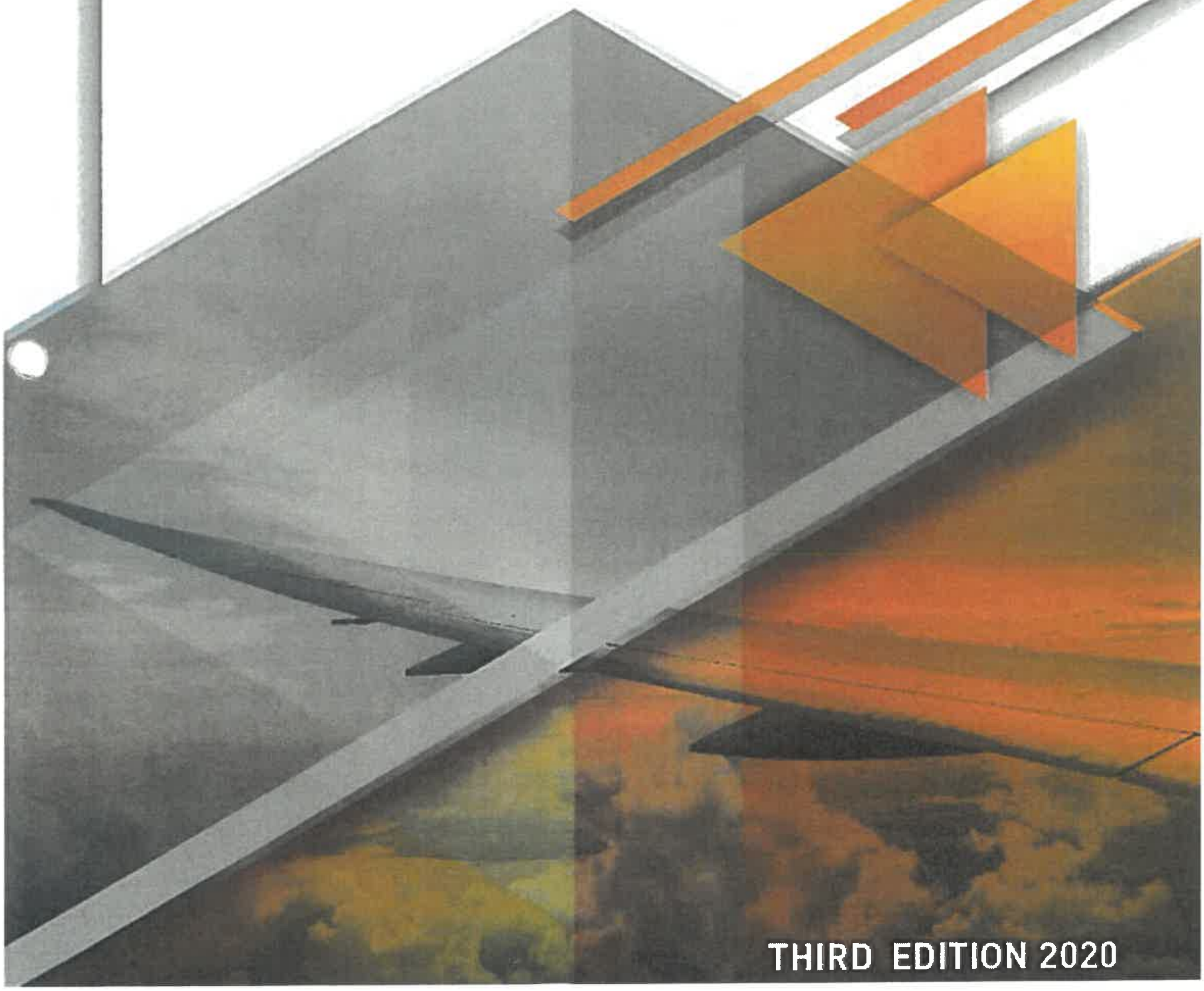
transport

Department:
Transport
REPUBLIC OF SOUTH AFRICA

NATIONAL AIRSPACE MASTER PLAN 2020 - 2025



THIRD EDITION 2020

PREFACE

1. PREFACE

The air transport industry plays a major role, not only in the global economic activity, but even more so in the South African environment. In every region of the world, States depend on the aviation industry to maintain or stimulate economic growth and to assist in the provision of essential services to local communities. In this light, civil aviation can be seen as a significant contributor to the overall well-being and economic vitality of individual nations as well as to the world in general. Because of the continued growth in civil aviation, in many places, demand often exceeds the available capacity of the air navigation system to accommodate air traffic, resulting in significant undesirable consequences not only to the aviation industry, but also to general economic health. One of the keys to maintaining the vitality of civil aviation is to ensure that a safe, secure, efficient, and environmentally sustainable air navigation system is available, at the global, regional and national levels. This requires the implementation of an airspace management plan and the associated Air Traffic Management (ATM) system that allows maximum use to be made of enhanced capabilities provided by technical advances.

As far back as the 1980's, the ICAO Council considered the growth of civil aviation, considering the emerging technologies, and determined that a thorough assessment and analysis of procedures and technologies serving civil aviation was in order. In 1983, the ICAO council established the special committee on Future Air Navigation Systems (FANS), which in 1991 evolved a second committee to monitor and coordinate transition planning for the future air navigation system.

In September 1991, the tenth Air Navigation Conference endorsed the FANS Concept. After acceptance by the ICAO council, it came to be known as "Communications, Navigation, and Surveillance/Air Traffic Management (CNS/ATM) systems."

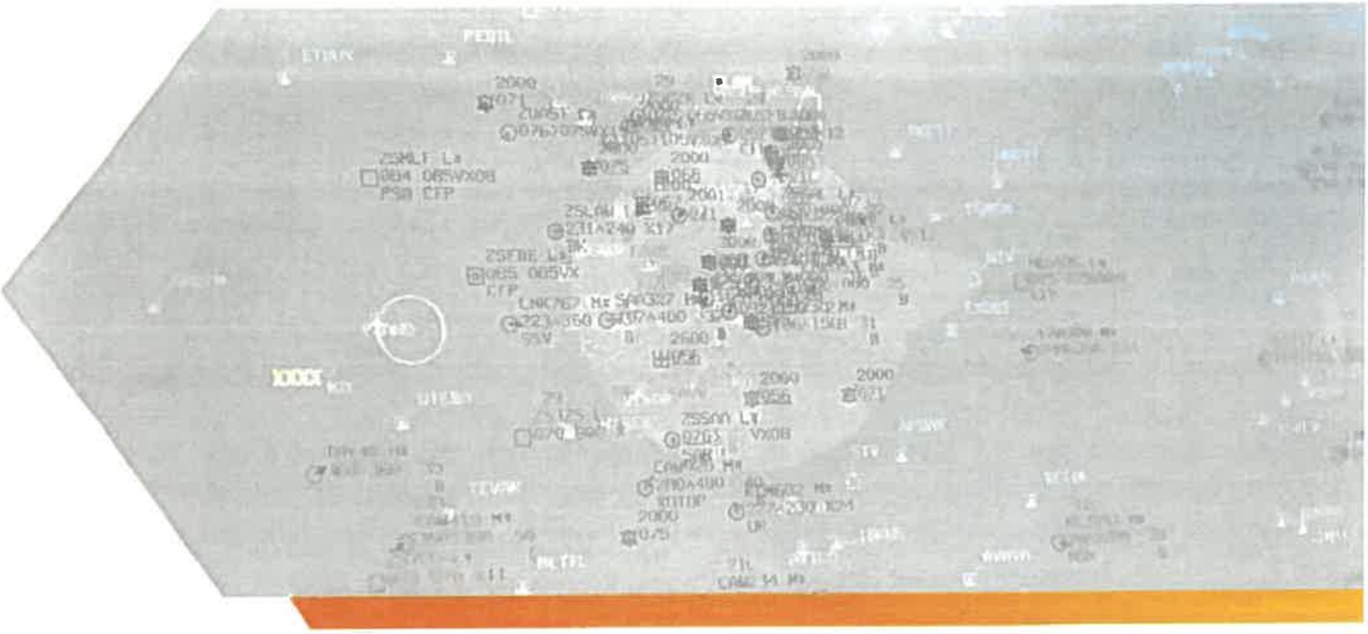
After the following guidance document known as the Global Air Navigation Plan for CNS/ATM Systems (GANP, ICAO Doc 9750) was developed as a strategic document to guide the implementation of CNS/ATM systems.

The industry experienced a technical drive for implementation of systems without the necessary user requirements been identified and it was recognised that technology was not an end in itself, and that a comprehensive concept of an integrated and global ATM system, based on clearly established operational requirements, was needed.

This concept therefore in turn, would form the basis for the coordinated implementation of the available CNS technologies, but dependant on defined ATM System User Requirements.
To develop the concept, the ICAO Air Navigation Commission established the Air Traffic Management Operational Concept Panel (ATMCP).

The operational concept which was adopted globally was intended to guide the implementation of CNS and indeed, ATM technologies by providing a description of how the emerging and future ATM system should operate. This, in turn, assists the aviation community to transition from the air traffic control environment of the 20th century to the integrated and collaborative air traffic management system needed to meet aviation's needs in the 21st century with the goal being an integrated, global ATM system.

The intention of this National Airspace Master Plan is to serve as a broad description on Government's policy on the management of South African Airspace in response to the ICAO Global ATM Concept, the consequential ICAO Global and Regional Air Navigation and safety plans with specific references to the users' expectations and ATM community requirements for the use of the airspace and associated services to ensure successful seamless outcomes.



It is therefore a prerequisite to assess and document the ATM system requirements as it pertains to South Africa and adjacent routing or homogeneous areas and thereby best guide the timely acquisition of the most appropriate and suitable Communication, Navigation and Surveillance (CNS) solutions, to meet the Air Traffic Management (ATM) requirements.

Given that ICAO has recently articulated the need not to leave any State behind during the reach for, or transition to achieving the agreed to global ATM system, this plan obviously considers collaboration nationally, regionally and internationally to be a key element which needs to be considered with every step of the way forward.

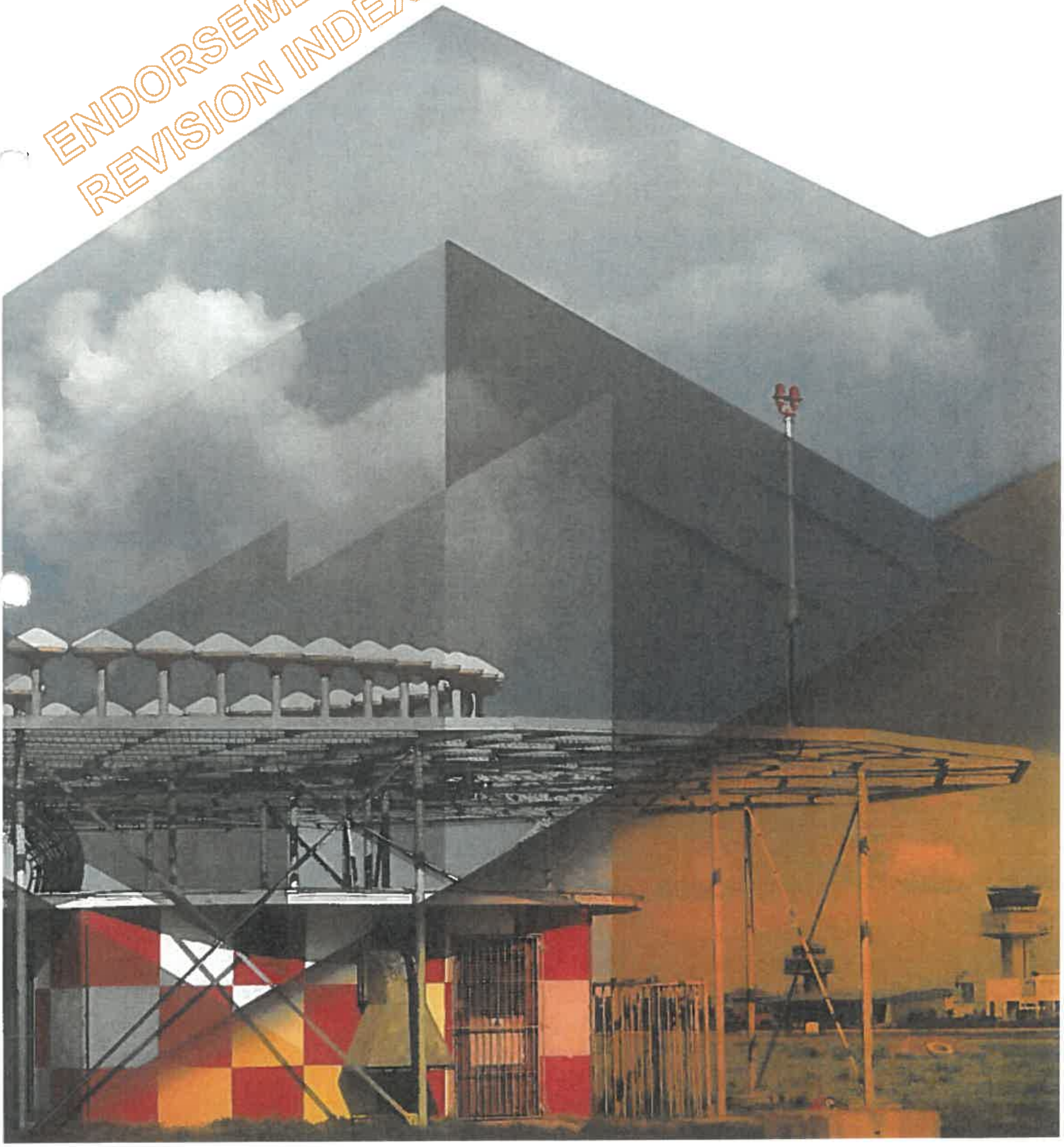
Related to collaboration is an imperative for understanding that the ATM community and their interdependence can no longer support a "silo" mentality or structure.

