NAMIBIAN CIVIL AVIATION AUTHORITY

Advisory Pamphlet (AP)

ANSSO-ATS-AP172/05

DETERMINING ATS SYSTEM CAPACITY

1. **Explanation of Advisory Pamphlets (AP) system. The Namibian Civil Aviation Authority (NCAA) issues advisory pamphlets to inform the aviation public in a systematic way of non-regulatory material. Unless incorporated into a regulation by reference, the contents of an advisory circular are not binding on the public. Advisory pamphlets are issued in a numbered-subject system corresponding to the subject areas of the Namibian Civil Aviation Regulations (NAMCARs).**

   Advisory Pamphlets are intended to provide information and guidance to illustrate a means but not necessarily the only means of complying with the Regulations, or to explain certain Regulatory requirements by providing interpretative and explanatory material. Where an AP is referred to in a 'Note' below the regulation, the AP remains as guidance material.

   APs should always be read in conjunction with the referenced regulations.

2. **Reproduction of Advisory Pamphlets. Advisory pamphlets may be reproduced in their entirety or in part without permission from the Civil Aviation Authority.**

3. Effective date: 23/11/2023

NAMIBIA CIVIL AVIATION AUTHORITY
NCAA
2023 -11- 23
Private Bag 12003
Ausspannplatz
Windhoek
Office of the Executive Director

Ms. Toska Sem
Executive Director of Civil Aviation

DETERMINING ATS SYSTEM CAPACITY

1. PURPOSE

This Advisory Pamphlet (AP) provides guidance to ATS providers for determining the Capacity of the ATS System. It provides instruction for the development and review of the procedures for determining the capacity of the ATS system to meet the requirements of NAMCAR Part 172 and the associated technical standards.

2. BACKGROUND

(a) The NAMCARs Parts 172 requires an ATS provider to develop a procedure for determining the Capacity of the ATS System.

(b) Below are the extracts from the Civil Aviation Regulations Part 172 – Air Traffic Services provider, to which this Advisory Pamphlet apply.

3. EXTRACTS FROM NAM-CARS, PART 172 – AIR TRAFFIC SERVICES

172.05.8 ATS system capacity and air traffic flow management

(1) An ATS provider must establish ATS system capacity and where required, air traffic flow management.

(2) An ATS provider must determine the capacity of the air traffic control services concerned for the provision of air traffic service.

4. EXTRACTS FROM Procedures for Air Traffic Management Part 3 – ATS system capacity and air traffic flow management

1.3 Regulation of ATC capacity and traffic volumes

(1) Where traffic demand varies significantly on a daily or periodic basis, facilities and procedures should be implemented to vary the number of operational sectors or working positions to meet the prevailing and anticipated demand. Applicable procedures should be contained in local instructions.

(2) In case of particular events which have a negative impact on the declared capacity of an airspace or aerodrome, the capacity of the airspace or aerodrome concerned shall be reduced accordingly for the required time period. Whenever possible, the capacity pertaining to such events should be pre-determined.

(3) To ensure that safety is not compromised whenever the traffic demand in airspace or at an aerodrome is forecast to exceed the available ATC capacity, measures shall be implemented to regulate traffic volumes accordingly.

1. Determination of capacity of an ATS

1.1 The capacity of an ATM system depends on many factors including traffic density and complexity, the ATS route structure, the capabilities of the aircraft using the airspace, meteorological factors, air traffic management (ATM)/communications, navigation, and surveillance (CNS) equipment and controller workload. Every effort should be made to provide sufficient capacity to cater to both normal and peak traffic levels; however, when taking any action to increase capacity, the responsible ATS authority shall ensure, in accordance with the procedures specified in Chapter 2, PANS - ATM that safety levels are not jeopardized.

1.2 The number of aircraft provided with an ATC service shall not exceed that which can be safely handled by the ATC unit concerned under the prevailing circumstances. In order to define the maximum number of flights which can be safely accommodated, the appropriate ATS authority should assess and declare the ATC capacity for control areas, for control sectors within a control area and for aerodromes. This capacity is the "declared capacity" for the airspace or airport.

1.3 ATC capacity should be expressed as the maximum number of aircraft which can be accepted over a given period of time within the airspace or at the aerodrome concerned.

Note: - The most appropriate measure of capacity is likely to be the sustainable hourly traffic flow. Such hourly capacities can, for example, be converted into daily, monthly or annual values.

2. ATS Capacity assessment

2.1 In assessing capacity values, factors to be considered should include, inter alia:

a) the level and type of ATS provided;
b) the structural complexity of the control area, the control sector or the aerodrome concerned;
c) controller workload, including control and coordination tasks to be performed;
d) the types of communications, navigation and surveillance systems in use, their degree of technical reliability and availability as well as the availability of back-up systems and/or procedures;
e) Availability of ATC systems providing controller support and alert functions; and,
f) Any other factor or element deemed relevant to controller workload.

