ASTRA

The Australian Strategic Air Traffic Management Group

Air Traffic Management 07

A STRATEGIC VISION FOR AUSTRALIA

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A STRATEGIC VISION FOR AUSTRALIA

Part A

THE ATM STRATEGIC PLAN

stakeholders

DEVELOPMENT OF THE PLAN

This edition of the **Australian ATM Strategic Plan** and its complementary document, the **Operational Evolution Document**, have been developed collaboratively by the ASTRA member organisations listed below. Participation in this process does not, in and of itself, imply agreement to implement particular projects - any such decision needs to be supported by risk-based analysis and the normal business processes including cost benefit analysis and business case. ASTRA member organisations agree to keep ASTRA informed of their own ATM plans and any differences with this plan that are likely to affect other stakeholders.

Aircraft Owners & Pilots Association of Australia
Airservices Australia
Alliance Airlines
Australian & International Pilots Association
Australian Airports Association
Australian Defence Force
Australian Maritime Safety Authority
Australian Sport Aviation Confederation
Civil Aviation Safety Authority
Department of Infrastructure, Transport, Regional Development and Local Government
Qantas Airways
Regional Aviation Association of Australia
VirginBlue Airlines

foreword

ASTRA, the Australian Strategic Air Traffic Management Group, is Australia's whole of industry Air Traffic Management (ATM) planning body. ASTRA includes airlines, airports, regional aviation, pilots, general aviation organisations and various government agencies. ASTRA is a collaborative group of organisations who give their time and expertise freely to assist Australia's aviation community in identifying and planning future air traffic management needs.

ASTRA plans over the long term and anticipates the development and application of technology and operational practices for the next 25 years. The ATM planning issues and strategies addressed by ASTRA are to a large extent the same issues and strategies addressed by ICAO in the Global Air Traffic Management Operational Concept, but as applied to the Australian operational context. ASTRA's ATM planning is strategic. The detailed project planning for the funding, acquisition, introduction and development of Australia's ATM systems remains the responsibility of the Service Provider and User organisations.

The ATM Strategic Plan is the first of a suite of documents supporting the evolution to a future air traffic management [ATM] system in Australia that is performance-based, addresses ATM community expectations, is cost-efficient and is globally harmonised. This version of the plan is the result of collaborative efforts by Australian ATM stakeholders, driven by an appreciation of the many interdependencies within the ATM system.

First drafted in 1999, the ATM Strategic Plan is designed to ensure that Australia remains at the forefront in improving air traffic management, thus growing value within the ATM community, the wider air transport domain and the national interest. Those opportunities include not only the exploitation of the substantial benefits of present and emerging communication, navigation, and surveillance capabilities, but also the consideration of new regulatory and institutional arrangements, and changes to procedures and practices across the ATM domain, both in the air and on the ground.

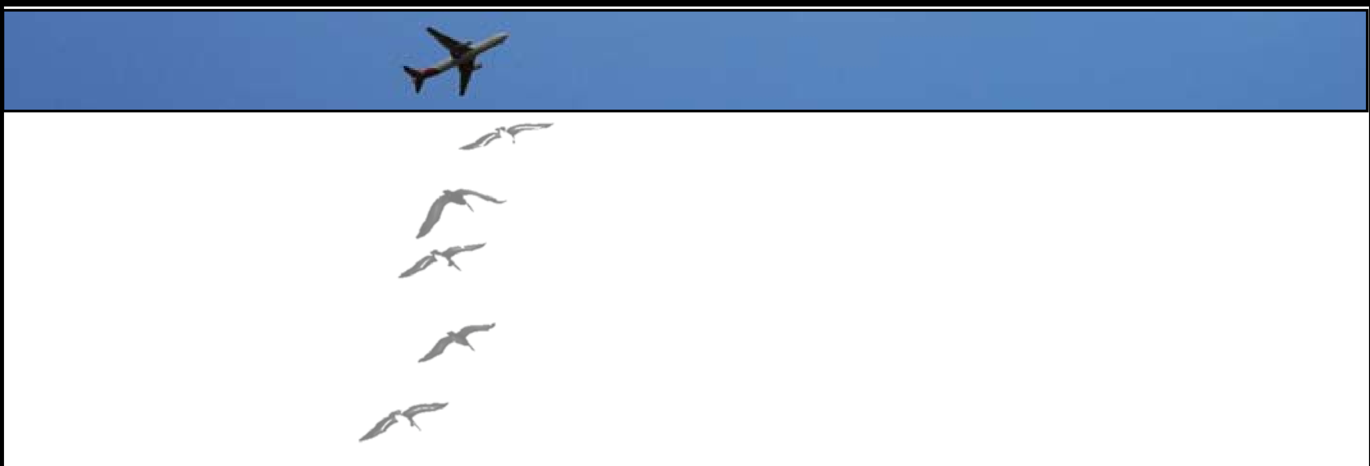
Achieving this goal requires commitment from all ATM stakeholders. The ATM strategic management framework, under the auspices of ASTRA, has already realised benefits including knowledge dissemination, effective working relationships and a shared ATM vision.

As part of the commitment to providing an ATM system that meets ATM community expectations, this edition of the Plan reflects global trends in ATM strategic planning including the introduction of performance-based ATM concepts, integration of the recently completed ICAO Global ATM Operational Concept and alignment with work underway in Europe and the United States. As in the previous edition, this edition identifies concepts and strategies to achieve a long-term (20+ years) desirable future as described in the Target Operational Concept.

Part B of the document suite, the **Operational Evolution Documen**t, describes implementation strategies, and identifies potential operating scenarios for the near, medium and long term. Part B will provide a focus for ATM stakeholders to proceed to the subsequent stages of project definition and implementation. These latter stages – Part C of the planning suite – will be developed in individual stakeholder implementation documents.

The current Australian ATM system provides safe and efficient ATM services today and implementation of the strategies will take full account of the low traffic densities in many areas of Australia. In particular, ASTRA recognises the need for implementation of changes to the ATM system to consider the needs of all airspace users by applying sound risk management principles and cost benefit analysis.

Development of the Australian ATM Strategic Plan and its complementary documents is an evolutionary process. Whilst the ATM Strategic Plan has been designed to 'stand the test of time', it will be reviewed and updated regularly to ensure it remains relevant to the national interest, government policy and individual stakeholder's strategic objectives.



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1. introduction

Air traffic management is defined by ICAO as 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.

For many years the term air traffic management (ATM) has been used by various bodies to mean different things, and is sometimes interpreted as a synonym for air traffic control or air traffic services. Recently, ICAO developed the definition above and published an operational concept, making it clear that ATM includes all traffic in any airspace, as well as the infrastructure, people, procedures and technology involved in aircraft operations. The definition also emphasises the need for a collaborative approach to developing the ATM system.

The primary functions of the ATM system will enable flight from/to an aerodrome into airspace, safely separated from hazards, within capacity limits, making optimum use of all system resources. ATM stakeholders include all airspace users, airports, air navigation service providers, regulators, manufacturers and a variety of other interested parties.

ICAO'S VISION FOR AIR TRAFFIC MANAGEMENT

To achieve an interoperable global air traffic management system, for all users during all phases of flight, that meets agreed levels of safety, provides for optimum economic operations, is environmentally sustainable and meets national security requirements.

Australian Context

A common coordinated national strategy allows ATM community members[1] to make investment and other decisions with confidence, not only within the Australian ATM domain, but regionally and globally. This in turn benefits aviation safety, environmental sustainability, operational and economic efficiency, regional service objectives and national interests. Significantly, an integrated ATM strategy also facilitates the growth of ancillary industries – tourism, transport related commerce, aviation manufacturing, and other downstream activities.

The Strategic Plan aims to provide leadership and direction to the ATM community on the future capabilities and technologies required to deliver an ATM system that is responsive to airspace users, is capable of ensuring a safe, economic and efficient system that accommodates demand, is globally interoperable, environmentally sustainable and satisfies national interests including defence and security.

The Strategic Plan establishes the vision for ATM in Australia in the period to 2025 and beyond. In recognition of the potential for significant changes in operating capabilities and technologies over such a period, the plan must necessarily be high level, with the strategies identified being robust enough to 'stand the test of time', and maintain a strategic, rather than tactical direction that can be followed throughout the planning period.

As can be seen in Figure 1, the Strategic Plan is one of a series of documents, each one progressively describing the transition from concept to reality and from the current operating environment, through planning and implementation stages, to the 'end-state'.

The Strategic Plan underpins the operational concept. In turn, it is underpinned by progressive operational evolutions [sometimes referred to in other ATM references as 'concepts of operation' or 'concepts of use'] and the implementation roadmaps. Together with the operational concept, the Strategic Plan describes 'what' needs to be done and the management processes necessary to achieve the strategic objectives.

The strategies proposed in the Plan have relevance to all stakeholders and a variety of operations. For example, User Preferred Trajectory (UPT) is relevant to all operations, from light aircraft through to commercial airline operations. Similarly, the concept of Flexible Use of Airspace (FUA) should not be perceived as applicable only to military areas but rather an approach to the ideal use of all airspace in the future.

The operational evolutions will describe both 'how well' it needs to be done and 'how' and 'when', in broad terms, it should be done. They will also include descriptions of 'sets of changes' that will occur through the various planning horizons – the Operational Improvement Groups [OIGs].[2] The roadmaps will show in detail when the changes should be implemented and who should make those changes.

The ATM Strategic Plan and Operational Evolution Document are not intended to contradict or overrule policy or programs of stakeholders. Rather, it is intended to publish a common vision that all stakeholders can work toward. Therefore, over time, stakeholders will be able to integrate their approaches to air traffic management and achieve the expectations outlined in this plan. Other documents, such as the Australian Airspace Policy Statement and the Defence Capability Plan, will address specific areas of relevance to the future of the ATM system and will therefore provide greater detail on individual programs being developed and implemented by stakeholders.

1 - ATM COMMUNITY MEMBERS include: Airlines [scheduled and non-scheduled], Military and State Aviation, Business Aviation, General Aviation, Air Navigation Service Providers [including Defence, Airservices Australia, Bureau of Meteorology, Aeronautical Information Service Providers, etc], Airports [civil and military], Regulators, Government and other State authorities [including airspace management agencies], ICAO. 2 - An OPERATIONAL IMPROVEMENT GROUP is the sum of the ATM enhancement activities by one or more stakeholders over a planning horizon [short, medium or long term] - in a particular performance area - or across the entire system. The OIGs are discussed in more detail in the OED.

2 - An OPERATIONAL IMPROVEMENT GROUP is the sum of the ATM enhancement activities by one or more stakeholders over a planning horizon [short, medium or long term] - in a particular performance area - or across the entire system. The OIGs are discussed in more detail in the OED.