To this end, the Department of Transport (DoT) has established an ATM/cns Implementation Committee under the Chairmanship of ATNS, who have been delegated to manage the National and Delegated Airspace of South Africa. The ATM/cns Implementation committee was established to ensure that the implementation of the ATM System is a coordinated, harmonious, collaborated process, involving the entire affected community and all relevant activities from strategic to tactical.

In addition, consideration needs to be given to the reality of reliance on additional supporting services such as weather services, which was identified by ICAO as an important partner in achieving the expected outcomes envisaged by the ATM Operational Concept and consequently, this National Airspace Master Plan.

The challenges and outcomes of the ATM/cns Implementation Committee will be subject to scrutiny and guidance from the National Airspace Committee (NASCOM) under the chairmanship of the SACAA and delegated the responsibility to ensure South Africa's compliance with global convention, standards, recommended practices, assurance of acceptable service and safety levels and all within acceptable and agreed to, planning horizons.

ENDORSEMENTS AND APPROVAL
REVISION INDEX



2. ENDORSEMENTS AND APPROVAL

The South African National Airspace Master Plan introduces strategies that will enable a safe, secure, efficient and environmentally sustainable ATM system.

The NAMP is the highest level of strategic guidance for use in developing and implementing airspace and associated ATM initiatives.

Endorsement of the NAMP implies agreement to the vision, mission, goals, key strategies and commitment to participate in the cooperative planning process.

Given the dynamic nature of the air traffic environment, the NAMP may be reviewed and updated annually to reflect the changing situation and to include the contributions of additional stakeholders.

The NAMP was formally endorsed by the NASCOM for recommendation to the Director of Civil Aviation and subsequently recommended to the Director General of Transport for consideration and approval.

SOUTH AFRICAN CIVIL AVIATION AUTHORITY

SACAA____________________**Date** 17 FEB 2020

DIRECTOR OF CIVIL AVIATION: Ms. P. KHOZA

The Director General of Transport hereby endorses and approves this document as the South African National Airspace Master Plan.

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Department: Transport
REPUBLIC OF SOUTH AFRICA

DOT ____________________**Date**____________________

DIRECTOR-GENERAL OF TRANSPORT: Mr. ALEC MOEMI

3. REVISION INDEX

Version	Revision	Date	Reason for change	Pages Affected
Draft	0.1	07/05/2019	NAMP/ASBU WG input	All
Draft	0.2	30/06/2019	ATM/cns implementation committee input	4,6,10,16,22,40,44
Draft	0.3	19/08/2019	NAMP/ASBU WG input	3,5,19,21,22,24,25,39,42
1		01/01/2020	Third Edition	All

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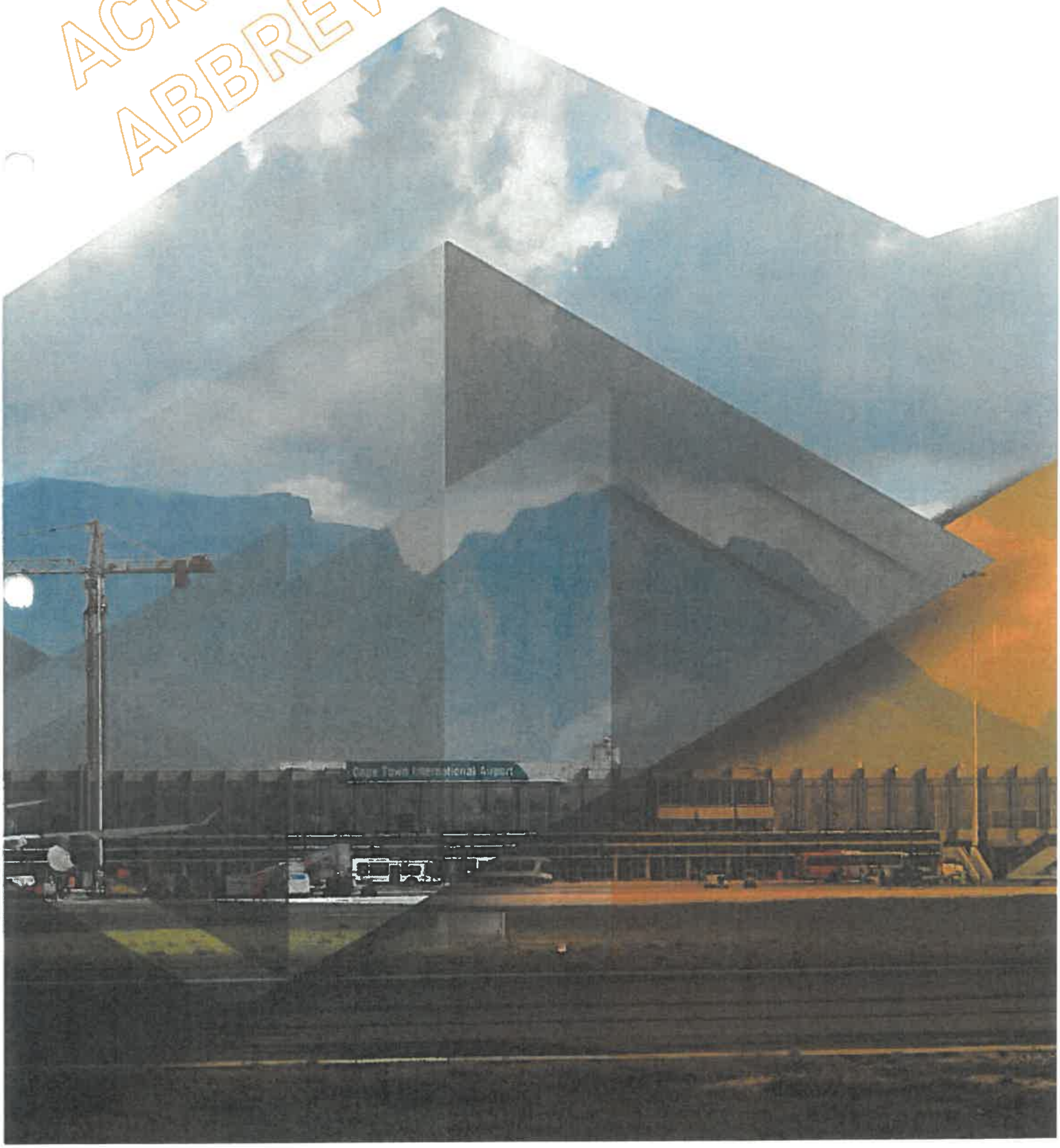
ACRONYMS AND ABBREVIATIONS

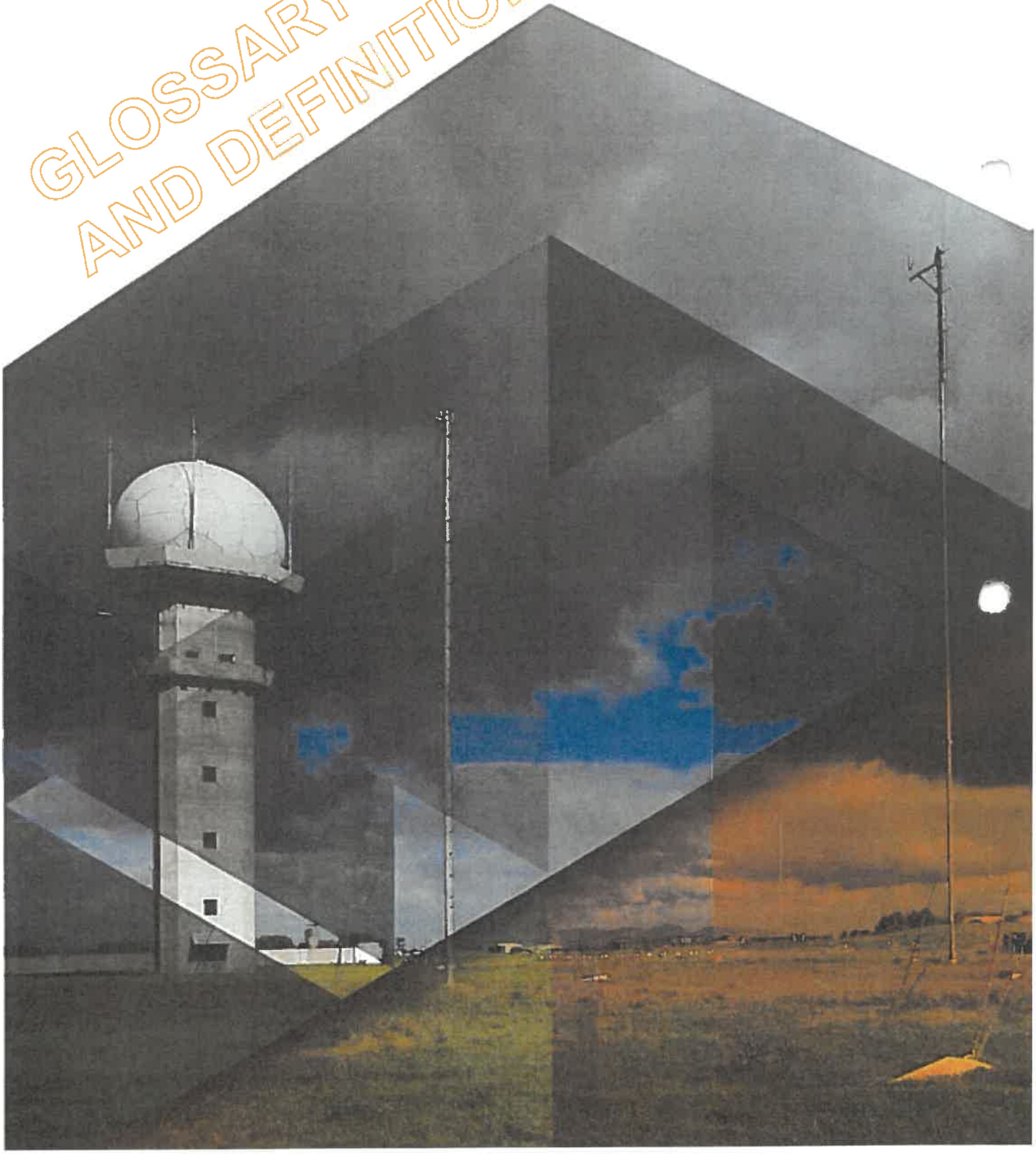


5. ACRONYMS AND ABBREVIATIONS

ABAS	Aircraft Based Augmentation System
ACAS	Airborne Collision Avoidance System
ACARS	Aircraft Communication Addressing and Reporting System
ACC	Area Control Centre
ADS	Automatic Dependent Surveillance
ADS-B	ADS-Broadcast
AFI	Africa-Indian Ocean Region
AFI-RAN	Africa-Indian Ocean (AFI) Regional Air Navigation (RAN)
AFTN	Aeronautical Fixed Telecommunication Network
AIDC	ATS Inter-Facility Data Communications
AIP	Aeronautical Information Publication
AIM	Aeronautical Information Management
AIS	Aeronautical Information Service
AIXM	Aeronautical Information Exchange Model
AMAN	Arrival Manager
ANP	Air Navigation Plan
ANSP	Air Navigation Service Provider
AO	Aerodrome Operations
AOM	Airspace Organisation and Management
AORRA	Atlantic Ocean Random Routing Area
APIRG	AFI Planning and Implementation Regional Group
APP	Approach
ASBU	Aviation System Block Upgrade
ASM	Airspace Management
A-SMGCS	Advanced - Surface Movement Guidance and Control System
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATM/cns	Air Traffic Management/communication navigation surveillance
ATM SDM	Air Traffic Management Service Delivery Management
ATMOC	Air Traffic Management Operational Concept
ATNS	Air Traffic and Navigation Services
ATS	Air Traffic Services
ATSA	Air Traffic Situational Awareness
ATSC	Air Traffic Services Communications
ATSU	Air Traffic Service Unit
ATZ	Aerodrome Traffic Zone
AWO	All-Weather Operations
CAA	Civil Aviation Authority
CAMU	Central Airspace Management Unit
CAPEX	Capital Expenditure
CAR	Civil Aviation Regulations
CATS	Civil Aviation Technical Standards
CCO	Continuous Climb Operations
CDM	Collaborative Decision Making
CDO	Continuous Descend Operations
CM	Conflict Management
CNS	Communication Navigation Surveillance
CPDLC	Controller Pilot Datalink Communication
DCB	Demand Capacity Balancing
DMAN	Departure Manager
DOT	Department of Transport
FF-ICE	Flight and Flow — Information for a Collaborative Environment
FIXM	Flight Information Exchange Model

