SAFE SKIES. **SUSTAINABLE FUTURE.**

ICAO APAC/MID ATFM-FF-ICE Seminar 2025

Dubai, UAE, 23 – 26 February 2025

Nicki Harricharan

CANSO Operations Programme Manager

Capacity Determination

CANSO Support for Capacity Determination

Strategic and Operational Capacity

Formula for Airport Capacity

Formula for Airspace Capacity

CANSO Support in Capacity Demand

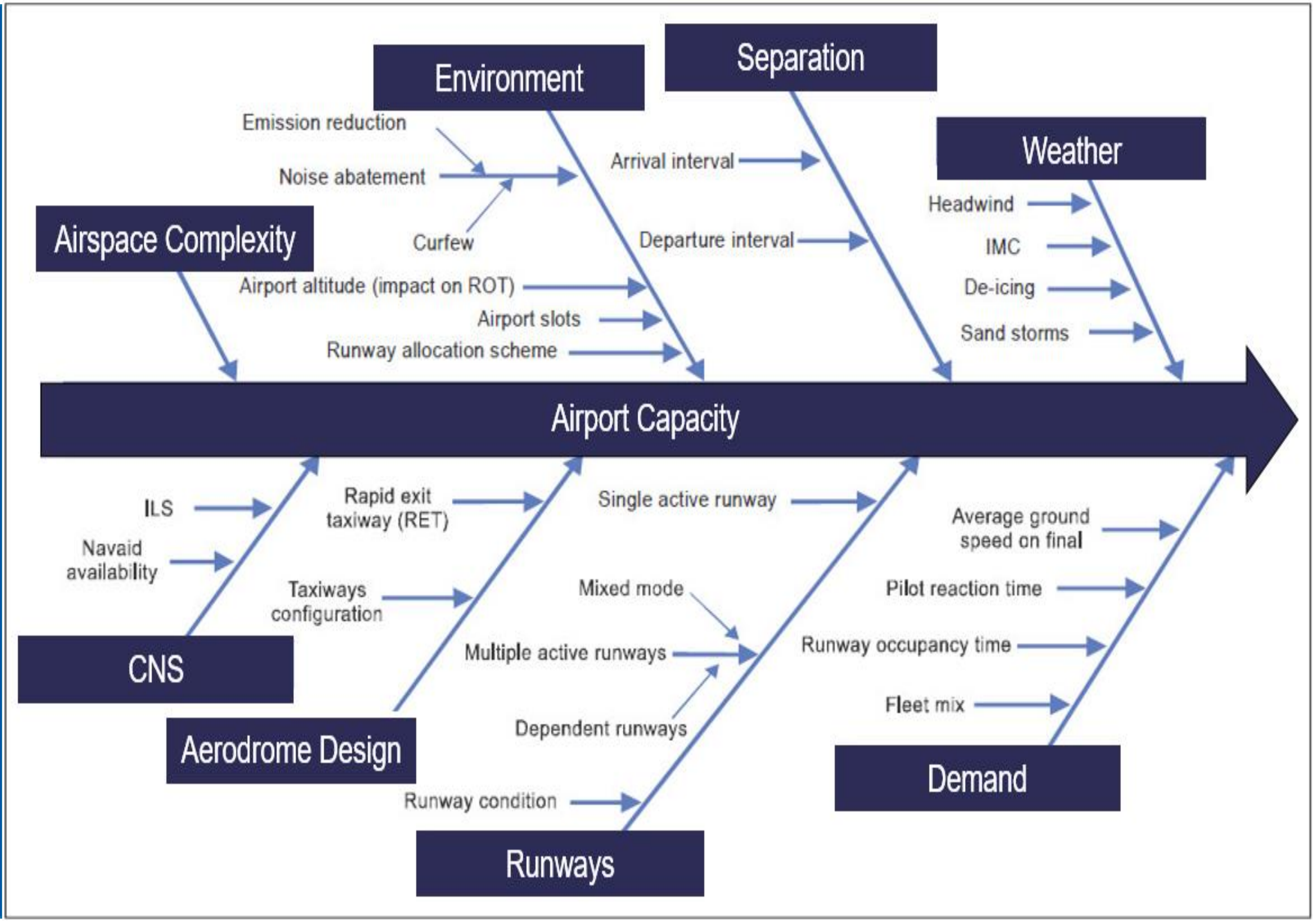
Capacity of an Airport or an Airspace Sector

