Doc 4444

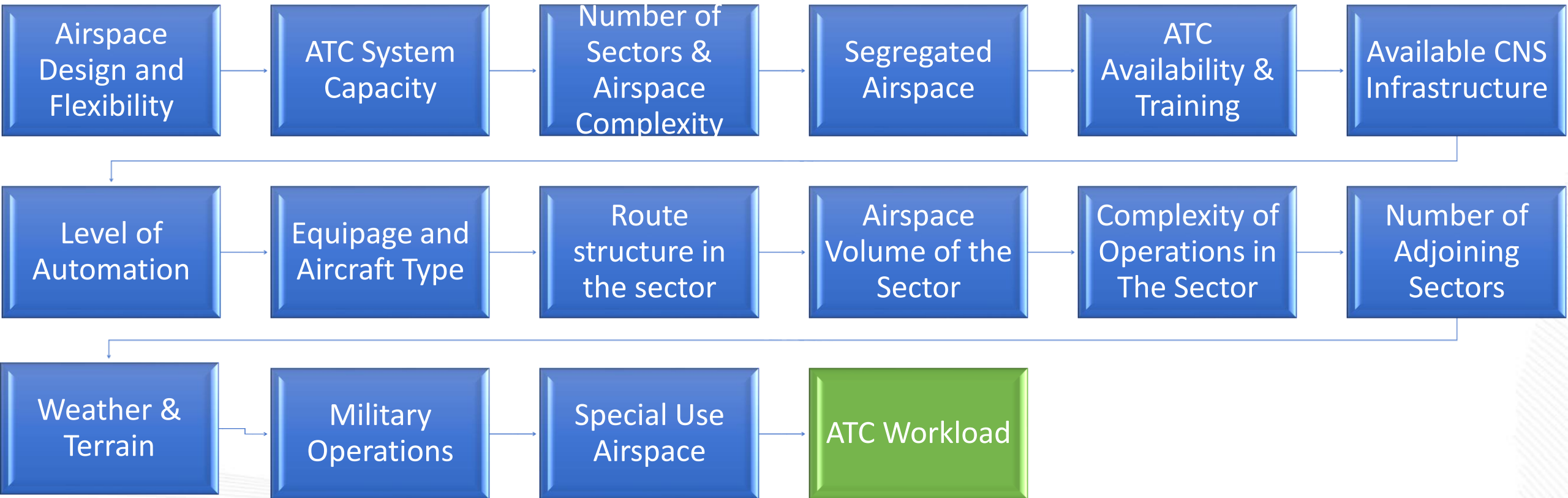
- Establishes that the appropriate ATS authority should periodically review ATS capacity in relation to traffic demand; and should provide for flexible use of airspace to improve operational efficiency and increase capacity.

# ATC Sector Capacity

ATC sector capacity refers to the maximum number of aircraft that can be managed safely within a defined airspace sector by air traffic controllers during a specific period



# ATC Sector Capacity



# ATC Sector Capacity



## ATC Workload

- Monitoring
- Radio Telephony
- Clearances
- Coordination
- Conflict Detection
- Conflict Resolution
- Sequencing
- Strip Marking
- Training



# Airport Capacity

The maximum number of aircraft operations (take-offs and landings) that an airport can handle within a specific timeframe under given conditions.

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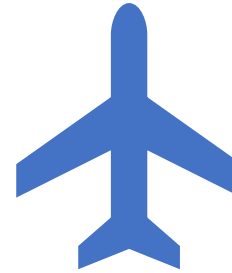
## Planning Factors