Note: - Summaries of techniques which may be used to estimate control sector/position capacities are contained in the Air Traffic Services Planning Manual (Doc 9426).

3. Enhancement of ATC capacity

3.1 The appropriate ATS authority shall:

a) implement steps aimed at maximizing the use of the existing system capacity; and
b) develop plans to increase capacity to meet the actual or forecast demand.

4. Capacity determining methods

4.1 It would be extremely complex to establish a universal rule to calculate capacity. Capacity can be affected by so many variables and external considerations that standardization is simply not possible. It is therefore up to the ANSP to decide how to determine its capacity by choosing from either basic methods based on observation or highly sophisticated mathematical models.;

4.2 Capacity limits may be assessed using feedback from control staff, incident reports where heavy workload is a factor and real-time observations. Post-operations analysis and monitoring provide essential feedback and can be of great use to refine capacity determination.

4.3 Operational capacities are not static values, as they vary with traffic complexity and other factors. In general, sustained levels of demand superior to capacity warrant some form of ATFM intervention, whereas short demand spikes moderately above capacity may be managed through attentive oversight, without intervention. Tolerance thresholds may be defined to frame those possible variations of the capacity and to ensure that variations remain within a defined range. Figure II-3-1 illustrates the various elements that are usually taken into account when defining airspace capacities. Figure II-3-2 illustrates the main factors affecting airport capacity. Such factors may be considered as limits, but also as means to improve capacity.