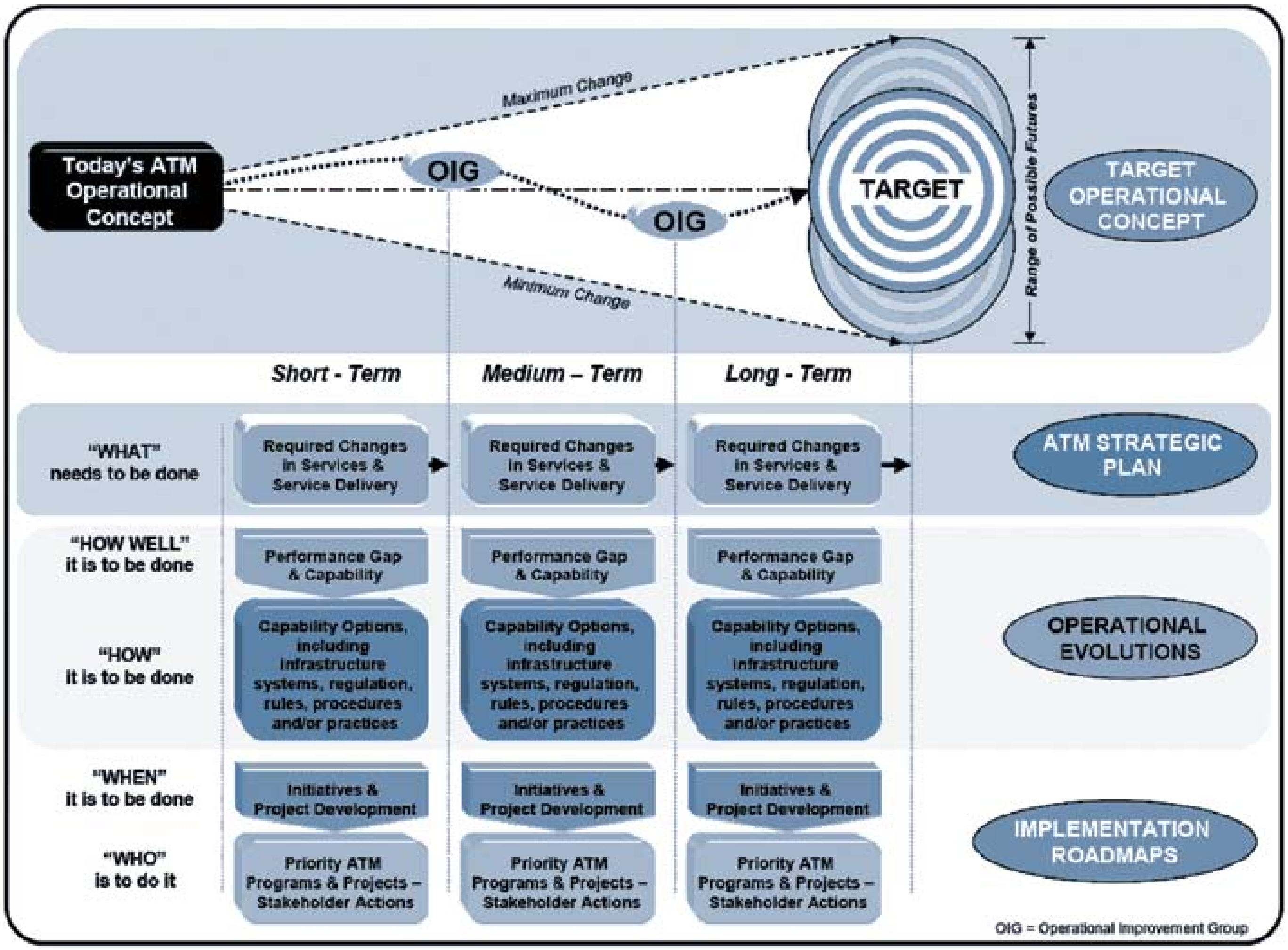

Figure 1: The Strategic Planning Hierarchy

A strategic plan is most effective when there is widespread agreement with, and commitment to, its objectives. The industry needs to work cohesively to deliver the desired outcomes. In recognition of the interdependencies in the planning process required to shape the development of the Australian ATM system, key stakeholders were encouraged to seek the establishment of a more collaborative ATM planning and project implementation framework.

In 1999 ATM stakeholders held the inaugural meeting to commence the ATM Strategic Planning process. This resulted in the establishment of the core planning group. Subsequently, ATM stakeholders have refined the Australian ATM Strategic Management Framework and developed the Australian ATM Strategic Plan.

The original planning group is now formally known as ASTRA. This group is recognized as the peak ATM strategic planning group for Australia and is responsible for the development and review of the Australian ATM Strategic Plan.

As always, responsibility for the authorization of any change and for change implementation rests with stakeholder management, although ASTRA's members may be asked to provide implementation advice and coordination. Figure 2 shows the hierarchical process. Appendix 1 shows a more detailed description of the ASTRA processes.

Figure 2: The ASTRA process

document structure

The Strategic Plan and the Operational Evolution Document have been developed to take account of leading edge developmental work in ATM evolution both in the global domain through ICAO, and in the Australian domain through the ASTRA processes. The combination of these global and domestic initiatives forms the basis of the Australian STRATEGIC VISION. Under the Vision is the Performance Framework, the primary product of which, in the Strategic Plan, is the set of system-wide PERFORMANCE OBJECTIVES.

Having established the vision and objectives, the Strategic Plan then enunciates the Target Operational Concept [TOC] and its supporting ATM STRATEGIES. Together, these form the ATM Strategic Plan which is intended to be updated on a 5 to 7 year cycle.

The Operational Evolution Document comprises the actual descriptive short and medium term evolution blocks, leading to the statement of OPERATIONAL OBJECTIVES, and then an outline of the way in which the Strategies will be realised. This document will be updated on a 2 to 3 year cycle. Figure 3 below illustrates the structure of the documents.

Figure 3: The Document Structure

the strategic vision

The Australian ATM environment, like many other environments, is driven by safety and increasingly by commercial requirements, national interests and sectional expectations. Like most participants in the ATM system, Australian civil airspace users (including airlines, cargo operators, business aviation, and general aviation) and service providers work in a highly competitive environment. Military operations are also subject to intense budgetary and financial pressures.

The costs of ATM infrastructure and service delivery can be a significant portion of user costs. Within the fiercely competitive industry of commercial aviation, the provision of safe ATM infrastructure must be achieved in a framework of economic efficiency. There is pressure for increased flexibility and lower costs associated with ATM service provision (whilst enhancing safety). This is a key driver in the pursuit of improved ATM systems.

Standards exist for global interoperability; however, many States have adopted only those necessary to sustain their own internal requirements. Some States have developed unique standards or have 'adapted' global standards for local application. Local, regional and international air traffic is growing rapidly. Increasingly, ageing aircraft assets are being redeployed globally and cost containment pressures on aircraft and ATM equipment manufacturers are increasing. Combined, these factors mean that States can no longer ignore the "bigger picture". Evolution of the ATM system in any State must be cognisant of the need to meet expectations of global standardisation or at the very least, global interoperability.

Evolution of the ATM system must also be driven by the need to address user expectations – particularly safety and operational efficiency – whilst considering practicality and affordability. The system must also be able to meet the increasing community expectations of environmental sustainability. In addition to safety, efficiency and environmental responsibility, Australia's ATM system must also have the facility to address national security imperatives. Consequently, national security may need to be afforded temporary primacy in order to address real or anticipated threats to the nation's welfare.

A performance-based system is projected to be the most rational approach to support the necessary changes. The ICAO ATM Operational Concept identifies a range of user expectations; however, it is recognized that within the planning horizon, the desired solutions may change. These will be identified and implemented through a performance case [including safety and business case] process.

The ATM community's expectations should guide the development of the future ATM system. The ICAO ATM Operational Concept will guide the development and implementation of specific ATM solutions and the abandonment of others. The evolution of the Australian ATM system must be driven by the needs of the airspace user community and enabled by the appropriate technologies or capabilities, in a framework of global harmonisation. It is essential that the evolution of the Australian ATM system is not 'arbitrarily satisfied' by the achievement of pre-determined goals, but aims to continually improve the quality of service.

In that context, the vision of the Australian ATM strategic planning process is to develop an ATM system that:

- is responsive to airspace users
- is focused on improving quality of service
- ensures a safe, economic and efficient system that satisfies demand
- is globally interoperable
- is environmentally sustainable
- satisfies the national interest including defence and security, and
- maintains Australia's status as a best practice model in air traffic management.

the performance framework – moving to performance-based ATM

Air traffic volumes and complexity are increasing and it is expected that air traffic demand will more than double[3] in Australia – and our region – by 2025. This will place a major strain on the Australian and Global ATM systems. The ATM system needs to evolve in a way that enables increasing demand to be accommodated safely, cost effectively and in a timely manner.

Performance-based ATM

ATM allows the various airspace users – from passenger carrying operations, through cargo, business, general aviation, military and State activity – to operate in an **efficient, cost effective and safe manner.** Each airspace user has desired outcomes for their operation, be it departing and arriving on time, the ability to conduct a mission, the ability to meet a business goal, etc.

The ability of the ATM system to effectively and consistently achieve those outcomes for all users against the full range of performance areas, is a measure of the performance of the system and, hence, the value to the users generated by the system. Improving performance creates value; decreasing performance erodes value.

Difficulties in setting performance objectives, goals and targets are common problems during the creation or application of a performance management system and are often hard to resolve. Using an appropriate Performance Management Framework makes target setting easier and more effective, for example, by making sure that the measures selected are relevant to objectives recognized as actionable and important by the partners designing and/or changing the system. According to ICAO[4], the objectives of a performance framework are to "…establish and measure performance outcomes in order to:

- Design, develop, operate and maintain a system that can meet the expectations of its users
- Determine that the [ATM] system is operating in accordance with its design, and
- Determine when and where action is to be taken to enhance performance levels when the [ATM] system is not meeting, or is predicted not to meet, expectations…"

A performance framework sets the foundation for implementing practical solutions aimed at mitigating or eliminating the sources of performance gaps. It provides a starting point to guide the actions of ATM community members towards continuous performance improvement and exceeding expectations.

Within the ATM system it is possible to establish **performance objectives, indicators** and **targets**. For the objectives to be measurable and effective, they must be quantifiable. This is the purpose of indicators and targets. The performance management processes require feedback loops so that adjustments and course corrections can be made as required.

3 - Market forecast analysis work done by Boeing and Airbus in their Outlook reports shows potential growth rates of between 4.5% and 6.0% per annum for the region over the next 20 years – giving a range of possible traffic demand in 2025 of between 190% and 270% of 2005 demand. Australian aircraft registration, aircraft movement and passenger statistics also indicate strong traffic growth over this period.