Air Traffic Sequencing &  
Coordination Conditions

Personnel Training

Nav-Aids

Communication



## Landing and Take-Off Operations

Regulatory aircraft separation  
minima

Aerodrome layout

Final approach speed

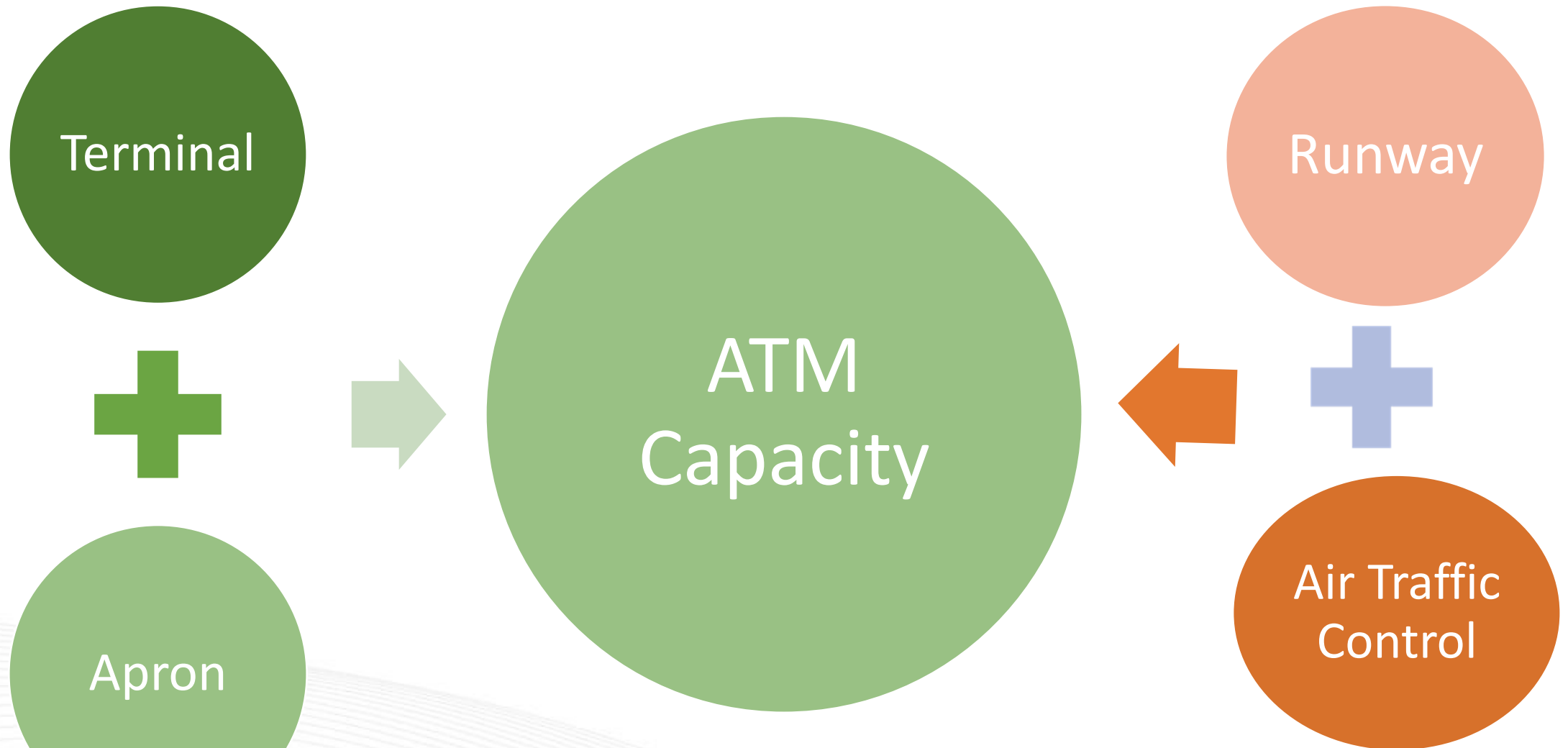
Aircraft Mix

Separation criteria adopted by ATC

Average runway occupancy time

Length of final approach segment

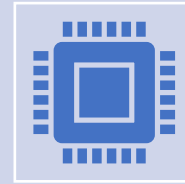
# ATNS 2014 ATM Capacity Determination Study



# DORATASK Methodology



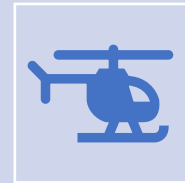
Widely used for task assessment and workload analysis.