- ❖ Managing ATM resources and maintaining traffic flow can be challenging without clearly defined capacity thresholds.
- ❖ Capacity is expressed as maximum number of aircraft through an ATM resource:
  - ✓ Airport
  - ✓ Airspace sector
  - ✓ Arrival/departure Fix
  - ✓ Waypoint
- ❖ Commonly measured in a 60-minute period

Airspace and Airport Capacity

- ❖ Effective ATFM implementation hinges on establishing defined capacities for every sector and airport.
- ❖ Two capacity determinations:
  - ➢ Strategic Capacity
    - ✓ Starting point for Data Capability Balance
  - ➢ Operational Capacity
    - ✓ Continually determined as conditions change
- ❖ Same factors to consider when determining Strategic/Operational Capacity

Airport Capacity Determination



Airport Strategic Capacity Determination

- Airport layout (RWY/taxiway configuration)
- Gates
- Check-in counters
- Security Screening
- Carousels
- Runway Throughput
- Customs and Immigration
- Sector capacity
- Arrival and departure capacity

Airport slot allocation does not consider operational ATM constraints such as weather & equipage outages

The Process

Airport Capacity Considerations

- Identify the organization responsible for the establishment and implementation of AARs at the selected airports
  - ✓ **NOTE:** It is recommended that you establish a small working group of the stakeholders that will have input into the AAR value. For example, ATCOs, supervisors, airport authority, a major airline.
- Establish optimum AARs for the airport identified; and
- Review and validate the airport primary runway configurations and associated AARs at least once each year

Doc 9971, Appendix II-B, 2

Airport Capacity Considerations Continued

- ❖ Calculate Optimum AAR values for each airport runway configuration for the following meteorological conditions:

  - ✓Visual Meteorological Conditions (VMC) - meteorological conditions allow vectoring for visual approaches
  - ✓Marginal VMC - meteorological conditions do not allow vectoring for visual approaches, but visual separation on final is possible
  - ✓Instrument Meteorological Conditions (IMC) – visual approaches and visual separation on final are not possible
  - ✓Low IMC - meteorological conditions dictate Category II or III operations

Doc 9971, Appendix II-B, 3.1

Formula Method

- Calculating Airport Strategic Capacity Determination: Optimum Airport Acceptance Rate (AAR)

  - ✓ Determine the average ground speed crossing the runway threshold and the spacing interval required between successive arrivals