GANP	Global Air Navigation Plan
GML	Geography Mark-up Language
GNSS	Global Navigation Satellite System
HC	Human Capital
ICAO	International Civil Aviation Organisation
iWXXM	ICAO Meteorological Information Exchange Model
IM	Information Management
OTN	Open Transport Network
OPSCOM	Operational User Consultation Committee
MLAT	Multi-Lateration
PBA	Performance Based Approach
PBCS	Performance Based Communications and Surveillance
PBN	Performance Based Navigation
PSR	Primary Surveillance Radar
RCP	Required Communication Performance
RE-CAT	Re-categorisation of aircraft wake turbulence separation criteria
RNAV	Area Navigation
RNP	Required Navigation Performance
RSP	Required Surveillance Performance
RPAS	Remote Piloted Aircraft System
SACAA	South African Civil Aviation Authority
SAR	Search and Rescue
SBAS	Satellite Based Augmentation System
SARPS	Standard and Recommended Practices
SATCOM	Satellite Communication
SD	Service Delivery
SOA	Service Orientated Architechture
SSR	Secondary Surveillance Radar
SWIM	System Wide Information Management
TCP	Transmission Control Protocol
TS	Traffic Synchronisation
UAS	Unmanned Aircraft Systems
UAV	Unmanned Aerial Vehicles
UML	Unified Modelling Language
UPR	User Preferred Route
UPT	User Preferred Trajectory
UTM	Unmanned Aircraft System Traffic Management
VHF	Very High Frequency
VSA	Visual Separation on Approach
VSAT	Very Small Aperture Terminal
WAM	Wide Area Multilateration
WX	Weather
XML	Extensible Mark-up Language

GLOSSARY OF TERMS AND DEFINITIONS



6. GLOSSARY OF TERMS AND DEFINITIONS

Airborne Collision Avoidance System (ACAS). An aircraft system based on secondary surveillance radar (SSR) transponder signals which operates independently of ground-based equipment to provide advice to the pilot on potential conflicting aircraft that are equipped with SSR transponders.

Automatic Dependent Surveillance—Broadcast (ADS-B) is a surveillance technology in which an aircraft determines its position via satellite navigation and periodically broadcasts it, enabling it to be tracked. The information can be received by air traffic control ground stations as a replacement for secondary surveillance radar, as no interrogation signal is needed from the ground. It can also be received by other aircraft to provide situational awareness and allow self-separation.

Air Traffic Flow Management (ATFM). A service established with the objective of contributing to a safe, orderly and expeditious flow of air traffic by ensuring that ATC capacity is utilised to the maximum extent possible, and that the traffic volume is compatible with the capacities declared by the appropriate ATS authority.

Air Traffic Management (ATM). The dynamic, integrated management of air traffic and airspace — safely, economically and efficiently — through the provision of facilities and seamless services in collaboration with all parties and involving airborne and ground-based functions.
Air Traffic Service (ATS). A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service).

Air Traffic Services Airspaces. Airspaces of defined dimensions, alphabetically designated, within which specific types of flights may operate and for which air traffic services and rules of operation are specified.

Note. — ATS airspaces are classified as Class A to G as shown in Annex 11.

ATM Community. The aggregate of organisations, agencies or entities that may participate, collaborate and cooperate in the planning, development, use, regulation, operation and maintenance of the ATM system.

ATM System. A system that provides ATM through the collaborative integration of humans, information, technology, facilities and services, supported by air and ground- and/or space-based communications, navigation and surveillance.

Benefit. Reduced cost to the user (to the ATM community as a whole) in the form of a saving in time and/or fuel; increased revenue; and/or an improvement to safety.

Controlled Airspace. An airspace of defined dimensions within which air traffic control service is provided in accordance with the airspace classification.

Note. — Controlled airspace is a generic term which covers ATS airspace Classes A, B, C, D and E as described in Annex 11.

Constraint. Any limitation on the implementation of an "operational improvement".

Controller-Pilot Data Link Communications (CPDLC). A means of communication between controller and pilot, using data link for ATC communications.

Capability. The ability of a system to provide a service or perform a function that, either on its own or with other services or functions, can deliver a definable level of performance. This level of performance is measurable within a framework of performance indicators and safety requirements.

Capacity. The maximum number of aircraft that can be accommodated in a given time period by the system or one of its components (throughput).

Delay. The difference between actual block time and ideal block time.

4-D Trajectory Management. The 4D trajectory concept is based on the integration of time into the 3D aircraft trajectory. It aims to ensure flight on a practically unrestricted, optimum trajectory for as long as possible in exchange for the aircraft being obliged to meet very accurately an arrival time over a designated point.

Demand. The number of aircraft requesting to use the ATM system in a given time period.

Efficiency. The ratio of the cost of ideal flight to the cost of procedurally constrained flight.

Enablers. Initiatives, such as (new) technologies, systems, operational procedures, and operational or socio-economic developments, which facilitate the implementation of operational improvements or of other enablers.

Equity. The first aircraft ready to use the ATM resources will receive priority, except where significant overall safety or system operational efficiency would accrue, or national interests dictate that priority be provided on a different basis. Equity is ensured for all airspace users that have access to a given airspace or service by the global ATM system.

Gate-to-gate. Considers the operation of an aircraft not just from take-off to touchdown (the airborne segment) but from the first movement with intention of flight to completion of movement after flight; that is from the gate (or stand or parking position) to gate (or stand or parking position).

GATMOC - Global Air Traffic Management Operational Concept presents the ICAO vision of an integrated, harmonized and globally interoperable ATM system. The planning horizon is up to and beyond 2025. The baseline against which the significance of the changes proposed in the operation concept may be measured is the global ATM environment in 2000.

Information Exchange Model. An information exchange model is designed to enable the management and distribution of information services data in digital format. Normally this is defined for a specific domain such as aeronautical information.

Multilateration (MLAT) System. A group of equipment configured to provide position derived from the secondary surveillance radar (SSR) transponder signals (replies or squitters') primarily using time difference of arrival (TDOA) techniques. Additional information, including identification, can be extracted from the received signals.

Mode S Transponder. Mode S is a Secondary Surveillance Radar (SSR) process that allows selective interrogation of aircraft according to the unique 24-bit address assigned to each aircraft. Recent developments have enhanced the value of Mode S by introducing Mode S EHS (Enhanced Surveillance).

Performance-Based Communication (PBC). Communication based on performance specifications applied to the provision of air traffic services.

Performance-Based Surveillance (PBS). Surveillance based on performance specifications applied to the provision of air traffic services.

Predictability. Is a measure of delay variance against a performance dependability target. As the variance of expected delay increases, it becomes a very serious concern for airlines when developing and operating their schedules. Conceptually, predictability metrics should be a comparison of the actual flight time to the scheduled flight time, since the scheduled time includes the amount of expected delay at a targeted dependability performance.

Seamless Airspace. Airspace without any visible boundaries or restraints to the operator

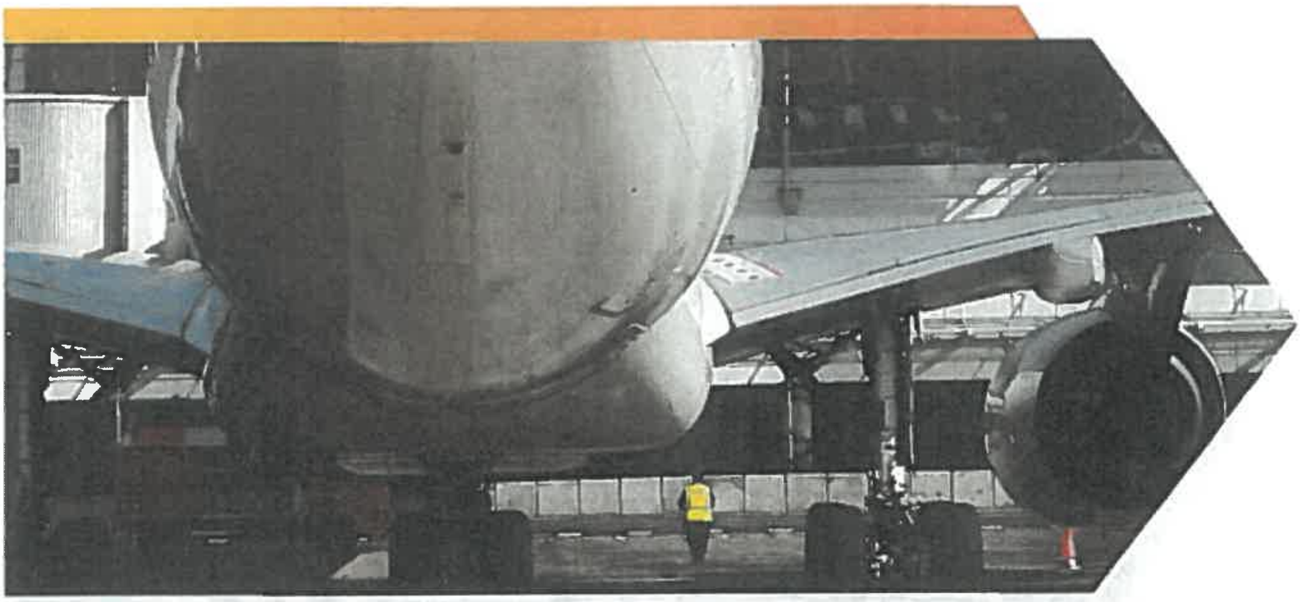
Service-Oriented Architecture (SOA). An approach to integrate applications running on heterogeneous platforms using industry-wide acceptable standards. Each application is exposed as one or more services where each information service provides a particular functionality. Information services (applications) communicate with each other in a coordinated sequence that is defined by a business process.

System-Wide Information Management (SWIM). SWIM consists of standards, infrastructure and governance enabling the management of ATM related information and its exchange between qualified parties via interoperable services.

Time Difference of Arrival (TDOA). The difference in relative time that a transponder signal from the same aircraft (or ground vehicle) is received at different receivers.

Traffic Synchronisation. Traffic synchronisation concerns the management of the flow of traffic through merging and crossing points, such as traffic around major aerodromes or airway crossings. It currently includes the management and provision of queues both on the ground and in the air. Traffic synchronisation, as a function, is closely related to both demand/capacity balancing and separation provision and may in the future be indistinguishable from them. Traffic synchronisation also concerns the aerodrome "service" part of the concept.

Trajectory or Profile. This is a description of the movement of an aircraft, both in the air and on the ground, including position, time and, at least via calculation, speed and acceleration.