An analytical model based on a Fast Time Simulation (FTS) provides clear examples and logical calculations.



Fast Time Simulation or FTS is a system used to simulate an airport and/or airspace by the specific requirements to develop and implement new procedures.



Yields highly realistic simulations of aircraft operations.

# DORATASK Methodology

- The workload is calculated by adding up the time the controller takes to perform all the necessary, observable, and non-observable tasks associated with air traffic flow in his/her sector and working position. Sector capacity is determined by adding the total task load to a parameter that indicates the amount of time needed for controller recovery.
- The DORATASK Model contains algorithms that estimate workload, which is the time the controller spends on planning tasks. These estimates and examples are based on statistical data that provide constant values used to adjust analytical formulae.

# Data Sampling



The controller workload is the summation of times spent on:

- Communication (transmissions/reception);
- Manual activities (filling out flight progress strips or aerodrome log) and coordination; and;
- Traffic planning and distribution
- Sequencing



# Future Airport and ATC Capacity Studies

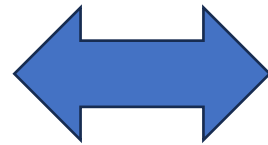
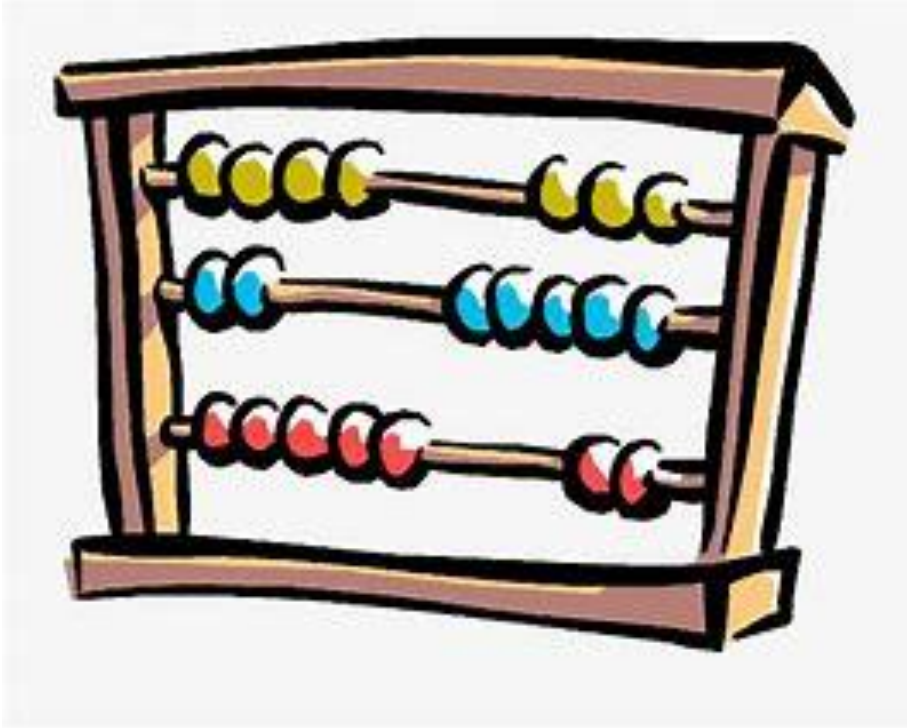


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# From Airport to Airspace Capacity Analysis



It's rather easy to count the number of movements at an airport until a certain delay criteria is reached.