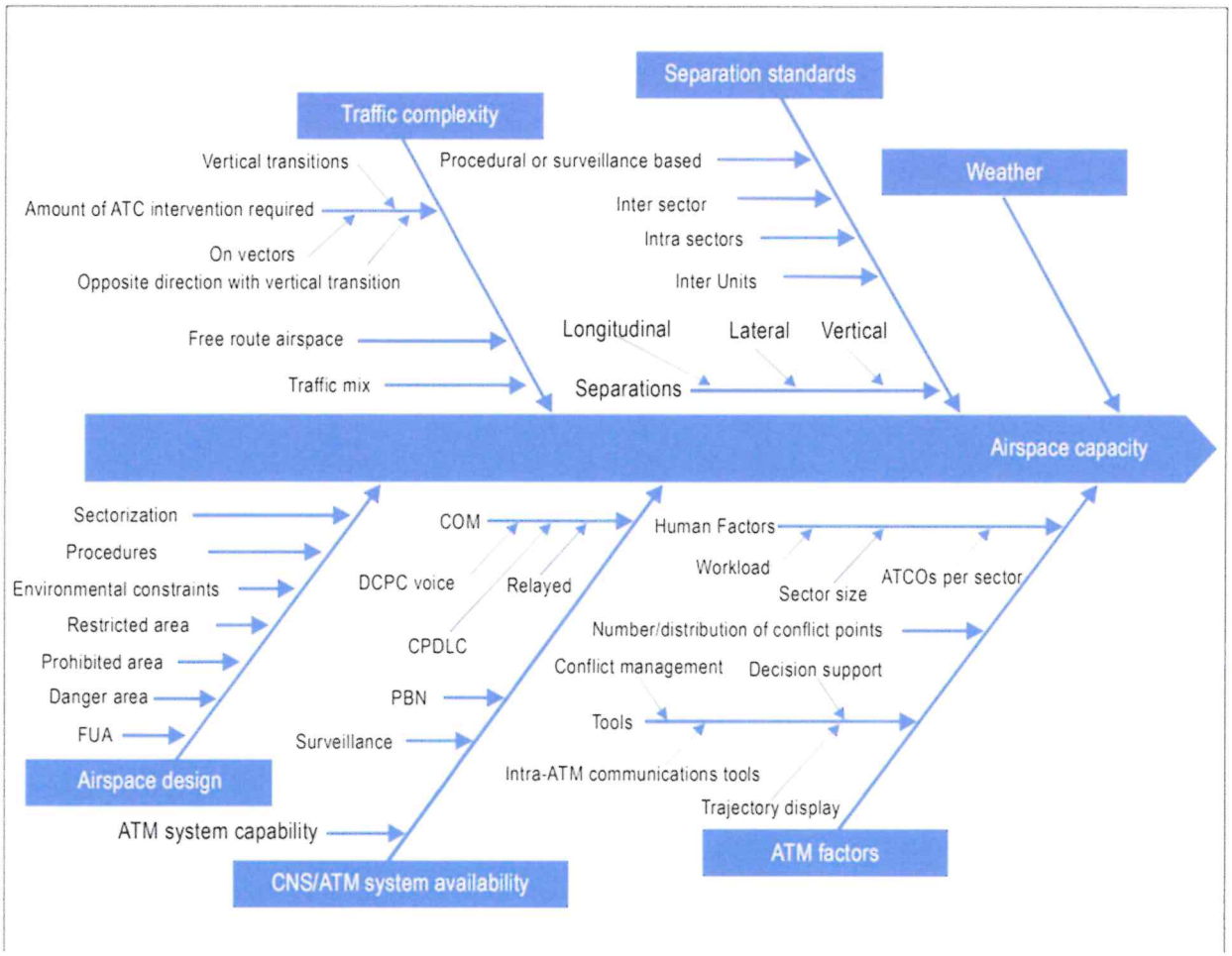

Figure 1. Factors affecting airspace capacity

4.4 Capacity measurement and calculation methodologies should be developed according to the requirements and conditions of their operational environment. Calculation methodologies have already been established by States in several ICAO regions and the various methods have different levels of complexity. Examples are provided in Appendices II-B, II-C and II-D.

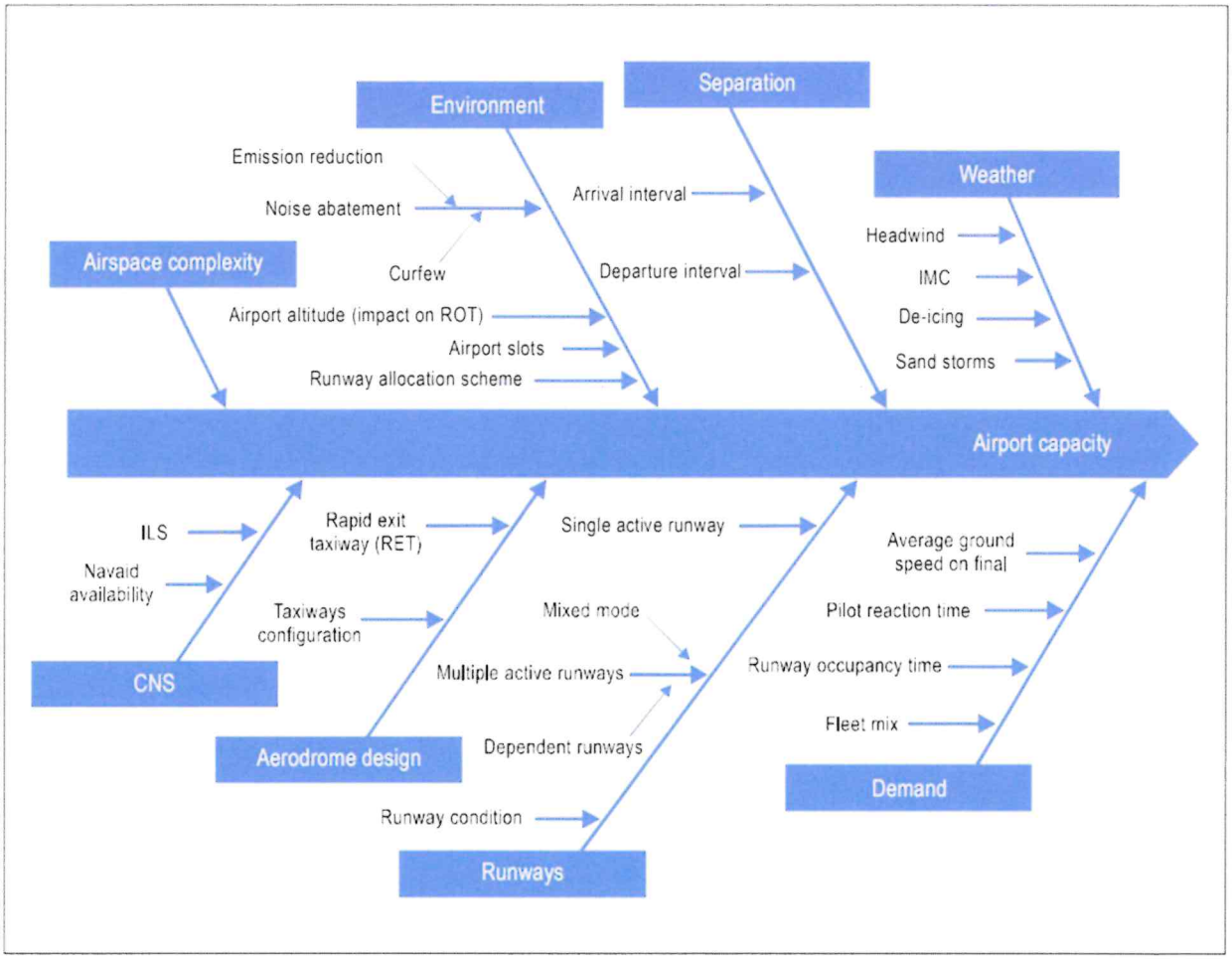

Figure 2. Factors affecting airport capacity.