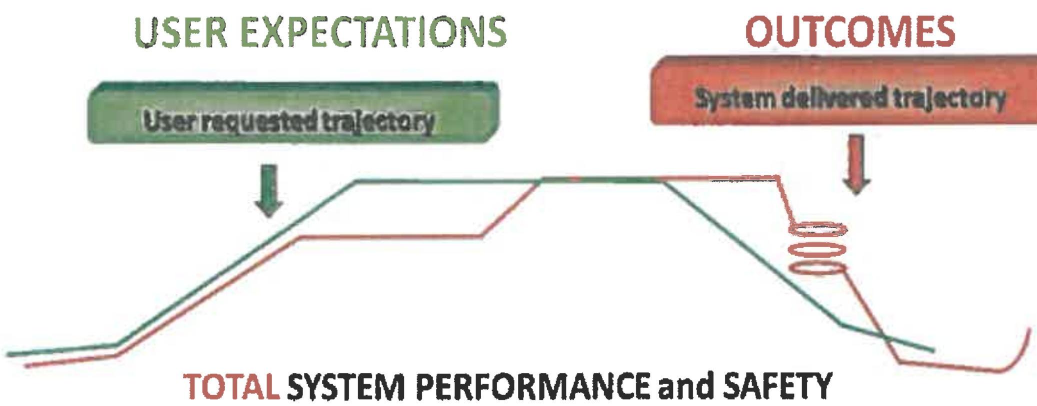


INTRODUCTION

7. INTRODUCTION

Whilst it must be recognised that the level of safety and efficiencies have noticeably increased over the years since the adoption of the ATM Concept and global and regional Air Navigation Plans, it has become all too apparent that more work needs to be done to further the outcomes resulting in the system delivered trajectory becoming more aligned to the user requested (preferred) trajectory, without any compromise to safety. User expectations are in certain cases not being met. This plan provides the guidance needed to consider addressing delayed departures and arrivals, excessive fuel burn due to holding, or long taxiway cues, chaotic diverse routing due to weather, non-standard ATM system management methods resulting in unpredictability and disjointed resource allocations and slow implementation of collaboration opportunities.

Given that the effort of managing airspace is a product of a system and collective action, the entire ATM Community is involved



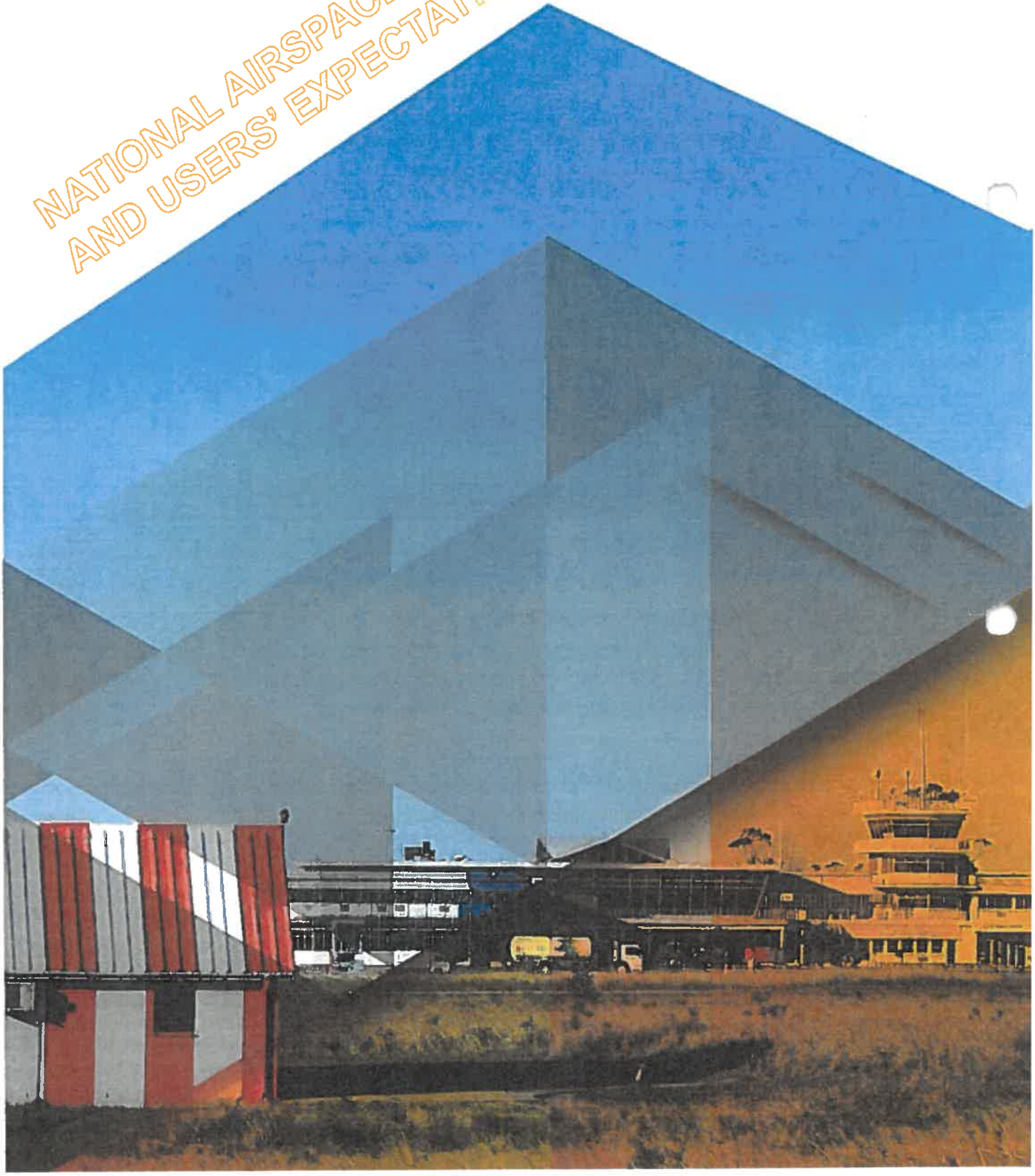
Key to the management of airspace in accordance with national requirements is a clear understanding of the expectations of the airspace user community.

Members of the ATM community will have differing performance demands of the system. All will have either an explicit, or implicit expectation of safety. Some will have explicit economic expectations, others efficiency and predictability. For optimum system performance, each of these sometimes-competing expectations will need to be balanced. Furthermore, explicit safety outcomes will need to be demonstrated and met.

The broad expectations in general terms result from efforts to document ATM "user requirements." The expectations are interrelated and cannot be considered in isolation. User requirements will need to be continually discussed and contextualised however will always need to be related to the broad expectations.

The Airspace Block Upgrade priorities and upgrades will be considered in view of the expectations and requirements.

NATIONAL AIRSPACE MANAGEMENT AND USERS' EXPECTATIONS



8. NATIONAL AIRSPACE MANAGEMENT AND USERS' EXPECTATIONS

8.1. Access and equity

The ATM system managed by ATNS in close collaboration with the SACAA and any other ATS service providers, must provide an operating environment that ensures that all airspace users have the right of access to ATM resources needed to meet their specific operational requirements; and ensures that the shared use of the airspace for different airspace users can be achieved safely. Generally, the first aircraft ready to use the ATM resources will receive priority, except where significant overall safety or system operational efficiency would accrue or national defense considerations or interests dictate by providing priority on a different basis.

The processes concerning this expectation should be documented and due consideration given to protocols around Strategic, Pre-tactical and Tactical Airspace reservations together with any agreements on operational procedures between service providers.

8.2. Capacity

The ATM system managers must plan to exploit the inherent capacity to meet airspace user demand at peak times and demanding locations while minimising restrictions on traffic flow. To respond to future growth, capacity must increase, along with corresponding increases in efficiency, flexibility, and predictability while ensuring that there are no adverse impacts to safety giving due consideration to the environment. The ATM system must be resilient to service disruption, and the resulting temporary loss of capacity.

8.3. Cost effectiveness

The ATM system must be cost-effective, while balancing the varied interests of the ATM community and varying level of services provided. The cost of service to airspace users should always be a consideration and appropriately collaborated upon when evaluating any proposal to improve ATM service quality or performance. Any ICAO guidelines regarding user charge policies and principles should be followed.

8.4. Efficiency

Efficiency addresses the operational and economic cost-effectiveness of gate-to-gate flight operations from a single-flight perspective. Airspace users want to depart and arrive at the times they select and fly the trajectory they determine to be optimum in all phases of flight. The ATM System service providers must maintain relevant data sets to be able to compare requested service levels and trajectories with those delivered for planning and regulator reporting purposes.

8.5. Environment

The ATM system must consider and plan to contribute to the protection of the environment by considering flight profiles, noise, gaseous emissions, and other environmental matters in the implementation and operations.

8.6. Flexibility

Whilst the need to manage resource allocations both from an ATM system management and aerodrome point of view, flexibility addresses the ability of all airspace users to modify flight trajectories dynamically and adjust departure and arrival times thereby permitting them to exploit operational opportunities as they occur and possibly improve business outcomes. Plans need to consider the opportunities the future technology presents.

8.7. Global interoperability

The ATM system design must be based on all the requirements and global guidance material, global standards and uniform principles to ensure the technical and operational interoperability of ATM systems and to facilitate homogeneous, global and regional traffic flows.

8.8. Participation by the ATM community

The ATM community must have a continuous involvement in the planning, implementation, and operation of the management of airspace and associated services to ensure that the evolution of the global ATM system meets the expectations of the community. Plans must ensure that no silos are created or entertained, and that collaboration is undertaken from strategic through to tactical service delivery.

8.9. Predictability

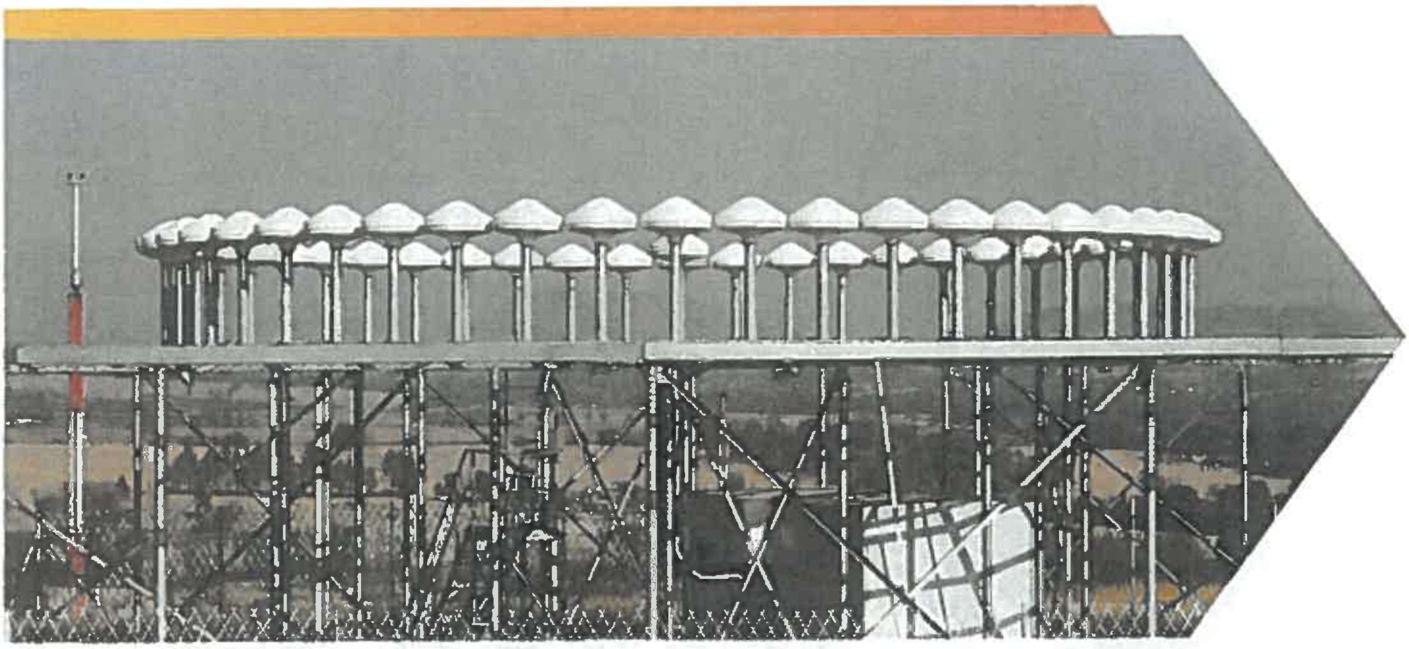
Whilst any plan must have contingencies in place to manage unexpected events, predictability is an absolute requirement for the entire ATM System to operate successfully. Consequently, it is a serious expectation that there is a robust level of predictability built into the community's (users and service providers) strategic and tactical plans. Level and consistency of predictability must enable adequate resource allocation, schedule compliance, safety related system management and operational execution. Provided system information, in all areas, will have to be at a level able to support the high level of operational predictability expected by users.