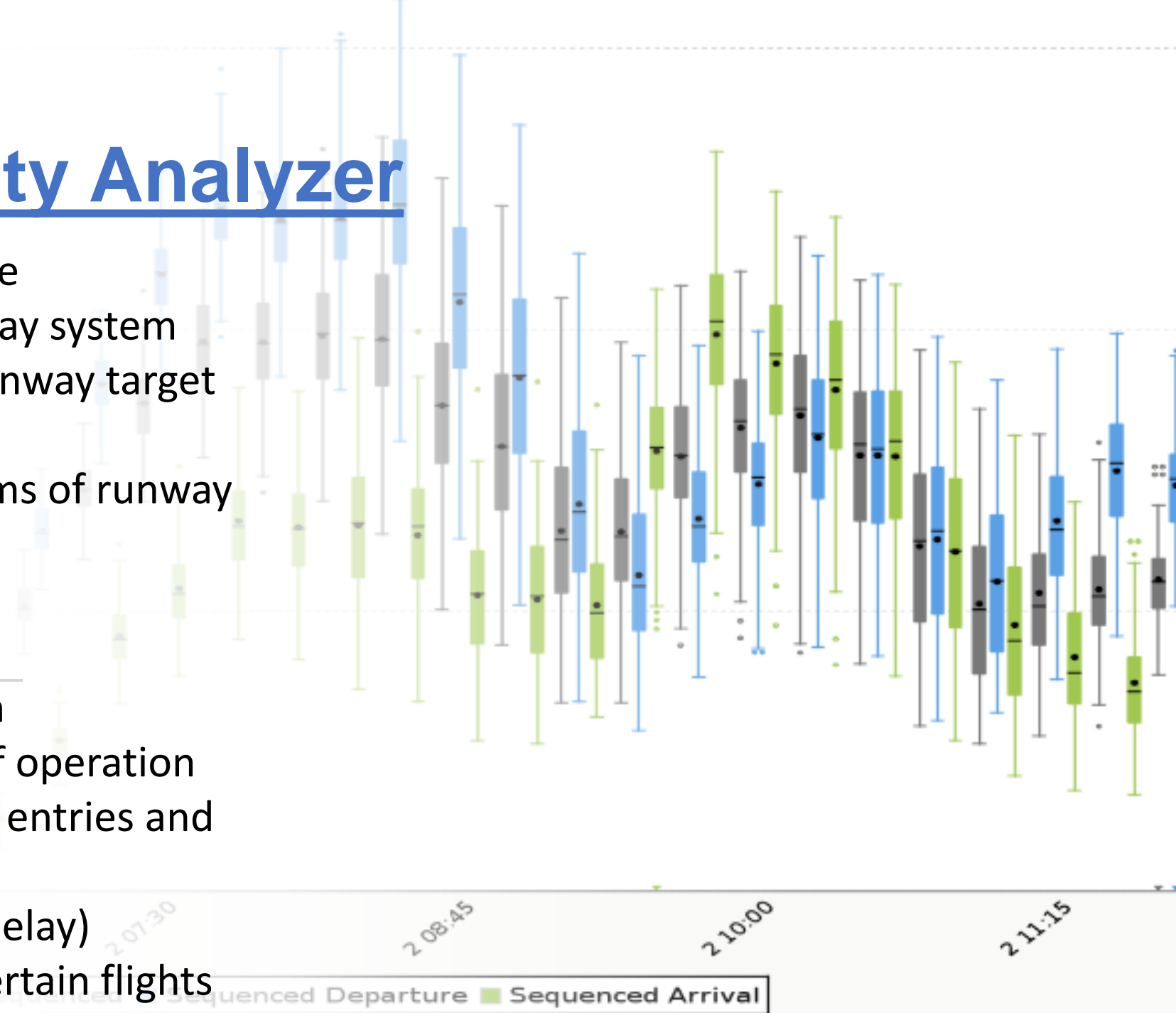
# Runway Capacity Analyzer

- Transoft Solutions' Runway Capacity Analyzer overcomes the limitations of existing analytical capacity assessments by applying Monte Carlo simulation method to calculate runway throughput. The method allows for a practically unlimited number of traffic sequences to be analyzed in order to obtain the corresponding capacities of the runway system in place at a given airport, while respecting the user definable (optional) constraints on fleet mix, Level of Service, arrival/departure ratio and existing schedule times.
- Monte Carlo methods, or Monte Carlo experiments, are a broad class of computational algorithms that rely on repeated random sampling to obtain numerical results. The underlying concept is to use randomness to solve problems that might be deterministic in principle. They are often used in physical and mathematical problems and are most useful when it is difficult or impossible to use other approaches. Monte Carlo methods are mainly used in three problem classes: optimization, numerical integration, and generating draws from a probability distribution.