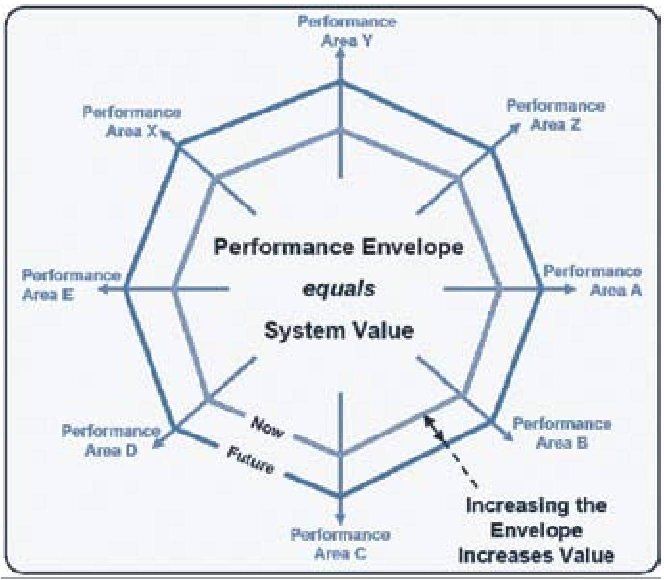

Figure 4: Linking Performance and Value

Performance management needs to incorporate a "closed loop" approach; that is, ensuring that the performance objectives are not merely "statements on paper", but the ability to drive performance towards the objectives is integrated into the concept and processes rather than "leaving it to chance".

To be understood and accepted, a performance target should synthesise complexity into a single number/value that is simple to understand and apply, yet comprehensive in its scope. Performance targets and design criteria provide a basis for:

- integrating policies in one area with those in other areas, and
- selecting appropriate design practices or solutions.

The case for an operational improvement should be made by way of a performance case – the logical integrated and documented argument, which demonstrates that the change will deliver or has delivered the required performance improvements. The performance case can be seen as a combination of business, safety, security, environment and other cases that address all ATM community expectations.

Monitoring and assessing the performance of the various enhancement activities provides the foundation for proactive performance management. The aim is to learn from experience and regularly improve system performance. This requires regular consultation and monitoring to assess progress towards achieving the performance targets. It is clear that the setting of performance targets, and their measurement, should be based on the principle of increasing collaboration between members of the ATM community to jointly address their expectations, business outcomes and operational concerns. The Australian ATM Strategic Management Framework provides the vehicle for such collaboration.

4 - ICAO Global ATM Operational Concept Doc 9854

building a performance framework

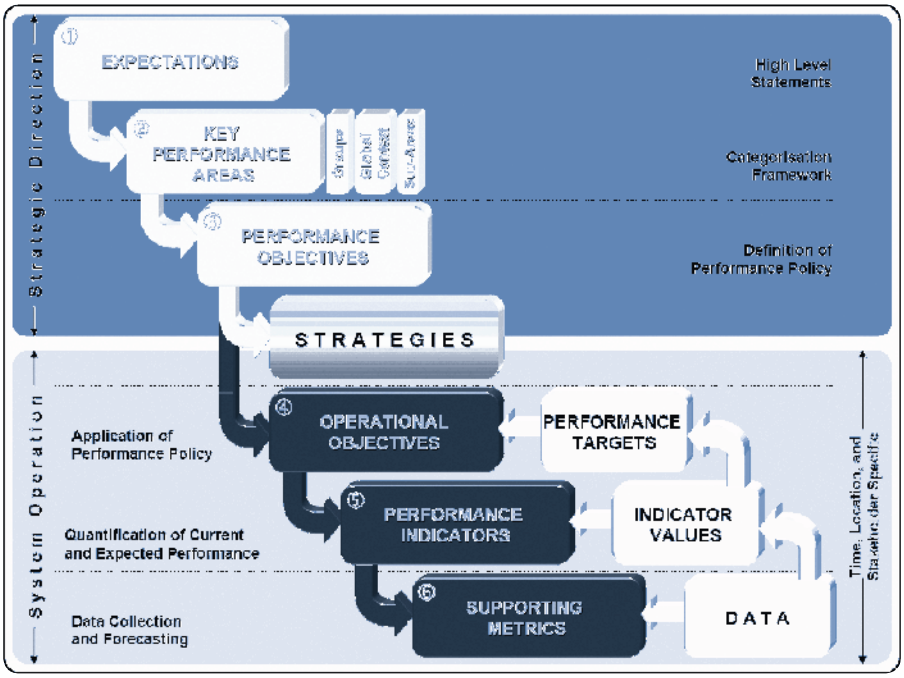

Figure 5: Performance Framework

The performance framework that will support the Australian Strategic Planning processes will be developed to both use and complement the ICAO Performance Based Transition Guidelines[5]. Figure 5 shows the 6-layered process used in the Australian context. Layers 1, 2 and 3 are focused at the strategic level and are discussed in more detail here. Layers 4, 5 and 6 are aimed at the operating level and will be developed in parallel to the Concepts of Operation and Use as well as the implementation roadmaps. The strategies provide the link between the Strategic Direction levels and System Operation levels.

layer 1 – expectations

The Australian ATM community comprises a number of stakeholder groups. Members have differing expectations of the system. All have either an explicit, or implicit, expectation of safety. Some have explicit economic expectations; others efficiency and predictability. Figure 6 shows the various stakeholder groups and, in general terms, their primary expectations of the ATM system[6].

In some cases, the expectations of the ATM system change over time. For example, an airspace user may have higher expectations of flexibility in the strategic time frame [e.g., 6 months or more before a flight at the schedule development stage or even at the fleet equipage stage], but stronger emphasis on predictability at the tactical "time of flight" stage.

It should be noted that whilst not explicitly identified in each community member area, all members have an expectation of safety and security. It should also be noted that whilst these members appear as "equal partners" in the ATM system, the level of influence on performance outcomes varies according to the specific performance expectation.

For example: a regulator can significantly influence commercial outcome through over- or under-regulation; military operations could significantly influence access and hence, cost-effectiveness, through overly restrictive activation of special use airspace; ICAO could significantly influence interoperability by defining multiple standards; ANSPs could significantly influence capacity through ineffective staffing, and so on.

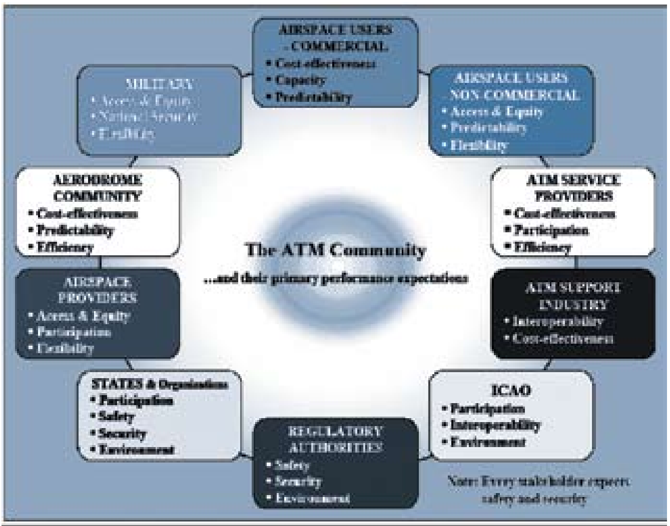

Figure 6: ATM Community and Expectations

5 - ICAO is developing guidance material for performance-based ATM. The latest version of the draft material is Performance-Based transition Guidelines [PBTG] draft version 0.5. It is expected to be finalised and promulgated by ICAO early in 2007.

6 - These expectation areas have been aligned with the 11 ICAO Key Performance Areas. Further discussion on the individual stakeholder group expectations can be found in Appendix B.

The expectations of each of the ATM community members are also affected by external or non-ATM influences. Figure 7 shows that whilst some of the ATM community members operate wholly within the ATM domain[7], some operate across the domain boundaries into the broader Air Transport Domain and at least one [the Air Defence Organisation] operates beyond the air transport domain into areas affecting non-ATM national interest and so on.

This "extrusion" into the wider domain provides the link into the Air Transport Value Chain [in the case of the Aircraft Operators], and the National Policy Chain[8] [in the case of Air Defence Organisations]. Components of the ATM system contribute to the national critical infrastructure and cannot be operated independently of national infrastructure expectations.

For optimum system performance, each of these sometimes-competing expectations requires balancing. Additionally, defined safety outcomes will need to be met and demonstrated. The management of performance is discussed in more detail in Chapter 4.

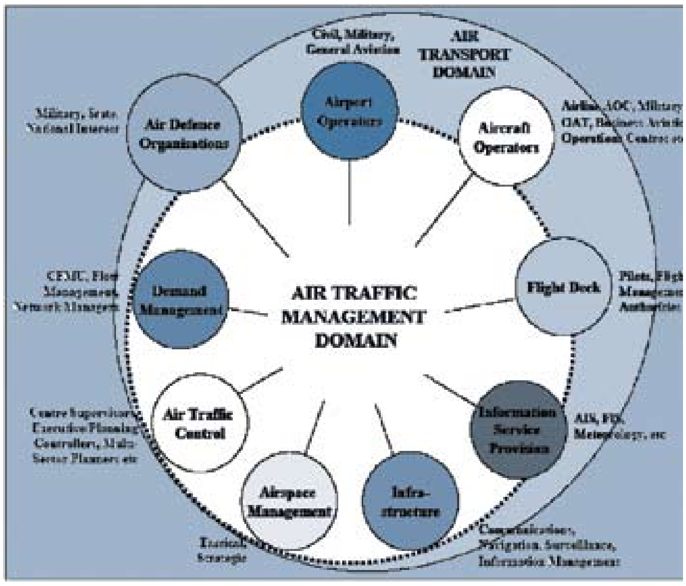

Figure 7: ATM and External Influences

ATM COMMUNITY EXPECTATIONS AND ICAO

The expectations for the global ATM system have been discussed among the global ATM community in general terms for many years. These expectations stem from efforts to document ATM "user requirements." ICAO developed a set of global ATM community expectations which are designed to underpin strategic planning processes world-wide. These expectations provide a convenient starting point for the Australian Strategic Plan and are reproduced at Appendix B. In general, change should not occur unless it is likely to provide demonstrable performance improvements for the ATM community expectations considered as a whole.