8.10.Safety

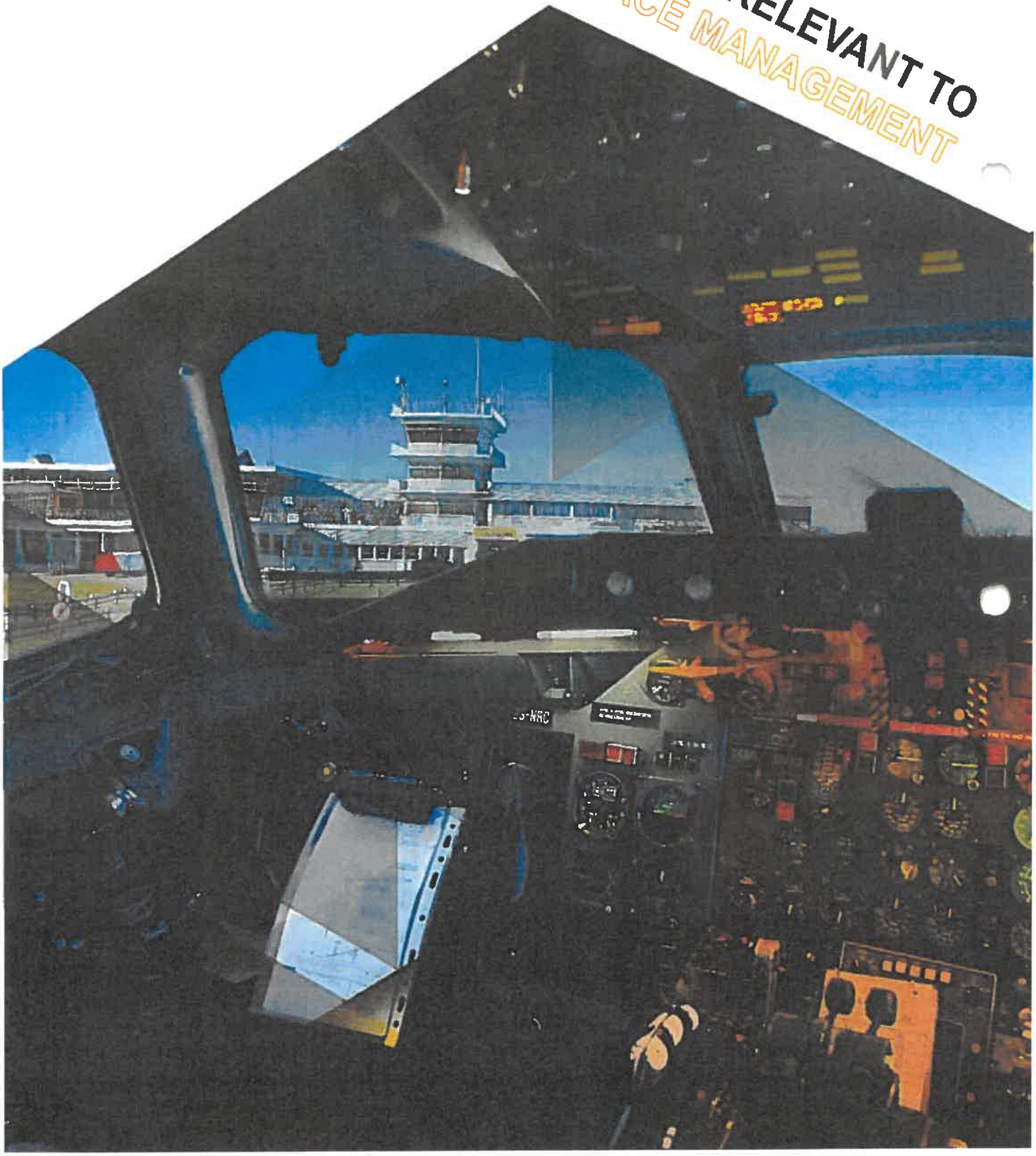
Safety is the highest priority in aviation, and ATM plays an important part in ensuring overall aviation safety. Uniform safety standards and risk and safety management practices should be applied systematically throughout the ATM system. In implementing elements of the global aviation system, safety will be assessed against appropriate criteria, and in accordance with appropriate and globally standardised safety management processes and practices.Effectively it therefore becomes a requirement that any implementation of any system solutions, procedural, technical or otherwise, irrespective of any business case and collaborated acquisition agreement, will be supported by a SACAA approved safety case.

8.11.Security

Adequate Security in aviation is a major expectation and there are certain aspects of security that will only become evident and manageable by the ATM System. Normally referring to the protection against threats, which stem from intentional (e.g. terrorism) or unintentional (e.g. human error, natural disaster) acts affecting the safety of aircraft, people or installations on the ground. The ATM system must contribute to security, including the threat of cyber security. Security risk management should balance the needs of the members of the ATM community who require access to the system, with the need to protect the ATM system. In the event of threats to aircraft or threats using aircraft, ATM system shall provide responsible authorities with appropriate assistance and information whenever required and all plans shall consider this aspect.



ATM SYSTEM COMPONENTS RELEVANT TO SOUTH AFRICAN AIRSPACE MANAGEMENT



9. ATM SYSTEM COMPONENTS RELEVANT TO SOUTH AFRICAN AIRSPACE MANAGEMENT

9.1. Airspace Organisation and Management (AOM)

All South African sovereign as well as delegated airspace is the concern of ATM and will be a useable resource. Any restriction on the use of any particular volume of airspace will be considered transitory. At the strategic level all airspace design is based on the multipurpose utilisation of the national airspace.

The ATNS strategy to support airspace organisation hinges on a well-established ability to allow for the safe and efficient switching between different tactical applications of airspace sectors or regions. This is aimed at accommodating commercial, military, general aviation, sports recreation, Unmanned Aircraft Systems (UAS) and other uses of airspace at the tactical level and follows the Collaborative Decision Making (CDM) process.

Airspace organisation establishes airspace structures to accommodate the different types of air activity, traffic volumes and differing levels of service and rules of conduct. Airspace management is the process by which the airspace options are selected and applied to meet the needs of the ATM community.

Airspace Organisation philosophies will conform to and evolve with international best practice concepts, available and planned global ATM processes while still accommodating older generation aircraft, for a defined period of time, in a manner that will not adversely impact on the current utilisation of the airspace.

Currently all airspace at and above Flight Level (FL) 200 will be class A and subject to agreed to and appropriate Conflict Management (CM) operations and apportionment. It is foreseen that as the ATM system evolves, the lower vertical limits may be adjusted to facilitate improved services levels.

As enabling technologies develop in the UAS sector it is expected that the demand for UAS operations in all classifications of airspace will increase, and the affected ATM community must plan for safe accommodation and integration of UAS into defined classes of airspace.

The end state integration of UAS seamlessly into non-segregated airspace will require CDM with the entire ATM community to ensure a safe and efficient interoperability of systems for all airspace users.

End state integration into controlled airspace, shall be preceded by UAS integration into the ATM system through establishing sound and proven processes which will be SACAA approved subsequent to the said CDM.

UAS integration into the ATM System shall not result in a significant impact on current users of the airspace. UAS shall comply with the existing and future regulations and procedures contemplated and developed for manned aviation however, this development will take cognisance of the change in flight operations and performances.

UAS integration shall not compromise existing aviation safety levels nor increase risk more than an equivalent increase in manned aviation would. UAS operations shall be conducted in the same way as those of manned aircraft and be seen as equivalent when developing Conflict Management (CM) principles, procedures and standards by the ATM service providers.

ATM system planning, CDM processes and tactical operations will always be based on up-to-date, quality assured, and accurate information sharing between ATM community members in a CDM environment. Therefore, airspace management will remain dynamic and flexible.

Due to the layout and location of congested terminal areas, the major city pairs in South Africa are subject to a fixed route structure supporting RNAV operations which are separated even in the absence of radar surveillance due to unforeseen circumstances.

Where routes are fixed, they shall support the delivery of uninterrupted climb and descent profiles. Terminal areas will be provided with Standard Departure and Arrival Routes, de-conflicted by design.

The Central Airspace Management Unit (CAMU) shall provide revised routes (flex tracks) when appropriate, to avoid hazardous segments, accommodate balanced airspace resource allocation, and enhance safety, efficiency and predictability. As far as possible, airspaces outside of the congested continental airspace shall enable free routing laterally and vertically allowing suitably equipped aircraft to make use of their capability and thereby realising benefits.

Airspace boundaries will be adjusted to accommodate particular traffic flows and should not be constrained by national or synthetic boundaries.

Upper airspace management and associated services for South African as well as delegated airspace will be managed as agreed through regional planning and implementation activities in a seamless and harmonised manner.

Airspace re-configuration, consolidation and centralisation of certain ATM system management processes will provide greater flexibility, enhanced safety and security.

South Africa needs to pursue rationalisation and harmonisation of airspaces, services and facilities in order to improve safety and efficiency while reducing costs and environmental impact, and enhance the possibilities of benefits to the entire ATM community.

Performance Based Navigation (PBN) and Performance Based Communication and Surveillance (PBCS) will be implemented in line with the Global and Regional Planning and ICAO timelines to ensure that maximum benefits can be achieved in the Airspace managed by South Africa.

Every effort needs to be made at implementing improved capacity, efficiency and safety by transitioning to RNAV applications with a target of 4-D Trajectory Management. User preferred routing application through trajectory-based operations will introduce significant efficiencies, cost savings as well as environmental benefits.

Whilst airborne and space based systems are supported, subject to a collaborated and defined user requirement statement, it is the DoT's Policy that a "back bone" (minimum possible) of terrestrial based navigational and landing aids at national aerodromes be maintained throughout the period.
It is the responsibility of ATNS to identify the Aviation System Block Upgrade (ASBU) requirements associated with AOM however; it is also a requirement to specify those relevant to South Africa.

Any enabling technologies aimed at assisting the implementation of this National Plan shall be subject to CDM with final approvals through normal business cases and the standard permission process.

9.2. Aerodrome Operations (AO)

As an integral part of the ATM system, the aerodrome which has a direct impact on airspace must provide the collaborated and agreed to ground infrastructure including, inter alia, lighting, taxiways, runway and runway exits, where relevant, surface guidance to improve safety and to maximise aerodrome capacity in all weather conditions.

CDM at strategic, pre-tactical and tactical stages with the rest of the ATM community must ensure that the aerodrome throughput capacity matches the relevant airspace management capacity.

Constraints on flights moving from the runway to the parking location and from the parking location to the runway will continue to be minimised.

System enhancements to minimise constraints will include:
Improved information exchange and coordination activities, and increased collaboration and information sharing among airspace users and service providers to create a more realistic picture of aerodrome departure and arrival demand.

Automation aids for dynamic planning of surface movements will provide methods and incentives for collaborative problem solving by airspace users and service providers. This will improve the management of excess demand through balanced taxiway usage and improved sequencing of aircraft to the departure threshold.

In addition, support tools will permit the optimisation of take-off points along the runway, by accessing information on aircraft performance capabilities such as required take-off distance and climb-out capabilities. This will also apply in the case of arriving aircraft, allowing exit points from a runway to be accurately predicted or realistically assigned.

Integration of surface automation with departure and arrival automation will facilitate the coordination of all surface activities. Runway and taxiway assignments will be based on projected arrival/departure runway loading and surface congestion, airspace user runway preference, and parking location. Environmental considerations such as noise abatement or emission minimisation will also be considered to the extent that safety is not compromised.

Arrival runway and taxiway assignments will be planned early in the arrival phase of flight. Departure assignments will be made when the flight profile is filed and updated accordingly until the time of push-back.

The entity plans need to accommodate the possibility of early arrivals on intercontinental flights, provided within the pre-tactical window, given that operators preferred trajectory may be altered to benefit from environmental advantages.