# Runway Capacity Analyzer

- Obtain optimized traffic sequence
- Evaluate throughput of the runway system
- Evaluate delay with respect to runway target times
- Test future traffic demand in terms of runway capacity shortfall or excess
- Study the impact of:
  - Fleet mix
  - Required aircraft separation
  - Runway layout and mode of operation
  - Location and use of runway entries and exits
  - Level of Service (accepted delay)
  - Preferential treatment of certain flights



# Airspace Analysis

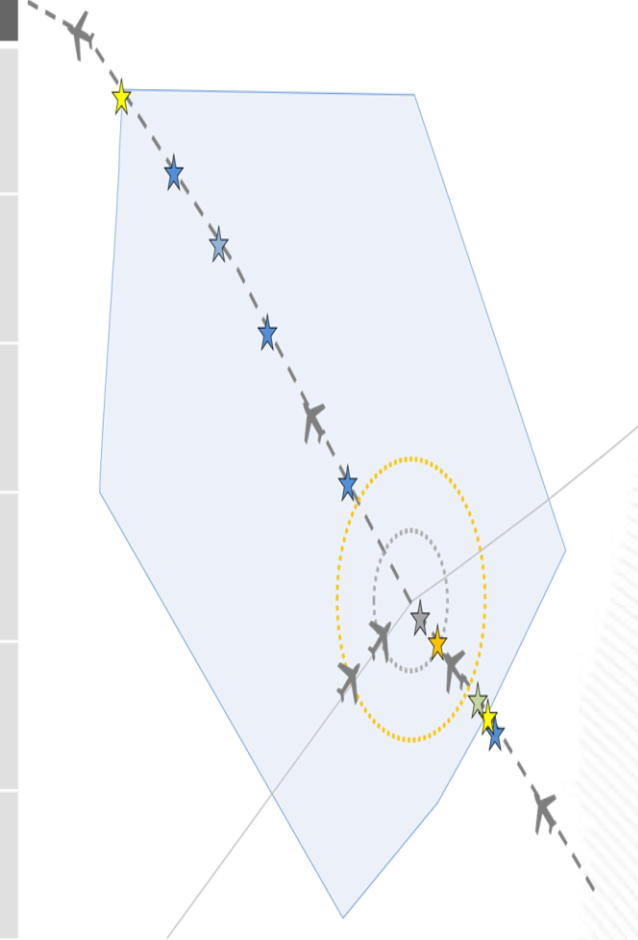
AirTOP = Task Based Workload Model

## Example: Monitoring task

Modelling of the controller's routine activities

- Radar monitoring, repetitive activity
- Strip marking, on paper or paper less
- Monitoring of flight path and altitude