ATM COMMUNITY EXPECTATIONS AND INTERNATIONAL BEST PRACTICE

As is the case with many ICAO documents, the ICAO expectations have been created as a 'compromise set' aimed at balancing varying global expectations and creating a baseline for moving towards a globally integrated ATM system. Inevitably there will be local circumstances and conditions which require adaptation or scaling of the expectations and even the creation of a more specific set. The challenge for the Australian Strategic Planning process is to ensure that Australian performance expectations are aligned with the ICAO set and with developmental work in the major global aviation communities, particularly the United States and Europe.

Appendix B shows the ATM community expectations set out in the ICAO Global ATM Operational Concept (Doc 9854) and some of the expectations developed in recent European discussions.[9] ASTRA has also taken into account discussions in the United States Joint Program Development Office [JPDO] project.

ATM COMMUNITY EXPECTATIONS - QUALITY OF SERVICE AND CONTINUOUS IMPROVEMENT

Setting and achieving goals and targets to meet the specific expectations detailed above is only a part of the aspiration of the ATM community. It also has expectations of continuous improvement and commitment to service quality. This requires the development of a continuous and sustainable improvement culture towards all aspects of the ATM operating environment; not simply those described in the expectations. The continuous improvement culture underpins and supports the performance framework and performance-based ATM.

7 - There is also a smaller sub-domain of the ATM domain – the current ATC domain – which is not shown in the diagram – but which [currently] consumes the most significant proportion of ATM resources.

8 - Introduced for completeness – but not described further here.

9 - European Single European Sky ATM Research [SESAR] project 2006

KEY PERFORMANCE AREAS

At level 2 of the performance framework, the expectations have been translated to key result areas, or Key Performance Areas, as meeting expectations is a key goal of the future ATM System [refer Chapter 2]. It also allows ready alignment between Australia and the ICAO global framework which is progressively infiltrating other major aviation environments. ASTRA has therefore adopted the following Key Performance Areas [listed alphabetically]: Access and Equity, Capacity, Cost Effectiveness, Efficiency, Environment, Flexibility, Global Interoperability, ATM Community Participation, Predictability, Safety and Security.

KEY PERFORMANCE AREA GROUPS

Many of the expectations have differing levels of influence over time and are also the subject of different timeframes for amendment or adjustment. For example, expectations for safety are stable over long periods of time: they do not change on a daily or even monthly basis. Neither is it easy to shift associated safety objectives and safety targets. At the other end of the scale, expectations of flexibility can change on an hour by hour basis and associated performance parameters can be “adjusted” in real time.

Some expectation areas have a direct influence on the ATM system; others are indirect, being shaped by public perception or government policy rather than operational imperative. It is therefore useful to group the expectations into high level categories to allow management strategies to be shaped accordingly. Consistent with global best practice[10], the 11 expectation areas have been sub-divided into 3 key performance area groupings (see Table 1).

KEY PERFORMANCE SUB-AREAS

ATM system performance is complex and, except for a general overview report, it is impractical to attempt to manage system performance as a single element in each performance area. It is more practical to divide each performance area into a [small] number of sub-areas. The identification of sub-areas is generally related to the perceived [or observed] ability to measure, manage and report.

In the ATM Strategic Plan, the sub-area differentiation has been focused on inputs, outputs and, where appropriate, impact. This allows concentration of effort first in the preventative domain [inputs], then in the after-event domain, both in managing what has happened and managing the potential impact of negative outputs. Table 2 shows the potential sub-areas associated with each Key Performance Area. Some sub-areas have been developed; others are being developed and matured through further work. As they are matured they will be carried forward into the system operation components of the performance management framework.

Table 1: Performance Sub-Groups

Group 1	Group 2	Group 3
Societal Outcome	**Performance Enablers**	**Operational Performance**
• Safety	• Access and Equity	• Capacity
• Security	• Global Interoperability	• Cost Effectiveness
• Environment	• ATM Community Participation	• Efficiency
	• Flexibility	
	• Predictability	

10 - ICAO, SESAR

Table 2: Performance Sub-Areas

Key Performance Area	Identified/Proposed/Potential Sub-Areas
GROUP 1 – SOCIETAL OUTCOME	
Safety	Inputs – Adoption / application of Safety Management Systems Outputs – Incidents, Accidents Impact – Loss of life, Economic effect(s)
Security	Inputs – Security Management Systems, Detection Outputs – Operational Security Incidents [terror threats, hijacks etc] Data Management Incidents Impact - Loss of Life, Economic effects
Environment	Inputs - Sustainability Management Systems Outputs - Environmental effects [noise, emissions, visual amenity]
GROUP 2 – PERFORMANCE ENABLERS	
Access and Equity	Inputs – Mission Planning Effectiveness, Ease of Access, Quantity of restricted / segregated airspace, Release of airspace Outputs – Mission Accomplishment, Flexibility, Airspace efficiency Impact - Economic effects, Mission ineffectiveness
Global interoperability	Inputs – Adherence to / commonality of standards, Number of boundary conditions Outputs – Changes / interruptions to trajectory, Inter-unit coordination effectiveness, Boundary issues Impact - Increased cost, Reduction in flexibility
ATM Community Participation	Inputs – Planning and Coordination processes, Outputs – Effectiveness Surveys, Complaints, Impact - Economic effects, Mission effectiveness
GROUP 3 – OPERATIONAL PERFORMANCE	
Capacity	Inputs – Capacity Management Frameworks, Systems Outputs - Provided Network, Airport or Airspace Capacity Impact - Delay
Cost Effectiveness	Inputs – Cost Effectiveness, Management processes Outputs – Costs, Service Charges, Benchmarking Impact - Increased fares, Re-sourcing of Services
Efficiency	Inputs – Efficiency Management processes Outputs – Vertical, Horizontal Flight efficiency, Impact - Delay, Excessive cost(s)
Flexibility	Inputs – Temporal, Horizontal and / or Vertical Planning Flexibility Outputs – Achieved trajectory Impact - Increased costs
Predictability	Inputs – Temporal, Horizontal and / or Vertical Planning Predictability Outputs – Achieved Planning Objective Impact - Increased fares, Excessive block times

4. australian strategic performance objectives

Layer 3 of the ATM Performance Framework involves translating the ATM community expectation embodied by each Key Performance Area into more specific ATM system performance objectives. These are defined to produce relevant and timely enhancements (operational improvements).

The performance objectives are written in qualitative terms and may include a desired or required trend for a performance indicator (e.g. reduce the cost per kilometre flown) while not yet expressing the performance objective in numeric terms (this is done as part of performance target setting).

The objectives in Table 3 have been derived from an examination of global best practice in this area, integrating the specific expectations of the Australian ATM community. The objectives below are set against each key performance area but, as is the case across the ATM Strategic Plan, they should not be considered in isolation rather as part of an integrated system. These are generic or 'whole-of-system' Australian objectives. Each ATM community member may establish further internal performance objectives.

Table 3:

Key Performance Areas	Strategic Performance Objectives
Access and Equity	1. To enable all airspace users fair and equitable access to all airspace, airports and required ATM services.
Capacity	2. To provide sufficient capacity to meet the demand of all users in an effective and efficient manner at all times, and during typical busy hour periods without imposing significant operational, economic or environmental penalties under normal circumstances. 3. To enable airports to make the best use of capacity, as determined by the infrastructure in place (land-side and air-side), political/environmental restrictions and the economical use of resources. 4. To increase overall ATM network capacity in line with traffic demand, ensure that ATM-induced delays are not a significant constraint and that the percentage of traffic delayed by ATM is less than today.
Cost Effectiveness	5. To reduce the direct and indirect ATM-related costs per unit of aircraft operations.
Efficiency	6. To enable all airspace users to operate as efficiently as possible while accommodating both civil and military operators' needs.
Environment	7. To promote the use of new ATM technologies, systems, capabilities and procedures which benefit the environment or mitigate aviation or ATM impact at global, regional and local levels. 8. To accelerate the implementation of ATM system improvements that reduce the impact of aviation on the environment. 9. To ensure that development and implementation of the Australian ATM Strategic Plan reflects ICAO environmental policies, and to work with ICAO and its member States to obtain improvements in ATM, in particular the accelerated implementation of those CNS/ATM concepts, procedures and systems that help to mitigate the impact of aviation on the environment.
Flexibility	10. To increase the responsiveness of the ATM system, and its services and processes, to real-time changes in airspace users´ needs.
Global Interoperability	11. To ensure that Australian ATM operations are compliant with ICAO CNS/ATM plans and global interoperability requirements; provide a seamless service to the user at all times and operate on the basis of uniformity throughout Australia and the adjacent FIRs. 12. To provide or adopt timely standards, specifications and procedures for ATM, supporting communications, navigation, surveillance and information management infrastructure and associated avionics requirements. 13. To enable interoperability between the different elements (aircraft, airport and ATM systems) together with their seamless integration, development and upgrading to new technology.
Participation by the ATM Community	14. To ensure that the ATM community has a continuous involvement in the planning and, where appropriate, implementation and operation of the ATM system.
Predictability	15. To improve the predictability of flight operations by reducing ATM-related variations in gate-to-gate transit times.
Safety	16. To ensure that system safety practices are implemented across all ATM community members and that an open reporting culture is demonstrated. 17. To improve safety levels by ensuring that the rate of ATM-induced accidents and serious or risk bearing incidents is continually decreasing.
Security	18. To establish effective mechanisms and procedures that enhance the responsiveness of the ATM system to security threats and events affecting flights (aircraft and passengers) or the ATM system. 19. To improve the effectiveness of existing, and determine new, mechanisms, criteria and structures to enhance civil-military co-operation and co-ordination. 20. To ensure access to, and availability of, airspace for military purposes through the implementation of special procedures where necessary.

5. the target operational concept

ICAO states that "…an operational concept is a statement of "what" is envisaged. It asks and answers the question of what outcomes are required in the case of the ATM system of the future. It is a vision statement. It is not a technical manual or blueprint, nor does it detail "how" things will be enabled; that lies in a lower document in the hierarchy, which may include concepts of operation or use, technical standards and strategic plans…".[11]

The **ICAO Operational Concept** was developed as a vision for harmonised global ATM enhancement in the period up to and beyond 2025. It has been adopted by all states and global aviation organisations as the "master vision" for ATM. Within the ICAO Operational Concept there is provision for scalability and adaptability, so that the circumstances relating to individual States and Regions can be accommodated, or so that implementation timing can be adapted to the level of need.

The **Target Operational Concept** (TOC) is a version of the ICAO Operational Concept that has been scaled and adapted for Australia. It takes the ICAO Concept vision into a level of detail, providing guidance for evolution of the ATM system in the Australian context. Originally developed ahead of the ICAO Concept, the Australian Target Operational Concept has now fully encompassed the ICAO Concept, and expanded areas that are of particular relevance to Australia.