Surveillance and guidance systems will continue to provide for greater situational awareness that will permit full capacity operations in all weather conditions beyond an airport defined perimeter. Surface-movement decision-support systems will also be an integral part of the total ATM system environment automation.

This will ensure that surface initiatives, user preferences and conflict management are not contradictory. Thus, runway assignments in departure and arrival will be based not only on the location of the assigned parking location, but also on the surface situations prediction of congestion and the related taxi plan.

For departures, taxi time updates and the associated estimates included in the taxi plan will be coordinated with airspace management to efficiently sequence ground traffic to match projected airborne traffic flows. The system will incorporate departure times, aircraft type, wake turbulence criteria, and departure routes to safely and efficiently sequence aircraft to the departure threshold.

For arrivals, the system will consider the intended parking location to minimise taxi time after landing. Additionally, improved information about aircraft intent will allow monitoring of taxi plan execution and will provide alerts to the potential for runway incursion. There must be a level of information sharing between aerodrome and Conflict Management Flight and Flow systems of Information for a tactically collaborative environment; this will also satisfy the requirement for dynamic and accurate data and information exchange to support the ATM system and expectations of the ATM community.

Precision approaches down to auto-land will be researched and implemented in collaboration with the relevant ATM community members. The role of local augmentation will receive specific attention.

It is the responsibility of ATNS to identify the ASBU requirements associated with AO however; it is also a requirement to specify those relevant to South Africa.

Any enabling technologies aimed at assisting the implementation of this National Plan shall be subject to CDM with final approvals through normal business cases and the standard permission process.

9.3. Demand and Capacity Balancing (DCB)

Airspace and aerodrome traffic flows and capacities will strategically be evaluated to allow for demand and capacity balancing allowing the airspace users to determine their preferred operation, while mitigating conflicting needs for airspace and aerodrome capacities.

This collaborative process between airspace user, airport operator and conflict management (ATS) facilitated by ATM Service Delivery Management provider, in this case ATNS, through the Central Airspace Management Unit, allows for the efficient management of the air traffic flow through the use of information on system-wide basis of air traffic capacity, weather phenomenon (terrestrial and space based), assets and equipment availabilities.

Through collaborative decision-making at the strategic stage, assets will be optimised to maximise throughput thus providing a basis for predictable resource allocation and traffic scheduling.

Through CDM, when possible, at the pre-tactical stage, adjustments will be made to assets, resource allocations, projected trajectories, airspace organisation, and allocation of entry/exit times for aerodromes and airspace volumes to mitigate any imbalance.

Airspace concepts and design must take cognisance of airspace user equipage. Any new airspace concept designs will ensure that the major users of any airspace or airspace system is not prevented from benefiting from new technologies, both airborne and terrestrial for the sake of accommodating less modern users.

PBN will be implemented in accordance with the South African PBN Roadmap as may be amended, ultimately achieving 4-D Trajectory Management.

At the tactical stage, actions will include dynamic adjustments to the organisation of airspace to balance capacity; dynamic changes to the entry/exit times for aerodromes and airspace volumes; and adjustments to the schedule by the users, supporting 4-D trajectory management.

DCB actions aimed at ensuring safety, equity and access is a CDM process in which the collection, collation and analysis of data to produce an accurate picture of the demands and constraints that will affect any particular airspace volume will begin long before the day of operations (strategical). ATNS supports the overall DCB activity through annual traffic forecasts developed by means of a comprehensive forecasting model which informs the capacity initiatives of the company.

Traffic forecasts declared system and airspace capacities, Conflict Management workload and complexity of operations are used to determine the need for additional sectors. The information gathered from these activities informs the ATNS service delivery plan which includes Human Capital and CAPEX plans.

It is the responsibility of ATNS to identify the ASBU requirements associated with DCB however; it is also a requirement to specify those relevant to South Africa.

Any enabling technologies aimed at assisting the implementation of this National Plan shall be subject to CDM with final approvals through normal business cases and the standard permission process.

9.4. Traffic Synchronisation (TS)

Traffic synchronisation will be introduced to ensure the tactical establishment and maintenance of a safe, orderly and efficient flow of air traffic. Traffic synchronisation will encompass both the ground and airborne activities of ATM and will constitute a flexible mechanism for capacity management by allowing reductions in traffic density and adjustments to capacity in response to variations in demand.

Traffic synchronisation will be designed to assist the efficient use of integrated and automated surface, departure, arrival and en-route management to ensure an optimum traffic flow.

The objective will be to eliminate choke points and, ultimately, to optimise traffic sequencing to achieve maximisation of runway throughput. Traffic synchronisation will enhance the ATM system ability to tactically and collaboratively modify sequences to optimise aerodrome operations, including gate management and/or airspace user operations.

During this planning period there will be a progression to dynamic 4-D trajectory management and negotiated conflict-free trajectories. Airspace concepts and design will take cognisance of th advances in user equipage and thereby ensure that ATM Service Delivery Management is inclusive of Conflict Management, users of the airspace will benefit fully from new technologies, (both airborne and terrestrial.)

Optimisation of traffic sequencing will achieve maximisation of runway throughput for all existing runway configuration. 4-D trajectory management will be progressively introduced to minimise congestion and to improve over-all system throughput e.g., the use of taxi sequencing equipment (both to and from the gate).

ATNS will pursue regulatory amendments to support the use of station keeping requirements placed on flight crews in all phases, to maintain the required sequence and traffic flow. This will ultimately support the concepts of self-separation and free flight.

Flight parameters will be available to the ATM system, allowing for dynamic spacing and sequencing of arriving and departing aircraft, taking cognisance of wake vortex, which will continue to be a determinant of minimum spacing.

Re-Categorisation (Re-Cat) of aircraft wake turbulence separation criteria will be monitored as it will introduce additional capacity during sequencing of arriving and departing aircraft at identified aerodromes.

It is the responsibility of ATNS to identify the ASBU requirements associated with TS however; it is also a requirement to specify those relevant to South Africa.

Any enabling technologies aimed at assisting the implementation of this National Plan shall be subject to CDM with final approvals through normal business cases and the standard permission process.

9.5. Airspace User Operations (AUO)

Airspace user operations which refer to the ATM system relating to aspect of flight operations and the national plan, accommodates diverse types of airspace user missions. The system will need to evolve to accommodate increasingly diverse types of vehicles and performance capabilities. These are expected to encompass, but are not limited to, air transport, military missions, business, aerial work and recreation. These missions will have differences in planning horizons, from those scheduled well in advance to just prior to flight. Both manned and unmanned aerial and trans-atmospheric vehicles, will form part of the ATM system.

The ATM system will accommodate the limited ability of some vehicles to dynamically change trajectory. The development of the ATM system and aircraft capabilities, based on global standards, will ensure global interoperability of ATM systems and airspace user operations. User requirements and operational capabilities (crew and equipment) will be addressed in order to enhance safety and efficiency through CDM, in accordance with the NAMP.

PBN implementation will allow dynamically-optimised 4-D trajectory planning. ATNS and other ATM service providers must plan to continuously meet the expectations of the airspace users regarding predictability, harmonisation and interoperability. The dynamic flight and flow data which must be made available by ATNS, will be incorporated within the ATM system to enhance the general, tactical and strategic situational awareness and Conflict Management of the airspace users.

It is the responsibility of ATNS to identify the ASBU requirements associated with AUO however; it is also a requirement to specify those relevant to South Africa.

Any enabling technologies aimed at assisting the implementation of this National Plan shall be subject to CDM with final approvals through normal business cases and the standard permission process.

9.6. Conflict Management (CM)

Conflict Management is an area where diligent and specific collaboration between all affected ATM community members will need to take place from strategic to the tactical domain, as this involves more than what has been the understood norm associated with ATC separation methodologies to this point in time.

Conflict management will consist of varying layers, namely:
- Strategic Conflict Management through airspace organisation and management;
- Demand and Capacity Balancing, and Traffic Synchronisation; and
- Separation provision and collision avoidance.

Conflict Management will limit, to an acceptable level, the risk of collision between aircraft and hazards.

Hazards that an aircraft will be separated from are, other aircraft, terrain, weather, wake turbulence, incompatible airspace activity and, when the aircraft is on the ground, surface vehicles and other obstructions on the apron and manoeuvring area.

Key conceptual changes which will include planning and revised processes and procedures subject safety evaluations include:
- SACAA plans to introduce a system of classification and modes in collaboration with the affected ATM Community which can accommodate;

- Strategic Conflict Management which will reduce the need for separation provision to a designated level resulting in the ATM system minimising restrictions on user operations therefore, the predetermined separator will be the airspace user unless safety or the ATM system design requires a separation provision service;
- The role of separator may be delegated however such delegations will be temporary;
- In the development of separation modes, separation provision intervention capability must be considered;
- The conflict horizon will be extended as far as procedures and information will permit; and
- Collision avoidance systems will be part of ATM safety management but will not be included in determining the calculated level of safety required for separation provision.
- It is the responsibility of ATNS to identify the ASBU requirements associated with CM however; it is also a requirement to specify those relevant to South Africa.

Any enabling technologies aimed at assisting the implementation of this National Plan shall be subject to CDM with final approvals through normal business cases and the standard permission process.

9.7. ATM Service Delivery Management (ATM SDM)

ATM Service Delivery Management will operate in a more dynamic way instead of today's more static operations which are according to defined procedures. The migration will be from current controlling of individual aircraft trajectories to seamlessly managing flight trajectories from gate-to-gate for all phases of flight and across all service providers through CDM. The ATM SDM will more efficiently address the balance and consolidation of the decisions of the various ATM components and their related processes and services, as well as the time horizon at which, and the conditions under which, these decisions are made.

ATM SDM is composed of three main functions which will be executed in a collaborative manner:

- ATM Performance Management;
- ATM Services Management; and
- ATM Assets Management

ATM SDM will manage the optimised performance of the ATM system. ATM system design will be determined by collaborative decision making based on system-wide information sharing and system-wide performance cases. ATM SDM will continue to manage, plan and coordinate the provision of ATM services. Services to be delivered will be more efficiently established on an as-required basis subject to ATM system design.

ATM system design will be determined by collaborative decision making, system-wide safety management and business cases. When there is a request for ATM services, the process will consist of building an agreement on the flight trajectory based on user requirements and preferences, the constraints and opportunities related to the other services, and the information available on the operational situation. The agreement will then be the subject of monitoring.

A significant deviation from the agreement, as observed or inferred from information available, will trigger a revision to the agreement or a warning to draw attention to the need to revert to the agreement.

ATM Service Delivery Management will manage the distribution of the responsibilities for the various services and their seamless performance, including the designation of a predetermined separator for separation provision.

This function will be important to ensure that the services delivered by the ATM service delivery system will, through collaborative decision making, balance and optimise user-requested trajectories to achieve the ATM community's expectations. To maintain situational awareness, ATM Service Delivery Management will monitor a wide range of non-flight-specific infrastructure and traffic demand information.

ATM Service Delivery Management principles will include:

- Trajectory, profile, and aircraft or flight intent (predictability); and
- Management by trajectory, clearance, and aircraft performance characteristics
- ATM SDM will ensure redundancy capacity is developed through a Disaster Recovery (DR) framework to protect the ATM Community and to enable to maintain or rapidly resume critical ATM SDM functions following a disaster.

Although it is accepted that there are competing service delivery entities on the horizon, ATNS will remain the responsible ATM SDM managers for the national and delegated airspace as it affects Area, Flight Information Region (FIR), Defined Terminal and Control Zones for South Africa.

It is the responsibility of ATNS to identify the ASBU requirements associated with ATM SDM however; it is also a requirement to specify those relevant to South Africa.

Any enabling technologies aimed at assisting the implementation of this National Plan shall be subject to CDM with final approvals through normal business cases and the standard permission process.