  - ✓ Divide the groundspeed by the spacing interval to determine the optimal AAR

NOTE: when the quotient is a fraction, round *down* to the next whole number

Doc 9971, Appendix II-B, 3.2

Example of Formula Method

Example 1: 130 KTS / 5 nm = 26

Optimum AAR = 26 arrivals per hour

Doc 9971, Appendix II-B, 3.2

130 KTS: Example aircraft ground speed on final at your airport

5 NM: Example required spacing between arrivals on final at your airport

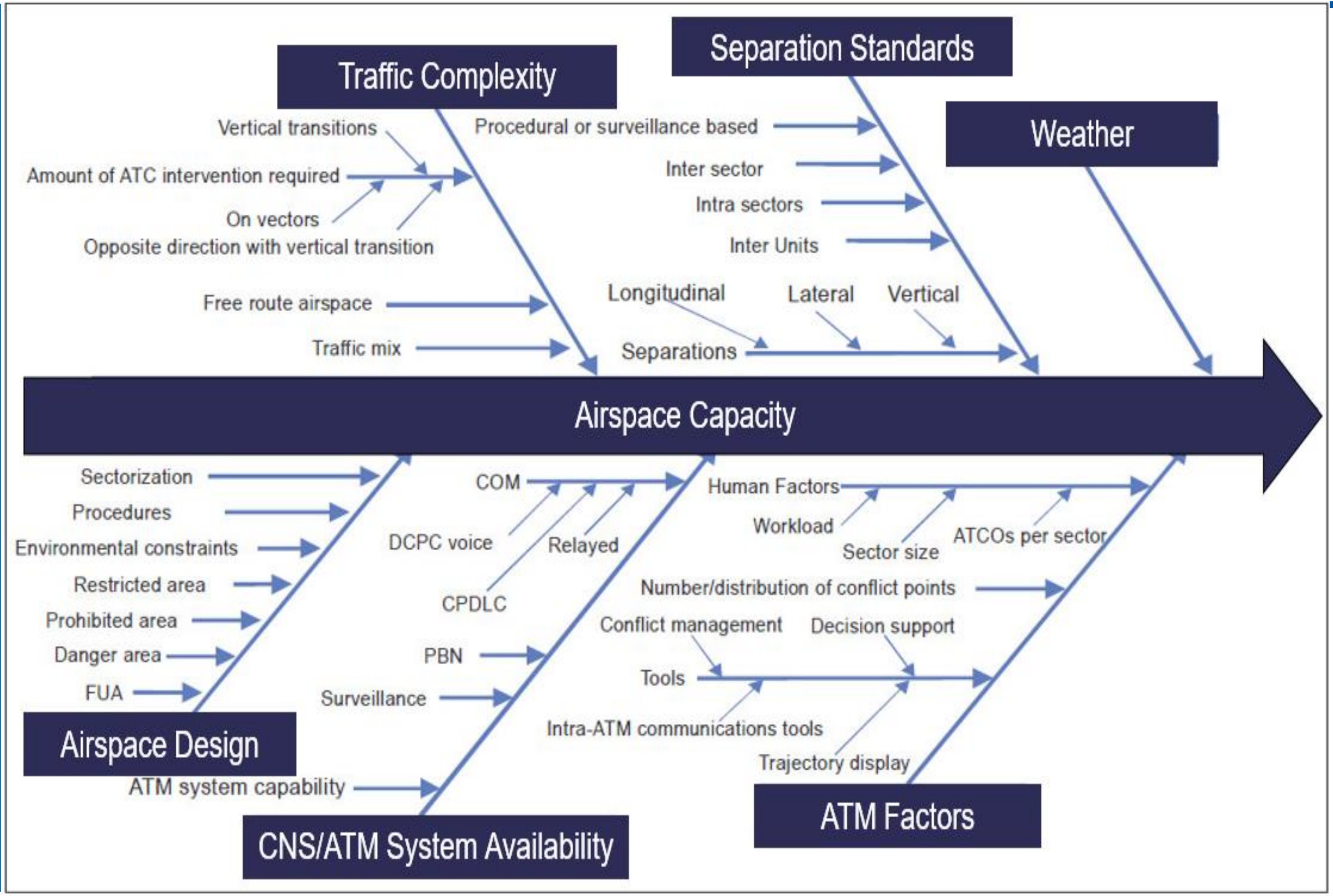
26: Example optimum airport acceptance rate at your airport

Table method for determining the Optimum AAR (Doc 9971)

Table II-App B-1. Optimum AAR

	Nautical miles between aircraft at the runway threshold									
	3	3.5	4	4.5	5	6	7	8	9	10
	Potential AAR									
Ground speed at the runway threshold										
140 knots	46	40	35	31	28	23	20	17	15	14
130 knots	43	37	32	28	26	21	18	16	14	13
120 knots	40	34	30	26	24	20	17	15	13	12
110 knots	36	31	27	24	22	18	15	13	12	11

Airspace Capacity Determination



The Process

ICAO

Airspace Capacity

- ❖Airway structure in the sector
- ❖Airspace volume of the sector
  - ✓ Vertically and horizontally
- ❖Complexity of operations in the sector
  - ✓ Number of adjoining sectors
  - ✓ Amount of climbing/descending traffic
  - ✓ Terrain
  - ✓ Military operations and special use airspace

Operational Capacity

- Operational capacity is the expected capacity associated with the tactical situation at the airspace including:

  - ✓ Weather conditions
  - ✓ Infrastructure conditions
  - ✓ CNS Status
  - ✓ Fleet Mix
  - ✓ Staffing
  - ✓ Equipage

Formula Method

- For each 15-minute period:
  - ✓ Determine the average time, in minutes, that an aircraft spends in a sector

- The total number of aircraft observed in a sector during a 15-minute period

- The total minutes of flight time generated by those aircraft in the 15-minute period

- Adjustment factor (± number of flights)

Observation

Example:

- **15 flights** are observed in a sector in a 15-minute period as shown in the table.