This chapter introduces the TOC and describes "what" is envisaged for Australian ATM through the next 20+ years. Chapter 6 describes the strategies that are expected to realise the vision – "how" it is to be done. Chapters 3 and 4 of this document describe the process for determining "how well" the ATM system should operate. The Operational Evolution document will describe the application of those strategies in the short and medium term, through sets of operational improvements – effectively "when" it is to be done.

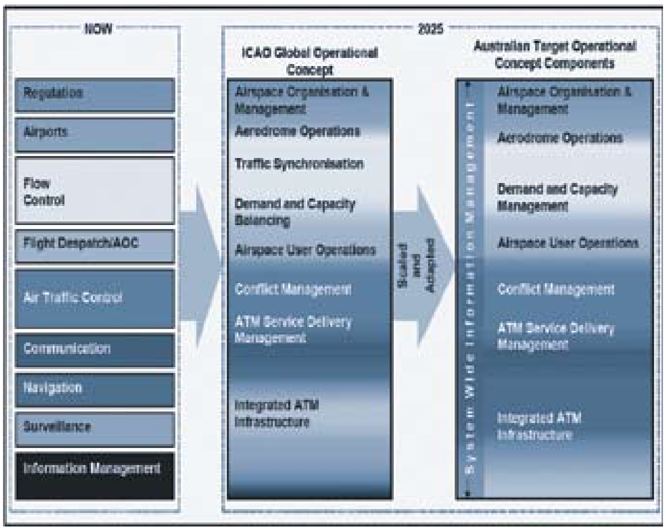

Figure 8: ATM System Components – ICAO and ASTRA

11 - ICAO Global ATM Operational Concept: Document 9854

12 - ICAO Global ATM Operational Concept: Document 9854

The Target Operational Concept

ICAO defines ATM as "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". Further, ICAO defines the ATM system as "a system that provides ATM through the collaborative integration of humans, information, technology, facilities and services, supported by air, ground and/or space-based communications, navigation and surveillance".[12]

To aid the description of services and processes involved in ATM and, in particular in the ATM system of the future, the ICAO Operational Concept disaggregates the ATM system into 7 concept components. It also describes a number of transversal elements – supporting "glue" – including information management. ICAO also describes in broad terms the processes of implementing the Operational Concept in the States and Regions while acknowledging that a "one size fits all" model would not recognise the significant differences in operations between States and between Regions. The key philosophy is a "one shape (rather than one size) fits all" approach, with each State or Region scaling and adapting the model to best fit local circumstances.

In developing the concept components and elements to be used in the Australian Target Operational Concept, ASTRA has considered a number of factors. Firstly, the Australian strategic planning process was begun in advance of the ICAO concept work and formed a significant input to ICAO. Australia has now had several years of practical experience in the application of ICAO's theory.

Secondly, certain components adapted into the ICAO operational concept had their origins in the complex operating environments of Europe and the United States and, whilst relevant globally, they are seen as having lesser long term impact in the Australian operating environment. Thirdly, it was necessary to take into account the evolving performance-based ATM approach being developed by ICAO in support of its operational concept to 'future proof' the Australian strategies, as well as providing further practical experience into the ICAO domain.

Figure 8 shows the typical current system components, the components and supporting elements advocated in the ICAO Global ATM Operational Concept, and the components and supporting elements adopted by ASTRA for the Australian Target Operational Concept.

As can be seen in Figure 8 – and as is described below – ASTRA has "scaled and adapted" the global concept to Australian application through its consultative process. The Australian Target Operational Concept is entirely consistent with the ICAO Global ATM Operational Concept.

Concept Components

The following sections describe the components both from an ICAO perspective and from the perspective of the Australian adaptation. In turn, these conceptual changes drive the key ATM strategies described in chapter 6. Table 4 gives a brief overview.

Table 4:

Target Operational Concept Component	Description
Airspace Organisation and Management	Establishes airspace structures that equitably accommodate the different types of air activity, volume of traffic and differing levels of service.
Aerodrome Operations	Enables the efficient use of the capacity of the aerodrome airside infrastructure.
Demand/Capacity Management - Demand and Capacity Balancing - Traffic Synchronisation - Constraint Management	Establishes maximum system capacity and optimal flow by minimising conflicting user needs and optimisation of system performance in the presence of imposed constraints.
Airspace User Operations	Manages flight operations to gain optimum outcomes from the ATM system. It incorporates mission planning, notice of flight intent, aircraft selection and capability, preparation of the user-preferred trajectory, dispatch, interaction with the providers of ATM service delivery management and operational control of the flight.
Conflict Management	Undertakes the limitation, to an acceptable level, of the risk of collision between aircraft and other aircraft or hazards.
ATM Service Delivery Management - including Trajectory Management	Acts as a service 'brokerage' function to ensure that overall system performance is maintained through the seamless integration and provision of services across the entire ATM domain. Trajectory management ensures optimisation of individual flights within the ATM system given known constraints.
System-Wide Information Management (SWIM)	Establishes an environment where information can be shared between users who need to provide and access information. Intended to address information needs of the ATM system across strategic, pre-tactical, tactical and post flight timeframes and include flight intentions, capacity and constraints, demand/capacity balancing and situational awareness.

AIRSPACE ORGANISATION AND MANAGEMENT

The ICAO Operational Concept states:

Airspace Organisation and Management will establish airspace structures in order to accommodate the different types of air activity, volume of traffic, and differing levels of service. Airspace management is the process by which the airspace options are selected and applied to meet the needs of the ATM community. Key conceptual changes are:

a) All airspace will be the concern of ATM and will be a useable resource

b) Airspace management will be dynamic and flexible

c) Any restriction on the use of any particular volume of airspace will be considered transitory, and

d) All airspace will be managed flexibly. Airspace boundaries will be adjusted to particular traffic flows and should not be constrained by national or facility boundaries.

In the Australian context, Australian civil and military airspace is considered a national resource and airspace organisation and management seeks to optimise use of that resource while maintaining primacy of safety in all respects. Use of airspace will be based on the principles of access and equity.

To achieve the optimal use of airspace, design and classification may change over time to allow airspace to be managed flexibly as a homogeneous resource.

The notion of civil and military airspace will be replaced by a concept of a single 'national' airspace resource in which types of operations and ground based conflict management are applied and pilot situational awareness is ensured. The various airspace volumes will be organised and managed to facilitate user preferred trajectories to the fullest extent possible, initially within designated areas but expanding over the planning horizon.

In general, there will be no defined air route structures within the en-route ATM operating environment. Instead, airspace users will fly a system flight trajectory which is the airspace users' preferred trajectory, modified by the ATM system as required to ensure safety and equity.

Airspace boundaries, where required, will be adjusted dynamically to meet variable traffic flows and be designed for seamless operation between Flight Information Regions or other airspace management delineations. It is intended that any restriction on access to a particular volume of airspace will be as brief as possible. Airspace management will be flexible, responsive and supportive of traffic flows.

There will continue to be a requirement for some discrete management of defence imperatives. Priority access (e.g. national defence and security requirements) for any airspace volume will be flexibly managed at strategic, pre-tactical and tactical levels to maximise benefits to, and options for, all airspace users within a Flexible Use of Airspace framework.

AERODROME OPERATIONS

The ICAO Operational Concept states:

As an integral part of the ATM system, **Aerodrome Operations** must provide the needed ground infrastructure including, inter alia, lighting, taxiways, runways, runway exits and precise surface guidance to improve safety and to maximize aerodrome capacity in all weather conditions. The ATM system will enable the efficient use of the capacity of the aerodrome airside infrastructure. Key conceptual changes are:

a) Runway occupancy time will be reduced
b) The ability to safely manoeuvre in all weather conditions whilst maintaining capacity
c) Precise surface guidance to and from a runway will be required in all conditions, and
d) The position (to an appropriate level of accuracy) and immediate intent of all vehicles and aircraft operating on the manoeuvring and movement areas will be known and available to the appropriate ATM community members.

In the Australian context, the challenge for the ATM system will be to ensure that all stakeholders may potentially operate to preferred capacity. As aerodromes are a focal point in the ATM system, it is important that aerodrome operators work with other stakeholders to ensure that ground capacity does not become the system constraint.

To minimise ground-based delays, airspace users will increasingly focus on apron and ground management efficiencies by applying movement priorities to achieve the best outcome. Aerodrome operations encompass factors such as airport location, design and the implementation of operations and systems on or in the vicinity of the aerodrome. Additionally, airports may manage capacity by the allocation of aircraft movement slots to ensure that runway capacity is not exceeded as well as managing the availability of aircraft parking.

The effect of meteorological conditions will be progressively mitigated, not only through the implementation of better all-weather capabilities [on the ground and in the air], but through better use of meteorological data and information to increase predictability and reliability. Forecast and now-cast data will be incorporated into the ATM decision-making processes on a real-time basis. This will require greater engagement of national and local meteorological services as ATM community members.

Aerodrome location has a significant impact on the ability to provide efficient air traffic management. The physical location of an aerodrome may be largely determined by political, economic, demographic, topographic and environmental factors; however, operational factors should also be considered. The aerodrome operational architecture will ensure ATM community expectations are satisfied and meet expected increases in capacity, predictability and efficiency demands through:

- runway capabilities appropriate to all user aircraft types
- runways that account for prevailing weather conditions
- parallel runways with sufficient spacing to ensure independent operations
- taxiway structure which minimises the crossing of active runways
- taxiway structure which minimises conflict between taxiing aircraft and enables minimal runway occupancy times
- runway/taxiway configuration which minimises taxiing distance
- efficient apron design
- situational awareness between all aircraft and ground vehicles
- airport surfaces protection in the vicinity of airports continuing to comply with Annex 14 or more stringent domestic standards
- balance between civil and military requirements at joint user airfields
- the ability for all-weather operations without a degradation in aerodrome operational capacity, and
- appropriate landing aids and systems that support all weather operations.

When one or more of the design components are inadequate to support the desired operational capacity of the aerodrome, ATM procedures, standards and infrastructure will be provided to compensate for the operational inadequacies.

DEMAND AND CAPACITY MANAGEMENT

The ICAO Operational Concept states:

Demand and Capacity Balancing will strategically evaluate system-wide traffic flows and aerodrome capacities to allow the airspace users to determine when, where and how they operate, while mitigating conflicting needs for airspace and aerodrome capacity. This collaborative process will allow for the efficient management of the air traffic flow through the use of information on system-wide air traffic flow, weather and assets. Key conceptual changes:

a) through collaborative decision-making at the strategic stage, assets will be optimized to maximize throughput thus providing a basis for predictable allocation and scheduling

b) through collaborative decision-making, when possible, at the pre-tactical stage, adjustments will be made to assets, resource allocations, projected trajectories, airspace organization, and allocation of entry/exit times for aerodromes and airspace volumes to mitigate any imbalance, and

c) at the tactical stage, actions will include dynamic adjustments to the organization 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.