9.8. Information Management (IM)

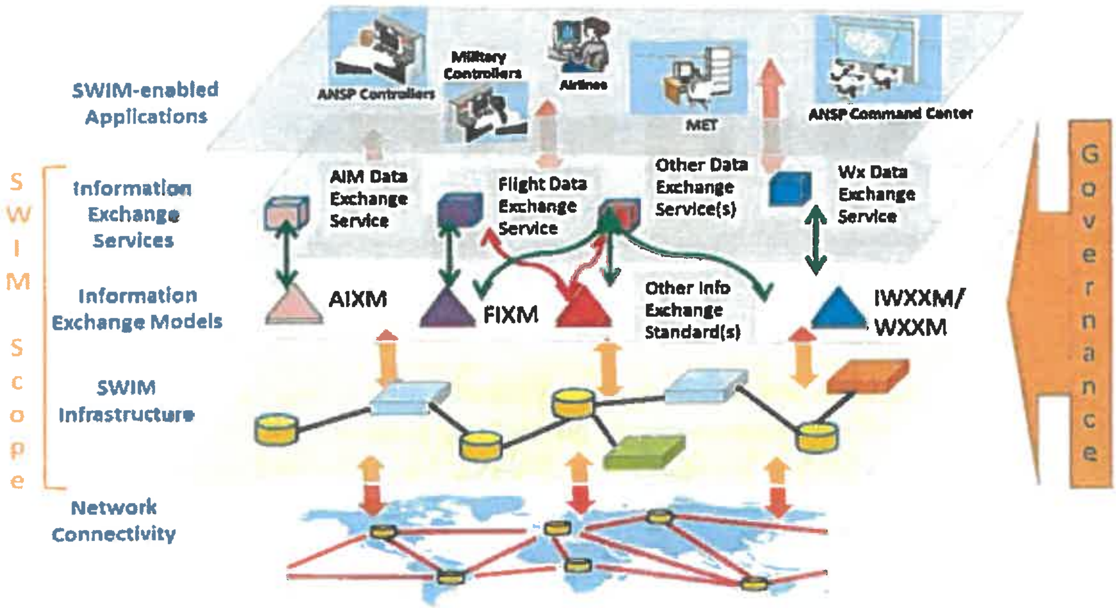
ATNS will be required, as part of the ATM Service Delivery Management mandate, to rationalise and implement an appropriate information system able to meet the needs contemplated by the ATM Operational Concept, which will provide all the information needed to undertake the ATM SDM in its entirety.

The increased requirement to become more efficient whilst increasing capacity as well as safety in the ATM environment is requiring that we introduce more automated systems and a variety of applications reliant on accurate, quality assured and timely information.

ATM data is currently stored in a variety of systems by various ATM community members in different locations using various exchange protocols and formats, which increases the challenges associated with the consolidation and integration of the data contained within these systems. System-wide interoperability and secure seamless information access and exchange requires introduction of significant changes in the business practices of managing information within the ATM system.

Within the ATM system, Aeronautical Information Management (AIM) will be responsible to ensure the flow of aeronautical data and aeronautical information necessary for global ATM system safety, regularity, economy and efficiency in an environmentally sustainable manner.

AIM will collect, manage and distribute aeronautical data and content (format, timeliness, collection, checking, distribution, etc.) as well as manage the technical elements (storage, consistency of data bases, global interfacing, etc.) of aeronautical data and information.



The plan is that AIM is to evolve into generic Information Management which is the full implementation of System Wide Information Management (SWIM). Information Management will fully include AIM while also encompassing all other ATM information management functions not already incorporated in AIM.

It is required that implementation of an ATM Information Reference Model (AIRM) within the ATM system is undertaken to ensure that exchange models such as Aeronautical Information Exchange Model (AIXM), Flight Information Exchange Model (FIXM), ICAO Meteorological Information Exchange Model (iWXXM) and other exchange models being developed, are consolidated and integrated into the Global Interoperable ATM system.

Interoperability is required to deliver the right information, at the time, at the right place, in the correct format.

The requirement for exchange of different datasets as require for systems to be able to accommodate, Extensible Mark-up Language (XML), Geography Mark-up Language (GML) and Unified Modelling Language (UML) file formats.

This will ensure the data exchange models are implemented in a structured, traceable, unified, harmonised, common digital format supporting the Service Orientated Architecture (SOA).
ATM planning, collaborative decision-making (CDM) processes and tactical operations will always be based on up-to-date, quality assured, and accurate information sharing between ATM community members in a CDM environment.

The growing need for Information Management (IM) and SWIM requires ATNS to enhance its information management systems and application capacity.

The current point-to-point data exchange links will be replaced by a system wide information exchange, which seeks to provide quality information to the needing ATM community members in a timely manner.

Information provision from adjacent but participating entities, such as ANSPs, airline operators, weather services etc., shall be subject to the same quality.

It is the responsibility of ATNS to identify the ASBU requirements associated with IM however; it is also a requirement to specify those relevant to South Africa.

Any enabling technologies aimed at assisting the implementation of this National Plan shall be subject to CDM with final approvals through normal business cases and the standard permission process.

CONCLUSION & REFERENCES

10. CONCLUSION

The National Airspace Master Plan provides the strategic view and direction of airspace organisation and management within South Africa.

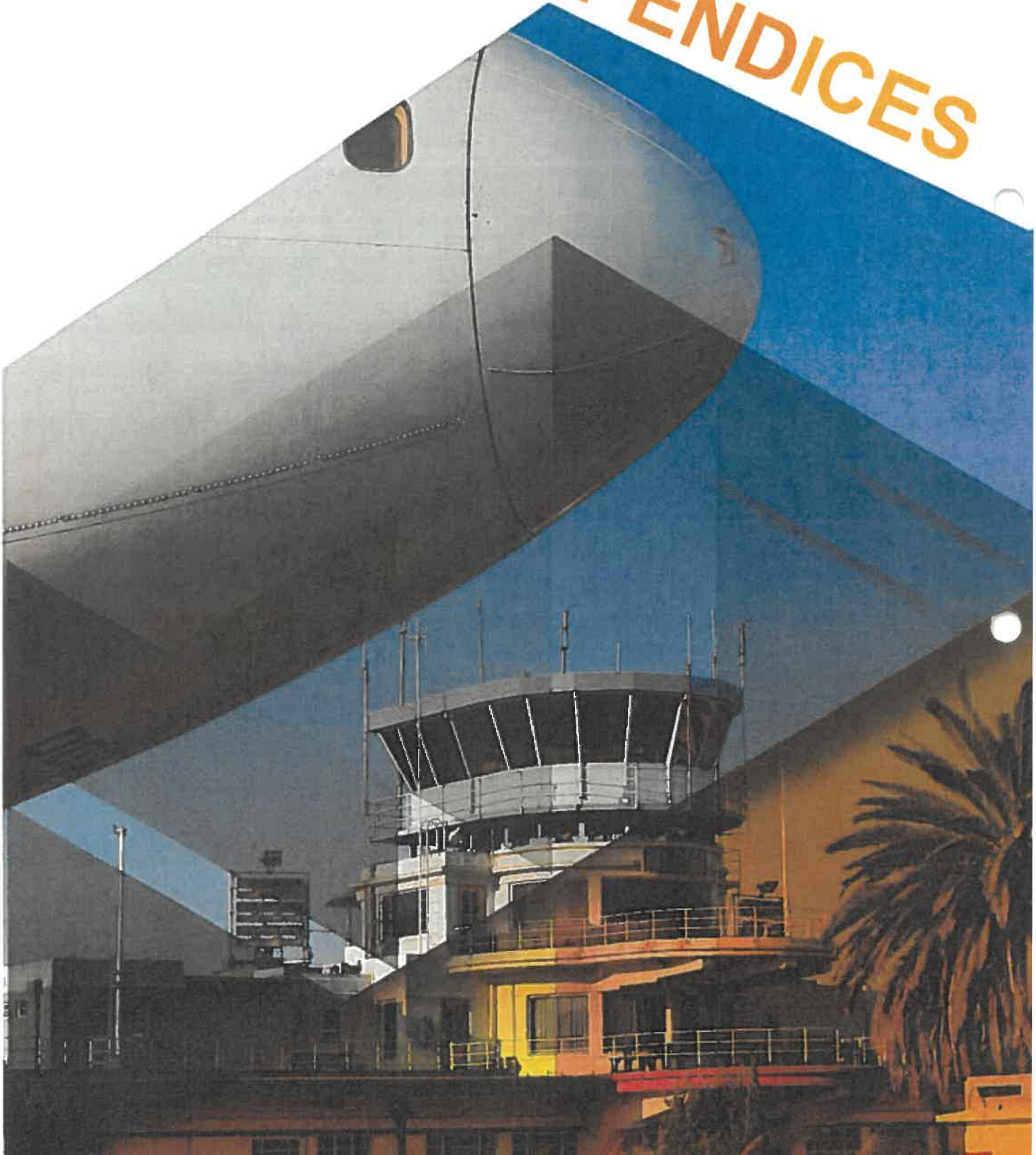
The strategic vision is to foster implementation of a seamless, global air traffic management system that will enable aircraft operators to meet their planned times of departure and arrival and adhere to their preferred flight profiles with minimum constraints and without compromising agreed levels of safety.

The National Airspace Master Plan also supports regional interoperability and harmonisation in that it provides for the needs and expectations of the airspace users, and also ensures the alignment of national efforts towards the achievement of the potential gains in safety, efficiency and environmental sustainability.

11. REFERENCES

ICAO Doc 4444 – Procedure for Air Navigation Services – Air Traffic Management (PANS-ATM)
ICAO Doc 7030 – Regional Supplementary Procedures
ICAO Doc 7474 – Basic Air Navigation plan (ANP) Volume 1
ICAO Doc 7474 – Facilities and Services Implementation Document (FASID) Volume 2
ICAO Doc 9750 – Global Air Navigation Plan (GANP)
ICAO Doc 9854 – Global Air Traffic Management Operational Concept (GATMOC)
ICAO Doc 9869 – Performance Based Communication and Surveillance (PBCS) manual
ICAO Doc 9883 - Manual on global performance of the air navigation system
ICAO Doc 10039 – Manual on System Wide Information Management (SWIM)
ICAO Doc 10066 - Procedure for Air Navigation Services – Aeronautical Information Management (PANS-AIM)
National Civil Aviation Policy (2017)
National Airspace Master Plan (2000, 2010)
AFI Planning and Implementation Regional Group (APIRG) Reports

APPENDICES



12. APPENDICES

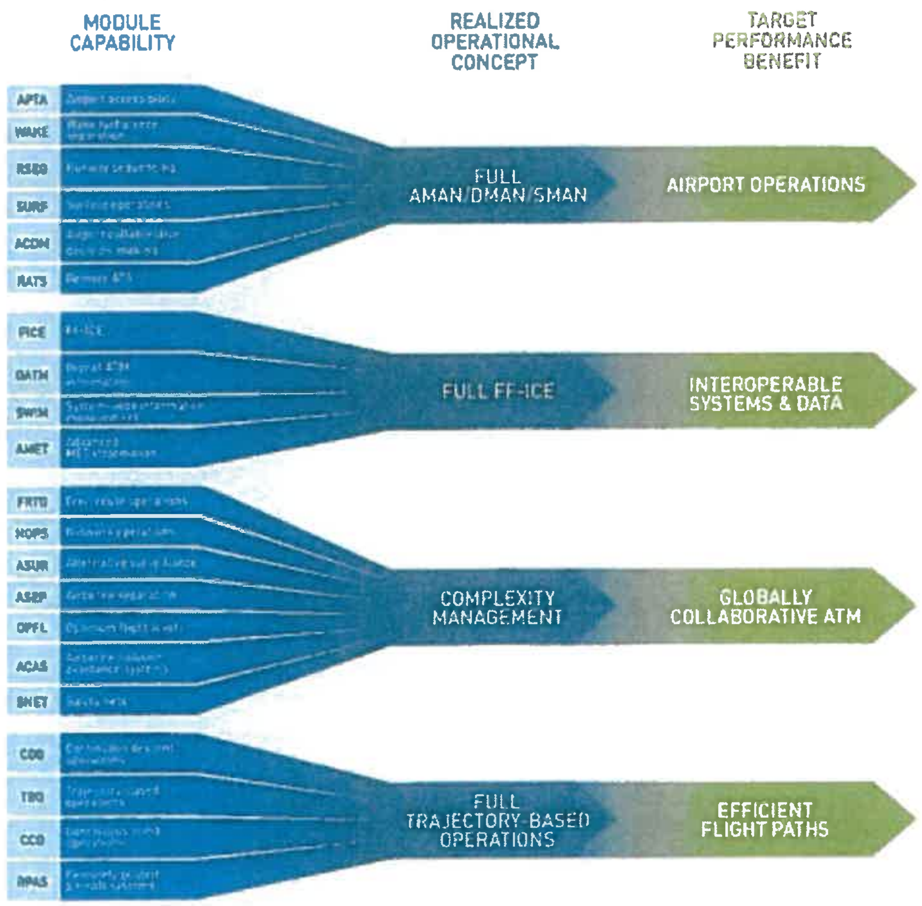
12.1. ATM COMMUNITY MEMBERS AND OTHER STAKEHOLDERS

The National Airspace Master Plan is supported by and has included consultation with the following Stakeholders:

- Department of Transport (DoT)
- South African Civil Aviation Authority (SACAA)
- South African Air Force (SAAF)
- Air Traffic Navigation Services (ATNS)
- Airports Company of South Africa (ACSA)
- Airlines Association of Southern Africa (AASA)
- Board of Airline Representatives of South Africa (BARSA)
- Commercial Aviation Association of Southern Africa (CAASA)
- South African Weather Services (SAWS)
- International Air Transport Association (IATA)
- Aircraft Owners and Pilots Association (AOPA)
- Aero Club of South Africa (AeCSA)
- Various Airline representatives
- Aerodrome operators

Although the above is not a definitive list, the South African Government by way of the Minister of Transport, being the sole shareholder of ACSA and ATNS and custodian of States responsibilities to the international community in terms of the ICAO convention.