- **120 minutes** is the Total minutes of flight time in this sector in a 15-minute period

AIRCRAFT ID	MINUTES IN SECTOR
UAL1039	9
CGBEP	10
DAL1822	7
FFT98	10
JBU1058	9
WJA2766	10
JB1869	9
SWG439	9
UAL1664	10
JBU174	9
AZV778	5
SWA812	10
JBU2537	4
N322EC	3
VQTGG	6
TOTAL MINUTES	**120**

Mathematical Method

- Example:

  - Observed 15 flights in the sector in a 15-minute period
  - Add individual sector times together
    - ✓ 120 minutes
  - Divide by 15 (flights)
    - ✓ Obtain the average
  - The quotient is the average sector flight time, in minutes
    - ✓ 8 minutes, in this example

Simple Mathematical Method

8 x 60 =

480

8: Average sector flight time in minutes

60: (Fixed) Minute to seconds conversion

480: Average sector flight time in seconds

Simple Mathematical Method

- ❖ Divide the average sector flight time in seconds by 36 seconds
  - ✓36 seconds is a value established for use in the United States by human factor experts
  - ✓It represents the average time a controller interacts with a flight while in a sector

- ❖ Example:
  - ✓The average sector flight time is 480 seconds
  - ✓Divide 480 seconds by 36 seconds (480 / 36)
  - ✓The quotient, 13.33 (round down to 13)
  - ✓13 is the optimum sector capacity value for 15 minutes

Simple Mathematical Method

480 / 36 =

13.33

13

480: Average sector flight time in seconds

36: (Fixed) Average time in seconds that an ATCO works each aircraft (as established by FAA Human Factor Experts)

13: Optimum sector capacity (round down from 13.33)

Simple Mathematical Method

- 120 minutes (total of the observed minutes)
- 120 minutes / 15 flights = 8 minutes per aircraft
- 8 = average sector flight time in minutes
- 8 minutes x 60 seconds/minute = 480 seconds per aircraft
- 480 = average sector flight time in seconds
- 480 seconds / 36 seconds per aircraft = 13.33 aircraft
- Round down to 13
- 13 aircraft = optimum sector capacity value

Table method for determining the Optimum Sector Capacity Value (Doc 9971)

Table II-App C-1. Simplified method

Average sector flight time (in minutes)	*Optimum sector capacity value (aircraft count)*
3	5
4	7
5	8
6	10
7	12
8	13
9	15
10	17
11	18
12 or more	18

Adjust the Optimum Sector Capacity Value

- May be adjusted up or down after taking into consideration the factors that affect the sector:
    - Airway structure in the sector
    - Airspace volume of the sector
    - Vertically and horizontally

- Complexity of operations in the sector
    - Number of adjoining sectors
    - Amount of climbing/descending traffic
    - Terrain
    - Military operations and special use airspace

Final Product: Sector Capacity

Optimum sector capacity value	13
+ / - Adjustment factors	-1
---------------------------------------	-----
Sector capacity	**12**

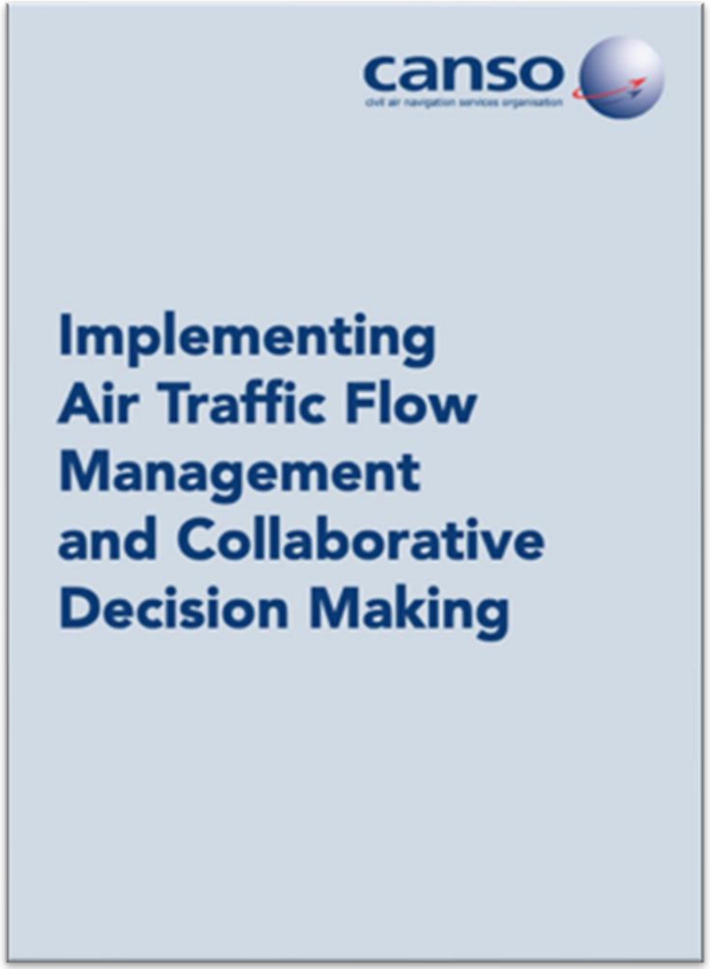
Examples of Capacity Determination Tools