Traffic Synchronization refers to the tactical establishment and maintenance of a safe, orderly and efficient flow of air traffic. Key conceptual changes:

a) there will be dynamic 4-D trajectory control and negotiated conflict-free trajectories

b) chokepoints will be eliminated, and

c) optimization of traffic sequencing will achieve maximization of runway throughput".

In the Australian context, demand and capacity balancing has been merged with traffic synchronisation to form **demand and capacity management**[13]. It also integrates a new sub-component of Constraint Management. The intent is to maximize the ATM system capacity and minimise the effects of ATM system constraints. It aims to manage air traffic flow at strategic, pre-tactical and tactical stages through the use of system-wide information and collaborative decision making among relevant ATM community members.

Demand and capacity management will allow airspace users to optimize their participation in the ATM system while mitigating conflicting needs for airspace and aerodrome capacity through collaborative evaluation and determination of system-wide air traffic and capacities. The tactical establishment and maintenance of optimum "gate-to-gate" flows of air traffic, including the elimination of chokepoints, will be achieved by using integrated and automated assistance to surface, departure, arrival and en-route management.

Constraint Management is not referenced directly within ICAO - it has been developed in the Australian context to ensure that any ATM system induced constraints will be removed or mitigated. The system will endeavour to remove constraints where possible, and minimise the effect of constraints through management and modification of trajectories (at any time during the flight life cycle) where removal is not possible. Where constraints are unavoidable, the earliest possible notice will be given to those affected.

The intent is that any modifications will be the minimum required to avert any conflict, meet runway capacity requirements and/or:

- satisfy environmental considerations (e.g., noise/visual/ emissions over built up areas or wild life sanctuaries or culturally sensitive areas)
- avoid politically sensitive areas (e.g. gaols, national security)
- avoid other sensitive sites (e.g. scientific equipment, explosives, gas discharges)
- avoid temporary sensitive sites, and
- meet specific operating rules or requirements (e.g. priorities).

13 - The use of the term "management" in Demand and Capacity Management is not meant to imply that any system design focus will be given to limitation of demand.

AIRSPACE USER OPERATIONS

The ICAO Operational Concept states:

Airspace User Operations refer to the ATM-related aspect of flight operations. Key conceptual changes include:

a) accommodation of mixed capabilities and worldwide implementation needs will be addressed to enhance safety and efficiency

b) relevant ATM data will be fused for an airspace user's general, tactical and strategic situational awareness and conflict management

c) relevant airspace user operational information will be made available to the ATM system;

d) individual aircraft performance, flight conditions and available ATM resources will allow dynamically-optimized 4-D trajectory planning

e) collaborative decision-making will ensure that aircraft and airspace user system design impacts on ATM are taken into account in a timely manner, and

f) aircraft should be designed with the ATM system as a key consideration.

In the Australian context, it is intended that the primary interaction with the ATM system will be through the definition and management of user-preferred trajectories. Airspace User Operations will incorporate mission planning, notice of flight intent, aircraft selection and capability, preparation of the user-preferred trajectory, dispatch, interaction with the providers of ATM service delivery management and operational control of the flight. It may be achieved by an aircraft operating organisation or company, an independent commercial provider of services, or the airspace user.[14]

It is intended that airspace users will advise the system of any modification operationally required to the current user-preferred trajectory and collaborate on changes in system status and configuration. Airspace User Operations has an enhanced role in the intervention and management of the flight with the purpose of achieving best business and operational outcomes. The evolution of the ATM system will provide operational benefits and incentives commensurate with aircraft capabilities.

CONFLICT MANAGEMENT

The ICAO Operational Concept states:

Conflict Management limits, to an acceptable level, the risk of collision between aircraft and hazards. Hazards that an aircraft will be separated from are: another aircraft, terrain, weather, wake turbulence, incompatible airspace activity and, when the aircraft is on the ground, surface vehicles and other obstructions on apron and manoeuvring areas. Key conceptual changes:

a) strategic conflict management will reduce the need for separation provision to a designed level

b) the ATM system will minimise restrictions to user operations; therefore, the pre-determined separator will be the airspace user unless safety or ATM system design requires provision of a separation service

c) the role of separator may be delegated, but such delegations will be temporary

d) in the development of separation modes, separation provision intervention capability must be considered

e) the conflict horizon will be extended as far as procedures and information permit, and

f) collision avoidance systems are part of ATM safety management but are not included in determining the calculated level of safety required for separation provision.

In the Australian context, Conflict Management will involve the strategic or tactical modification of the relevant flight trajectories in order to mitigate unacceptable risk of collision between an aircraft and other aircraft or hazards while taking into account any operational preferences and requirements. It is intended that conflict risk assessment will commence at the inception of the flight and will continue until the flight is completed. Four-dimensional trajectories will be analysed continually to determine the level of collision risk. Trajectory based conflict management will largely supplant the traditional horizontal and vertical separation standards. The application of sophisticated algorithms will support the strategic application of separation, reducing the need for tactical intervention. Tactical conflict management will be provided in one or more of the following ways or "modes":

- **Third-Party:** by a designated air navigation service provider [or other appropriately authorised entity] where third-party Conflict Management is mandated or requested by an airspace user. In this case, the service provider is contracted to provide collision risk management;
- **Co-operative:** by the airspace user and a designated air navigation service provider [or other appropriately authorised entity] where responsibility for collision risk management is shared or delegated;

14 - Airspace user may include the pilot, or in the case of unmanned aerial vehicles, the flight management authority

- **Distributed:** by the airspace users where responsibility is shared by the users. That is, the airspace users detect potential conflicts and collaboratively determine the conflict solution. In this case, aircraft collision risk management is provided by the airspace users relative to each other; or
- **Full self separation:** where responsibility for conflict management lies completely with the airspace user. That is, the airspace user detects potential conflicts and hazards and determines the conflict solution independently of other users and service providers. In this mode there must be no ambiguity as to the agent responsible for separating aircraft and hazards.

ATM SERVICE DELIVERY MANAGEMENT

The ICAO Operational Concept states:

ATM Service Delivery Management will operate seamlessly from gate-to-gate for all phases of flight and across all service providers. The ATM service delivery management component will address the balance and consolidation of the decisions of the various other processes/services, as well as the time horizon at which, and the conditions under which these decisions are made. Flight trajectories, intent and agreements will be important components to delivering a balance of decisions. Key conceptual changes:

a) services to be delivered by the ATM service delivery management component will be established on an as-required basis subject to ATM system design. Where services are established they will be provided on an on-request basis

b) ATM system design will be determined by collaborative decision-making and system-wide safety and business cases

c) services will be delivered by the ATM service delivery management component through collaborative decision-making, balanced and optimised user-requested trajectories to achieve the ATM community's expectation, and

d) management by trajectory will involve the development of an agreement that extends through all the physical phases of the flight.

In Australia, Service Delivery Management will be applied as a "brokerage" or "arbitration" function. The intent is to ensure overall system performance is maintained through the seamless integration and provision of services across the entire ATM domain – particularly where an airspace user may have inadequate or limited access to information on strategic constraints or tactical changes brought about by system degradation, in-flight emergency or traffic complexity.

The function is a strategic management or facilitation process rather than a tactical service. In this sense it is not the same as the traditional operational control function or air traffic control function. The objective is to establish "the ground rules" for an operating environment in advance of flights and monitor the performance of that environment on a strategic basis.

In its arbitration role, Service Delivery Management may also establish requirements for the provision of certain services in an operating area to ensure optimum overall system performance. In traditional terms, this would equate for example, to the mandating of air traffic control services [or later, Conflict Management services] in a busy terminal area. Applied in the context of the operational concept, service delivery management would establish mandated requirements for users to access certain services before operating in a specified area.

SYSTEM-WIDE INFORMATION MANAGEMENT

The ICAO Operational Concept states:

The function of Information Services deals with the exchange and management of information used by the different processes and services. It will ensure the cohesion of and linkages between the seven operational (sic) concept components.

In Australia, Information Services has been extended to encompass the concept of System-Wide Information Management (SWIM). It has been accepted that the implementation of the TOC will require collaboration between providers, users and regulators to optimise operational and business outcomes.

SWIM contemplates that decisions will be made more dynamically using more accurate information about intended and actual operations. Decisions will continue to be made as part of normal operational processes, but these will be improved through more information being made available at the right time, place and in the desired format. This will engender confidence in the ATM system and enable collaborative decision-making.

SWIM will establish an environment where information can be shared between users who need to provide and access information. It will address information needs of the ATM system across strategic, pre-tactical, tactical and post flight timeframes and include flight intentions, capacity and constraints, demand/capacity balancing and situational awareness. Specific examples of information that will form part of the SWIM function include:

- data necessary to support aircraft situational awareness (e.g. traffic information with respect to relevant/proximate trajectories across strategic, pre-tactical and tactical timeframes)
- data relating to the availability and allocation of terminal facilities (e.g. runways, taxiways, navigation aids, airport facilities)
- data relating to meteorological conditions such as altitudinal weather information, hazard information and weather forecasts and trends, and
- data relating to scheduled, planned and actual flight arrival and departures.

Implementing SWIM requires the capability to share information based upon agreed industry standards and protocols, simplifying data exchange, and enabling users to provide and access information as an integral part of their operations. Information will be exchanged on the basis of need, quality[16] and economics. Intellectual property and data sensitivity concerns will be addressed through agreed arrangements between providers and users of data.

Relative Influence

The relative influence of each of the components changes as the time horizon shifts from a long time prior to any particular flight [very strategic (5+ years)] to the actual time of the flight [tactical] and after the flight [post-tactical]. Figure 9 shows an example of the relative relationships between the various components as a particular flight time approaches. Airport Operations, Airspace Organisation and Management and Airspace User Operations have a relatively strong influence at the strategic level. The separation provision layer of conflict management is a mainly tactical tool. Providing the decision support tools for conflict management [at all layers] in a timely manner is one of the roles of ATM Service Delivery Management, as is coordinating the provision of ATM infrastructure. SWIM supports the components across the entire planning horizon.