12.2. NATIONAL ASBU IMPLEMENTATION PLAN



12.3. ASBU Block 0 – (2013)

Module	Module Capability
B0-APTA	**Optimization of approach procedures including vertical guidance.** This is the first step toward universal implementation of GNSS-based approaches.
B0-WAKE	**Increased runway throughput through optimized wake turbulence separation.** Improved throughput on departure and arrival runways through the revision of current ICAO wake vortex separation minima and procedures.
B0-RSEQ	**Improved traffic flow through runway sequencing (AMAN/DMAN).** Time-based metering to sequence departing and arriving flights.
B0-SURF	**Safety and efficiency of surface operations (A-SMGCS levels 1-2) and enhanced vision system (EVS).** Airport surface surveillance for ANSP.
B0-FICE	**Increased interoperability, efficiency and capacity through ground-ground integration.** Supports the coordination of ground-ground data communication between ATSUs, based on ATS interfacility data communication (AIDC) defined by ICAO Document 9694.
B0-DATM	**Service improvement through digital aeronautical information management.** Initial introduction of digital processing and management of information, by the implementation of AIS/AIM making use of AIXM, moving to electronic AIP and better quality and availability of data.
B0-ACDM	**Improved airport operations through Airport-CDM.** Airport operational improvements through the way operational partners at airports work together.
B0-DATM	**Service improvement through digital aeronautical information management.** Initial introduction of digital processing and management of information, by the implementation of AIS/AIM making use of AIXM, moving to electronic AIP and better quality and availability of data.
B0-AMET	**Meteorological information supporting enhanced operational efficiency and safety.** Global, regional and local meteorological information provided by world area forecast centers, volcanic ash advisory centers, tropical cyclone advisory centers, aerodrome meteorological offices and meteorological watch offices in support of flexible airspace management, improved situational awareness and collaborative decision-making, and dynamically-optimized flight trajectory planning.
B0-FRTO	**Improved operations through enhanced en-route trajectories.** To allow the use of airspace which would otherwise be segregated (i.e. special use airspace) along with flexible routing adjusted for specific traffic patterns. This will allow greater routing possibilities, reducing potential congestion on trunk routes and busy crossing points, resulting in reduced flight length and fuel burn.
B0-NOPS	**Improved flow performance through planning based on a network-wide view.** Collaborative ATFM measure to regulate peak flows involving departure slots, managed rate of entry into a given piece of airspace for traffic along a certain axis, requested time at a way-point or FIR/sector boundary along the flight, use of miles-in-trail to smooth flows along a certain traffic axis and rerouting of traffic to avoid saturated areas.

Module	Module Capability
B0-ASEP	**Air traffic situational awareness (ATSA).** Two ATSA (Air Traffic Situational Awareness) applications which will enhance safety and efficiency by providing pilots with the means to enhance traffic situational awareness and achieve quicker visual acquisition of targets: • AIRB (basic airborne situational awareness during flight operations); • VSA (visual separation on approach).
B0-ASUR	**Initial capability for ground surveillance.** Ground surveillance supported by ADS-B OUT and/ or wide area Multilateration systems will improve safety, especially search and rescue and capacity through separation reductions. This capability will be expressed in various ATM services, e.g. traffic information, search and rescue and separation provision.
B0-OPFL	**Improved access to optimum flight levels through climb/descent procedures using ADS-B.** This module enables an aircraft to reach a more satisfactory flight level for flight efficiency or to avoid turbulence for safety. The main benefit of in-trail procedure (ITP) is fuel/emissions savings and the uplift of greater payloads.
B0-ACAS	**ACAS improvements.** To provide short-term improvements to existing airborne collision avoidance systems (ACAS) to reduce nuisance alerts while maintaining existing levels of safety. This will reduce trajectory perturbation and increase safety in cases where there is a breakdown of separation.
B0-SNET	**Increased effectiveness of ground-based safety nets.** To enable monitoring of flights while airborne to provide timely alerts to air traffic controllers of potential risks to flight safety (such as short-term conflict alerts, area proximity warnings and minimum safe altitude warnings).
B0-CDO	**Improved flexibility and efficiency in descent profiles (CDO).** Deployment of performance-based airspace and arrival procedures that allow an aircraft to fly its optimum aircraft profile taking account of airspace and traffic complexity with continuous descent operations (CDOs).
B0-TBO	**Improved safety and efficiency through the initial application of data link and SATVOICE en-route.** Implementation of an initial set of data link applications supporting surveillance and communications in air traffic services.
B0-CCO	**Improved flexibility and efficiency in departure profiles - continuous climb operations (CCO).** Deployment of departure procedures that allow an aircraft to fly its optimum aircraft profile taking account of airspace and traffic complexity with continuous climb operations (CCOs).

12.4.ASBU Block 1 – (2019)

Module	Module Capability
B1-APTA	**Optimized airport accessibility.** This is the next step in the universal implementation of GNSS-based approaches.
B1-WAKE	**Increased runway throughput through dynamic wake turbulence separation.** Improved throughput on departure and arrival runways through the dynamic management of wake turbulence separation minima based on the real-time identification of wake turbulence hazards.
B1-RSEQ	**Improved airport operations through departure, surface and arrival management.** Extension of arrival metering and integration of surface management with departure sequencing will improve runway management and increase airport performances and flight efficiency.
B1-SURF	**Enhanced safety and efficiency of surface operations – SURF.** Airport surface surveillance for ANSP and flight crews, cockpit moving map displays and visual systems for taxi operations.
B1-ACDM	**Optimized airport operations through A-CDM total airport management.** Airport and ATM operational improvements through the way operational partners at airports work together. This entails implementing collaborative airport operations planning (AOP) and where needed an airport operations centre (APOC).
B1-RATS	**Remotely operated aerodrome control.** Remote provision of ATS to aerodromes or remotely operated aerodrome control tower contingency and through visualization systems and tools.
B1-FICE	**Increased interoperability, efficiency and capacity through FF-ICE, Step 1 application before departure.** Introduction of FF-ICE step 1, to implement ground/ground exchanges before departure using common flight information reference model, FIXM, XML and the flight object.
B1-DATM	**Service improvement through integration of all digital ATM information.** This module addresses the need for increased information integration and will support a new concept of ATM information exchange fostering access via internet-protocol-based tools Exchange models such as AIXM, FIXM, IWXXM and others relate their concepts to the AIRM fostering convergence, re-use, and collaborative alignment.
B1-SWIM	**Performance improvement through the application of system-wide information management (SWIM).** Implementation of SWIM services (applications and infrastructure) creating the aviation intranet based on standard data models, and internet-based protocols to maximize interoperability.
B1-AMET	**Enhanced operational decisions through integrated meteorological information (planning and near-term service).** Meteorological information supporting automated decision process or aids, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision support.
B1-FRTO	**Improved operations through optimized ATS routing.** Introduction of free routing in defined airspace, where the flight plan is not defined as segments of a published route network or track system to facilitate adherence to the user-preferred profile.
B1-NOPS	**Enhanced flow performance through network operational planning.** ATFM techniques that integrate the management of airspace, traffic flows including initial user driven prioritization processes for collaboratively defining ATFM solutions based on commercial/operational priorities.
B1-ASEP	**Increased capacity and efficiency through interval management.** Interval management improves the management of traffic flows and aircraft spacing. Precise management of intervals between aircraft with common or merging trajectories maximizes airspace throughput while reducing ATC workload along with more efficient aircraft fuel burn.
B1-SNET	**Ground-based safety nets on approach.** To enhance safety by reducing the risk of controlled flight into terrain accidents on final approach through the use of approach path monitor (APM).
B1-CDO	**Improved flexibility and efficiency in descent profiles (CDOs) using VNAV.** To enhance vertical flight path precision during descent, arrival, and enables aircraft to fly an arrival procedure not reliant on ground-based equipment for vertical guidance.
B1-TBO	**Improved traffic synchronization and initial trajectory-based operation.** To improve the synchronization of traffic flows at en-route merging points and to optimize the approach sequence through the use of 4DTRAD capability and airport applications, e.g. D-TAXI, via the air ground exchange of aircraft derived data related to a single required time of arrival (RTA).
B1-RPAS	**Initial integration of remotely piloted aircraft (RPA) into non-segregated airspace.** Implementation of basic procedures for operating RPA in non-segregated airspace.

12.5. Block 2 – (2025)

Module	Module Capability
B2-WAKE	**Advanced wake turbulence separation (time-based).** The application of time-based aircraft-to-aircraft wake separation minima and changes to the procedures the ANSP uses to apply the wake separation minima.
B2-RSEQ	**Linked arrival management and departure management (AMAN/DMAN).** Synchronized AMAN/DMAN will promote more agile and efficient en-route and terminal operations.
B2-SURF	**Optimized surface routing and safety benefits (A-SMGCS levels 3-4 and SVS) and enhanced safety and efficiency of surface operations (SURF-IA).** Taxi routing and guidance evolving to trajectory based with ground/cockpit monitoring and data link delivery of clearances and information as well as runway safety alerting logic. Cockpit synthetic vision systems.
B2-FICE	**Improved coordination through multicentre ground-ground integration (FF-ICE, Step 1 and flight object, SWIM) including execution phase.** FF-ICE supporting trajectory-based operations through exchange and distribution of information including execution phase for multicentre operations using flight object implementation and interoperability (IOP) standards.
B2-SWIM	**Enabling airborne participation in collaborative ATM through SWIM.** Connection of the aircraft as an information node in SWIM enabling participation in collaborative ATM processes with exchange of data including meteorology.
B2-NOPS	**Increased user involvement in the dynamic utilization of the network.** Introduction of CDM applications supported by SWIM that permit airspace users to manage competition and prioritization of complex ATFM solutions when the network or its nodes (airports, sectors) no longer provide capacity commensurate with user demands.
B2-ASEP	**Airborne separation (ASEP).** Creation of operational benefits through temporary delegation of responsibility to the flight deck for separation provision with suitably equipped designated aircraft, thus reducing the need for conflict resolution clearances while reducing ATC workload and enabling more efficient flight profiles.
B2-ACAS	**New collision avoidance system Implementation of Airborne Collision Avoidance.** System (ACAS) adapted to trajectory-based operations with improved surveillance function supported by ADS-B aimed at reducing nuisance alerts and deviations. The new system will enable more efficient operations and procedures while complying with safety regulations.
B2-CDO	**Improved flexibility and efficiency in descent profiles (CDOs) using VNAV, required speed and time at arrival.** Use of arrival procedures that allow the aircraft to apply little or no throttle in areas where traffic levels would otherwise prohibit this operation), supported by trajectory-based operations and self-separation.
B2-ACAS	**New collision avoidance system Implementation of Airborne Collision Avoidance.** System (ACAS) adapted to trajectory-based operations with improved surveillance function supported by ADS-B aimed at reducing nuisance alerts and deviations. The new system will enable more efficient operations and procedures while complying with safety regulations.
B2-RPAS	**Remotely piloted aircraft (RPA) integration in traffic.** Implements refined operational procedures that cover lost command and control (C2) link (including a unique squawk code for lost C2 link), as well as enhanced detect and avoid technology.