4.5 Each State is responsible for determining capacity, while using the methodology of its choice. Due consideration should, however, be given to the methods employed by neighbouring States, so as to ensure as much consistency as possible in the methods used to determine capacity for sectors or airports used by the same traffic flows. When regional agreements are established, this specific provision should be addressed.

4.6 There are two schools of thought on how to assess and establish ATC sector capacity: mathematical occupancy and complexity models, and controller workload assessment models. In both cases it is essential that the capacity calculated using these models be validated by other means (e.g., real-time observations, real-time simulations).

4.7 Mathematical occupancy and complexity models take account of:

a) traffic profile: cruise, climb, descent;

b) traffic mix: light, heavy, speed mix;

c) number and types of typical ATC interventions;
d) sector flight times; and
e) default workload per flight.

4.8 Controller workload assessment models break down the controller workload into a set of definable and measurable tasks for which average execution times are defined. These tasks include coordination, handling flight data, radio frequency, communications and conflict management. Since the amount of mental reasoning a controller uses cannot be measured, an acceptable workload threshold is normally established, and capacity is assessed to be at the point where this threshold is reached. Such models require intensive participation by the control staff in establishing task execution workload metrics.

4.9 Regardless of the method chosen to establish capacities, it is strongly recommended that any major calculated increase in capacity be implemented in an incremental way. This will allow real-time experience to be fed back into the models used and will also foster air traffic controller acceptance of the calculated capacity increase.

5. Flexible use of airspace

5.1 The appropriate service provider shall, through the establishment of agreements and procedures, make provision for the flexible use of all airspace in order to increase airspace capacity and to improve the efficiency and flexibility of aircraft operations. When applicable, such agreements and procedures should be established on the basis of a regional air navigation agreement.

5.2 Agreements and procedures providing for a flexible use of airspace shall specify, inter alia:

a. the horizontal and vertical limits of the airspace concerned;
b. the classification of any airspace made available for use by civil air traffic;
c. units or authorities responsible for transfer of the airspace;
d. conditions for transfer of the airspace to the ATC unit concerned;

e. conditions for transfer of the airspace from the ATC unit concerned;
f. periods of availability of the airspace;
g. any limitations on the use of the airspace concerned; and
h. any other relevant procedures or information.

APPENDIX A

DETERMINING SECTOR CAPACITY

Note. — This appendix provides an example of a simplified methodology for determining sector capacity at

an area control centre (ACC). This methodology is based on the process developed by the Federal Aviation

Administration (FAA) for establishing sector capacity. The formula is based on two assumptions: first, sectors work best.

when they handle no more than 25 aircraft during any 15-minute period; and second, sectors work best when they

handle no more than 18 aircraft during any one-minute period. The 25 aircraft assumption led to the determination that.

each aircraft requires 36 seconds of a controller's work time. Therefore:

(15 minutes x 60 seconds = 9 000 seconds. 9 000 seconds ÷ 25 aircraft = 36 seconds)

1. Sector capacity is determined using the average sector flight time in minutes from 0700 hours to 1900 hours., Monday through Friday, for any 15-minute time period.

2. The formula used to determine sector capacity is:

$(aaaaaaa\ ssssss\ fffht\ tttt\ ii\ mmmmmmm) \times (60\ sssssss)$

$36\ sssssss = ssssss\ cccccccc\ vvvvv0000000$

3. Steps to follow:

a) manually monitor each sector by observing and recording the average flight time in minutes;

b) after the average flight time is determined:

1) multiply the value by 60 seconds in order to compute the average sector flight time in seconds;

2) then divide by 36 seconds because each flight takes 36 seconds of a controller's work time; and

3) this is the sector capacity value (optimum).

4. Adjustments:

a) the optimum value for a sector is then adjusted for factors such as:

1) airway structure;

2) airspace volume (vertically and laterally);

3) complexity;

4) climbing and descending traffic;

5) terrain, if applicable

6) number of adjoining sectors that require interaction; and

7) military operations.

5. Alternatively, Table App-C-1 can be used.

6. The flying-time-based method for calculating capacity attempts to account for the primary limit for sector capacity and controller task workload, through an assumption that a controller spends 36 seconds providing ATC services to each flight. This assumption does not account for dynamic changes in sector traffic complexity characteristics over time, nor the benefits realized as new capabilities are deployed. Sector complexity profiles characterizing each sector's operations over a period of time can provide a more accurate statement of sector capacity levels. Key tasks accounted for by the complexity profile include entry, exit, non-RADAR arrival, non-RADAR departure, vertical transition, coordination, separation assurance, delay, etc.

Table I-App A-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 and more	18