- DORATASK Model UK
- Sector Design Analytical Tool (SDAT) USA
- Capacity Indicator Model (CIM) Europe
- Reorganized ATC Mathematical Simulation (RAMS) EUROCONTROL
- ATC Sector Capacity Calculation Model used in Brazil

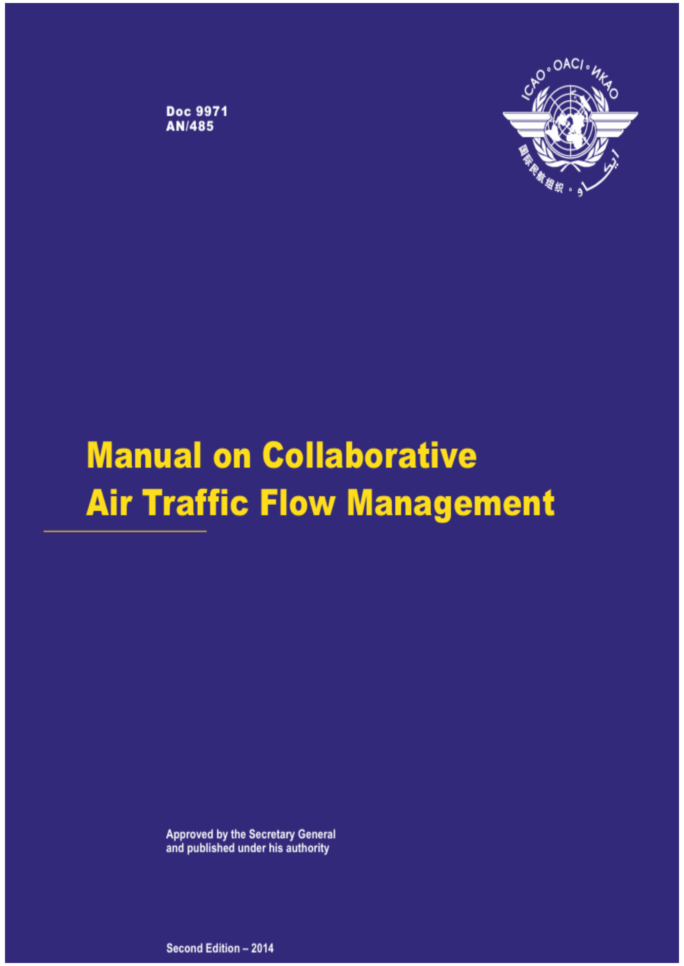
CANSO Supported Capacity Presentations

- ICAO Workshop on the Methodology for Determination and assessment of Airport and Assessment of Airport and ATC Sector Capacity
  Kampala, Uganda, 25 to 29 November 2024
- ICAO Workshop on the Determination and Assessment of ATC Capacity
  Abuja, Nigeria, 8 - 12 July 2024
- Presentation on the Determination and Assessment of ATC Capacity *for CANSO APAC Ops WG on November 1, 2022*

CANSO & ICAO Guidance for Effective ATFM Implementation



CANSO recommends States and stakeholders ensure effective ATFM implementation by leveraging the guidance provided by the CANSO document in combination with the ICAO Document 9971 Manual on CDM, yielding clear, tangible benefits.



Thank You

ICAO80