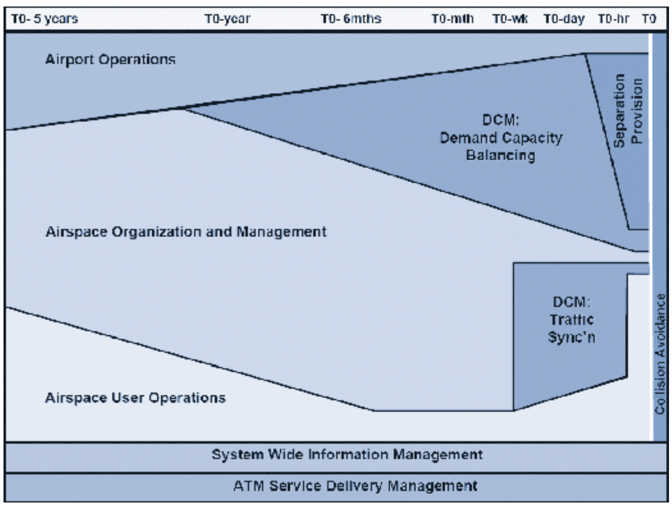

Figure 9: Relative Influence of ATM Components

15 - Applied to information quality refers to the accuracy, completeness, timeliness and appropriateness of the information to meet the user's needs.

6. atm evolution – the strategies

Seven strategies define the ATM development necessary to achieve the conceptual expectations of the TOC Components discussed in the previous chapter. This chapter describes the strategies briefly.

The application of the strategies - and the development of supporting Operational Improvement Groups - is discussed in more detail in the Operational Evolution document and other documents. Figure 10 shows the relationship between the Components and the Strategies. The graduated colours indicate, as in the case of the concept components, there is significant overlap between the strategies – i.e., they do not stand alone. Table 5 gives an overview of each strategy. The strategies are designed to ensure an evolutionary transition to the Target Operational Concept.

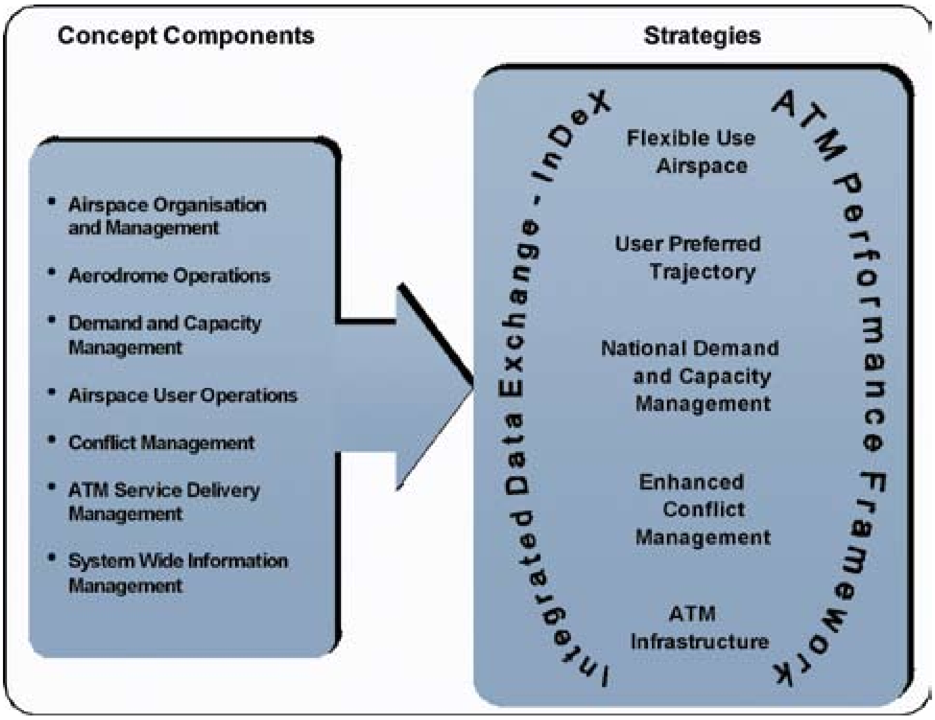

Figure 10: Concept Components and Realisation Strategies

Table 5:

Strategy	Description
Integrated Data Exchange (InDeX)	Establishes an integrated aviation information network to provide timely and high quality operational information to all users. This is a key enabler for other strategies.
User Preferred Trajectory	Allows a user to optimise their flight trajectory in four dimensions (i.e. three dimensions plus time) against their business or individual priorities.
Enhanced Conflict Management	Supports User Preferred Trajectories which will replace the current rigid separation standards.
Flexible Use of Airspace	Maximises the use of airspace to support civil and military operations without rigid airspace segregation.
National Demand/Capacity Management	Optimises air traffic flow throughout Australian airspace.
ATM Performance Framework	Provides the means to measure and report the efficiency and effectiveness of the ATM system, and to provide performance data to develop and refine strategies.
ATM Infrastructure	Provides integrated communication, navigation and surveillance infrastructure options as enablers, or supporting applications and capabilities which are essential to support the introduction of new ATM capabilities.

Integrated Data Exchange - InDeX

The Integrated Data Exchange (InDeX) strategy seeks to implement System-Wide Information Management (SWIM) by simplifying and improving existing data communications and establishing a single system-wide method of exchanging this information. InDeX will be progressively realised by focusing on the exchanges that need to be improved to support other ATM strategies or identified operational improvements.

Trajectory management will be assisted by the timely exchange of information relating to the intended operation of a flight that can be managed by the ATM system in the context of known airways constraints and conflict management. Demand/capacity management will be improved by collecting information about demand capacity imbalances in strategic timeframes that allow for preventative resolution and the synchronisation of traffic.

InDeX will be founded upon a commitment by all participants to the establishment and operation of the information management environment and the arrangements governing the exchange of information. Data to be exchanged needs to be defined and agreed in terms of:

- Business rules that determine when information is to be provided and accessed
- Standards and protocols used to ensure quality of information and simplify exchange.

InDeX's implementation will be achieved through an agreed industry change program to ensure information is made available to support business and operational outcomes through collaborative decision making.

User Preferred Trajectory

User Preferred Trajectories allow users to optimise a flight trajectory in all four dimensions [vertical, lateral, longitudinal and time]. It also integrates best business outcome or the ability to meet individual priorities.

A User Preferred Trajectory begins at flight inception [as far before a flight as fleet purchase] and concludes after an aircraft arrives at the gate [as far after a flight as flight profile analysis or charges reconciliation]. It includes en-route, terminal area and ground phases of the trajectory, including post flight analysis and reporting. Further discussion can be found in Appendix C.

Enhanced Conflict Management

Conflict management remains a key component of the future ATM system. Its application will evolve from the traditional and somewhat arbitrary single dimension standards to one based on conflict risk mitigation along an aircraft's trajectory as it proceeds through the ATM system. In the Target Operational Concept, conflict avoidance is achieved through risk management that, through standards, procedures and the benefit of strategic and tactical predictive tools, limits the risk of collision between aircraft and aircraft or hazards to acceptable levels.

Two streams of work are required to achieve an enhanced conflict management model. The first stream, concentrating on refining the current separation system based on fixed standards, will realise short/mid term benefits. The second stream is focussed in R&D in support of a future risk based conflict management paradigm: the benefits of which will not be delivered until the mid/far term.

Flexible Use of Airspace

The fundamental principle of Flexible Use Airspace is that airspace is a universal resource and should not be designated as purely civil or military. Rather, it should be considered as a continuum in which all user requirements should be accommodated to the greatest possible extent.

Flexible Use Airspace has been identified as an enabling activity to the implementation of User Preferred Routes and Trajectories. Flexible Use Airspace Research & Development has demonstrated its close link with User Preferred Routes and Trajectories, and collaborative trajectory planning as well as the critical importance of a shared model of airspace planning intent by pilots, airline operations/navigation planning personnel, controllers and other traffic managers.

Flexible Use Airspace will enhance the ability of the ATM system to achieve the User Preferred Trajectories whether that trajectory is defined by fixed air routes or not. Flexible Use Airspace enables greater access to airspace by both civil and military aircraft. Consistent with the principles of Flexible Use Airspace are dynamic airspace segmentation and roam free capability for military aircraft.

National Demand and Capacity Management

National demand and capacity management aims to maximise the ATM system capacity whilst minimising the effects of constraints. This will achieve system-wide traffic optimisation through the application of demand and capacity balancing and traffic synchronisation.

This strategy envisages a transition in traffic management away from today's emphasis on tactically adjusting demand to fixed capacity. It envisages a more strategic and collaborative approach to managing system-wide resources and capacities to match capacity with, rather than constrain, demand. The nature of tactical flow management will be more dynamic and adaptive to operate to finer capacity and time limits and cope with real-time events.

Demand/Capacity Balancing: - Flow management has relied heavily on the tactical application of holding, speed control and radar vectoring. It has been supported by limited strategic management through slot allocation and application of the Central Traffic Management System (CTMS) disruption management software at selected airports. Higher accuracy and predictability, together with a greater emphasis on strategic management through Collaborative Decision Making (CDM) processes, will be necessary to support the future ATM system.

Greater use will be made of aircraft flight management system capabilities to refine trajectories and more efficiently manage excess demand. Two important tasks have been identified to enhance demand/capacity management in the future ATM system. Phase 1, which has already commenced, focuses on operational performance measurement and trend analysis to identify future trigger points. Phase 2 will focus on system optimisation through SWIM implementation and CDM agreements.

Traffic Synchronisation: - Traffic synchronization refers to the tactical establishment and maintenance of a safe, orderly and efficient flow of air traffic. Traffic synchronisation is inter-related with both conflict management and demand and capacity balancing and will be fully integrated with these, leading to a continuous and organized flow of traffic.

Traffic synchronisation is encompassed within both the ground and the airborne part of ATM and will constitute a flexible mechanism for capacity management by allowing reductions in traffic density and adjustments of capacity to variations in demand.

Traffic synchronisation will use integrated and automated assistance to ground, departure, arrival and en-route management to ensure an optimum traffic flow. The objective will be to eliminate chokepoints and optimise traffic sequencing to achieve maximisation of runway throughput.

Traffic synchronisation, together with the other ATM components, will contribute to the efficient handling of traffic from gate to gate. There will be dynamic 4-D trajectory control and negotiated conflict-free trajectories. These techniques will reduce the need for traditional path stretching in high traffic density areas and will reduce the adverse impact this has on economy and efficiency.

Traffic synchronisation will apply and be tailored to all airspace and aerodromes where the optimised ordering and sequencing of traffic is critical to accommodate demand. Traffic synchronisation principles include:

- The ability to modify sequences to optimise aerodrome operations including gate management and/or airspace user operations
- Evolution into 4-D control where a flight is given a time profile to optimise throughput
- Delegation of maintenance of spacing to the flight deck to increase traffic throughput while reducing ground system workload
- Wake turbulence will continue to be a determinant of minimum spacing. Flight parameters will be available to the ATM system, allowing for dynamic spacing and sequencing of arriving and departing aircraft.