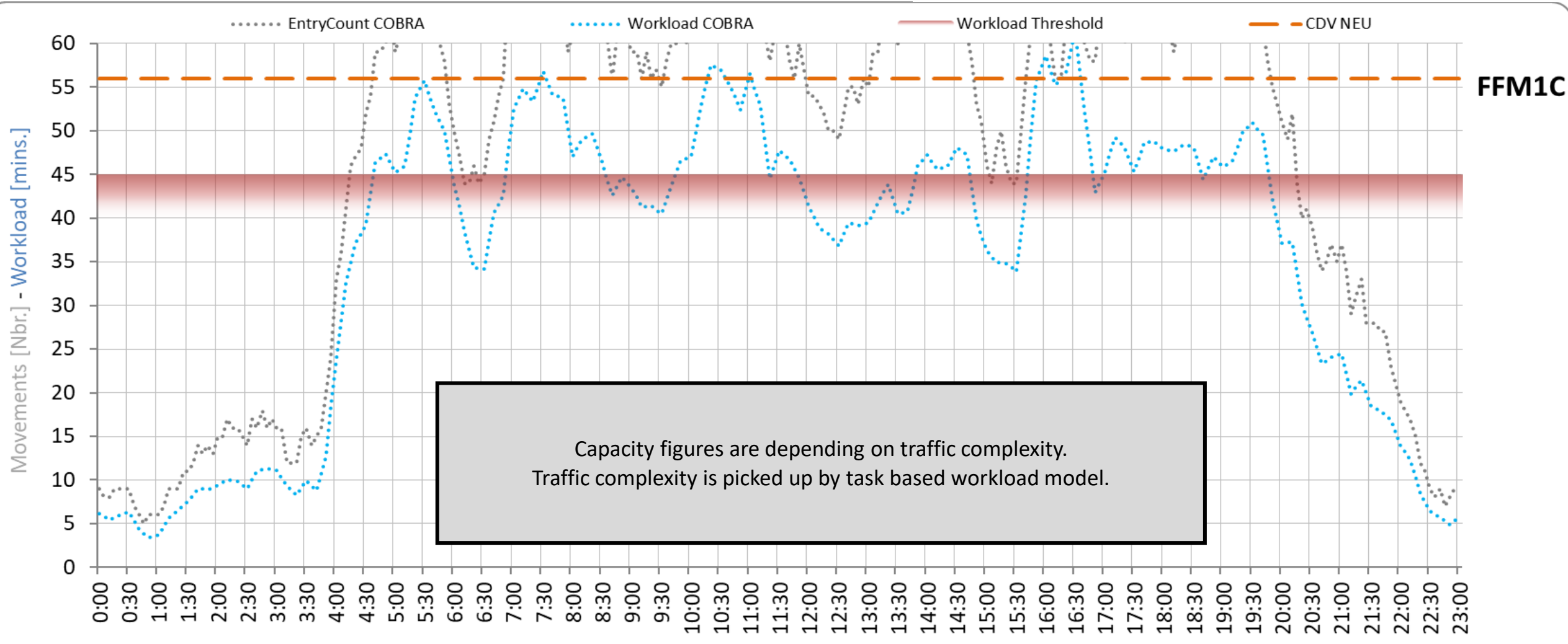
| Sector              | EDGG  |
|---------------------|---|
| Monitoring          | XX sec at Entry<br>XX sec every XX sec successive |
| Radio Telephony     | XX sec at Entry<br>XX sec at Exit                 |
| Clearances          | XX sec at Level Change<br>XX sec at Direct        |
| Coordination        | XX ec at Entry                                    |
| Conflict Detection  | XX sec at approximation of 6NM                    |
| Conflict Resolution | XX sec at approximation of 3,6NM                  |



# Example to Determine Capacity

**CDV : Capacity Default Value**

declared sector capacity refers to the number of flight entries per hour **assessed by the ANSP** and **declared to the Central Flow Management Unit (CFMU)**. This declaration ensures that the sector is protected from overload during air traffic control operations.



**FFM1C**

| Time               | 04:35   04:40 | 06:05   06:10 | 06:50   06:55 | 08:40   08:45 | 09:35   09:40 | 11:55   12:00 | 13:25   13:30 | 13:40   13:45 | 14:45   14:50 | 15:35   15:40 | 16:50   16:55 | 19:45   19:50 | AVG  | rounded |
|--------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|------|---------|
| Entry Count Time 1 | 54            | 47            | 56            | 56            | 58            | 57            | 60            | 61            | 58            | 50            | 58            | 58            | 56,1 | 56      |
| Entry Count Time 2 | 59            | 44            | 66            | 61            | 60            | 54            | 60            | 62            | 53            | 56            | 63            | 55            | 57,8 | 58      |



Thank You