ATM Infrastructure

The traditional differentiation between communications, navigation and surveillance infrastructure is becoming less clear and increasingly there are overlaps in traditional concepts of use. For example, Controller Pilot Data Link Communications (CPDLC) is a communications medium used for surveillance purposes as well as communication. Mode S Radar is a surveillance medium that can be used functionally for communications or even as part of a navigation solution. In considering the infrastructure, attention must be given to support systems, applications and resulting capabilities, not just the communication, navigation and surveillance technology.

The Target Operational Concept considers the ATM infrastructure as a "whole system" resource with no limitation on the functional architecture. In addition, while the Target Operational Concept is notionally independent of technology, it cannot be achieved with the current infrastructure. The pace of ATM system evolution depends on the availability of enabling technology and the lead times associated with technology transition.

This strategy recognises the importance of cooperative development and implementation of this supporting infrastructure in a manner which:

- ensures a harmonised outcome for the ATM community;
- enhances the opportunities for exploitation of ATM technology and service developments
- facilitates the delivery of the outcomes of the other strategies of this plan
- promotes the maximisation of effectiveness and efficiency, and
- provides ATM stakeholders with timely notification of expected changes to the infrastructure.

ATM System Performance Framework

The ATM system performance framework strategy addresses ATM community expectations and provides a system that is service orientated, performance driven and predicated on the strategies defined in the Plan. The complexity of the ATM system and its large number of participants requires planning and monitoring to meet community expectations.

The strategy aims to support accountability in stakeholder decision making through demonstrated performance data across ATM community expectations. The strategy will develop an ATM Performance Measurement and Reporting System (APMRS) to help balance the competing demands of the system. This balance will be assessed by a performance case approach.

glossary

ABAS	Aircraft-Based Augmentation System
ADF	Australian Defence Force
ADS B	Automatic Dependent Surveillance Broadcast
ADS C	Automatic Dependent Surveillance Contract
AFTN	Aeronautical Fixed Telecommunication Network
AMHS	Aeronautical Message Handling System
ANSP	Air Navigation Service Provider
APV	Approach with Vertical Guidance
ASAS	Airborne Separation Assistance System
ASMGCS	Airport Surface Movement Guidance & Control System
ASTRA	The Australian Strategic Air Traffic Management Group
ATC	Air Traffic Control
ATN	Aeronautical Telecommunications Network
ATLAS	The Australian Transition to Satellite Technology
ATM	Air Traffic Management
ATMCP	Air Traffic Management Concept Panel
ATS	Air Traffic Services
CASA	Civil Aviation Safety Authority
CDTI	Cockpit Display of Traffic Information
CNS	Communications, Navigation, Surveillance
CPDLC	Controller-Pilot Data Link Communication
CTMS	Central Traffic Management System
DME	Distance Measuring Equipment
FAA	Federal Aviation Administration (of the USA)
FIR	Flight Information Region
FUA	Flexible Use of Airspace
GA	General Aviation
GBAS	Ground-Based Augmentation System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GRAS	Ground-based Regional Augmentation System
HF	High Frequency
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
INS	Inertial Navigation System
IRS	Inertial Reference System
LAHSO	Land And Hold Short Operations
MEMS	Micro Electro-mechanical Systems
NDB	Non Directional Beacon
NM	Nautical Mile
NPV	Net Present Value
PDC	Pre-Departure Clearance
PRM	Precision Runway Monitor
PTL	Provisional Time of Landing
R&D	Research and Development
RNAV	Area Navigation
RNP	Required Navigational Performance
SAR	Search & Rescue
SBAS	Satellite-Based Augmentation System
SC	Safety Case
SID	Standard Instrument Departure
SMS	Safety Management System
SSA	System Safety Approach
SSR	Secondary Surveillance Radar
STAR	Standard Arrival Route
SWIM	System-Wide Information Management
SWOT	Strengths, Weaknesses, Opportunities & Threats
TCAS	Traffic Alert & Collision Avoidance System
TOC	ATM Target Operational Concept
TSO	Technical Standard Order
UAP	ADS B Upper Airspace Project
UAV	Unmanned Aerial Vehicle
UPR	User Preferred Route
UPT	User Preferred Trajectory
VFR	Visual Flight Rules
VHF	Very High Frequency
VOR	VHF Omni directional Range
VNAV	Vertical Navigation
4D	4 Dimensional

A1. Background

Recognition of the interdependencies in the planning process required to develop the Australian ATM system, coupled with the apparent ineffectiveness of the then planning processes, encouraged key ATM community members[16] to seek the establishment of a more collaborative cross-industry ATM planning and project implementation framework.

It was recognised that an effective strategic management framework – that facilitated Australian ATM innovation as well as adopted world best practice – would have a significant influence on the development of standards, practices and procedures. By dedicating resources to the task, ATM community members demonstrated their support for the establishment of such a framework. In 1999, the inaugural meeting of ATM community members established the core planning group.

Since then, more members of the ATM Community have joined the process and have worked to refine the Australian ATM Strategic Management Framework and develop the Australian ATM Strategic Plan. The original core planning group has evolved and is now formally known as ASTRA.[17]

A2. The framework

THE OBJECTIVES

The objectives of the Australian ATM Strategic Management Framework are to ensure that there is:

- innovation in ATM planning and implementation to meet ATM Community member expectations, consistent with Australia's on-going commitment to global harmonisation and standardisation
- collaboration and alignment on ATM strategic planning, and implementation within each ATM Community member organisation
- simultaneous and integrated planning, development and implementation effort by all relevant ATM Community members , to ensure the timely delivery of ATM improvements
- broad agreement by ATM Community members on the major ATM business issues
- broad agreement on the investment priorities to address the ATM capability gaps that lead to gaps in ATM performance, and
- a commitment to the development of sustainable performance cases to support optimum ATM investment decisions.

THE COMPOSITION

The Australian ATM Strategic Management Framework comprises:

- the Australian Strategic Air Traffic Management Group [ASTRA] to provide a forum for coordination between stakeholders involved in ATM strategic management activities
- an agreed strategic management process and methodology
- commitment and participation by senior representatives of ATM Community member organizations in:
  - ASTRA
  - its working groups; and
  - its implementation focus teams, and
- the Australian ATM Strategic Planning Forum.

16 – ATM Community members include: Airlines [Scheduled and non-Scheduled], Military and State Aviation, Business Aviation, General Aviation, Air Navigation Service Providers [including Defence, Bureau of Meteorology, Aeronautical Information Service providers, etc], Airports [civil and military], Regulators, Government and other State authorities, ICAO.

17 – The name ASTRA derives from **A**ustralian **Str**ategic **A**ir Traffic Management Group

THE STRUCTURE

The ATM strategic management framework comprises the key ATM Community members (ASTRA) and Working Groups that facilitate broader communications with other ATM Community members. The general structure of the framework is shown in Figure A.1. Note the hierarchical layering across three domains – planning, development and participation in realisation.

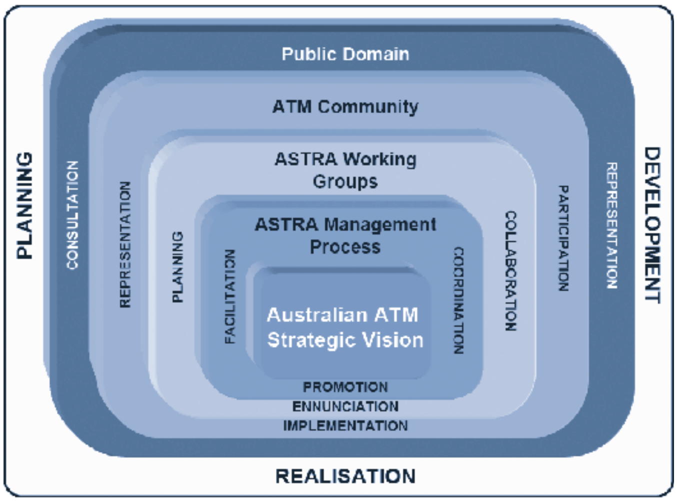

Figure A.1: ATM Strategic Management Hierarchy

STAKEHOLDER SENIOR EXECUTIVE LEVEL INVOLVEMENT

The Australian ATM Strategic Plan and the program/project priority list will be presented to senior executives within the relevant ATM stakeholder organizations for endorsement. In some cases, ATM community members may wish to discuss sensitive project issues [including commercial matters, or matters of national security]. In such cases the discussions will be held between appropriate parties independent of ASTRA. Final decisions on projects will be agreed between the senior executives of the relevant ATM community members. This includes decisions on timely commitment of resources and funding arrangements.

AUSTRALIAN STRATEGIC AIR TRAFFIC MANAGEMENT GROUP (ASTRA)

ASTRA is the core competency group within the framework. Its role is to coordinate all ATM planning and development. ASTRA is constituted by specialists in ATM planning, analysis, technical disciplines, finance and operations. All resources are provided by ATM community members. ASTRA establishes specialised working groups, as required, to advance specific concepts as the strategies contained within the strategic plan evolve. ASTRA also facilitates implementation focus teams, as required, to lead the development of implementation plans including cross-industry performance cases and, where appropriate, to coordinate implementation. ASTRA's agreed deliverables are:

- development and maintenance of the Australian ATM Strategic Plan
- development and maintenance of the ATM Target Operational Concept
- development and maintenance of key ATM strategies;
- analysis of ATM strategies and the subsequent identification and development of ATM capability options for existing and future ATM services and support functions
- development of the ATM performance framework, including assessment of ATM system performance gaps
- determination of ATM Operational Improvement Groups based on performance gap analysis and mitigation capability assessment
- initial identification of financial resource requirements for ATM project implementation
- development of proposals for major ATM investment and research and development projects, including cross-industry project business cases;
- monitoring and reporting on the progress of ATM implementation projects
- provision of specialist knowledge to ATM stakeholder executives, business centres and project teams
- establishment of an ATM information network, and
- facilitation of the Australian ATM Strategic Planning Forum.

AUSTRALIAN ATM STRATEGIC PLANNING FORUM

The Australian ATM strategic planning forum is an open forum that facilitates regular communication with all ATM community members and airspace users. The forum facilitates:

- communication of information about the Strategic Plan and associated documents
- open discussion on the Strategic Plan and implementation issues, and
- feedback from ATM Community members not directly involved in the strategic management process.

A3. Strategic management process

The ATM strategic management process involves strategic analysis, planning and implementation related to operational improvements and introduction of new ATM services over the long term. The process aims to achieve optimal outcomes for the entire ATM community.

CONCEPTUAL MODEL

A more detailed conceptual model for the ATM strategic management process is shown in Figure A2 below. This figure illustrates how:

- the ATM Target Operational Concept and related future ATM services are derived from a range of future scenarios
- the ATM services evolve to realise the target concept
- for each five year period a range of capability options are developed, and
- from the capability options, the priority programs and projects are identified.

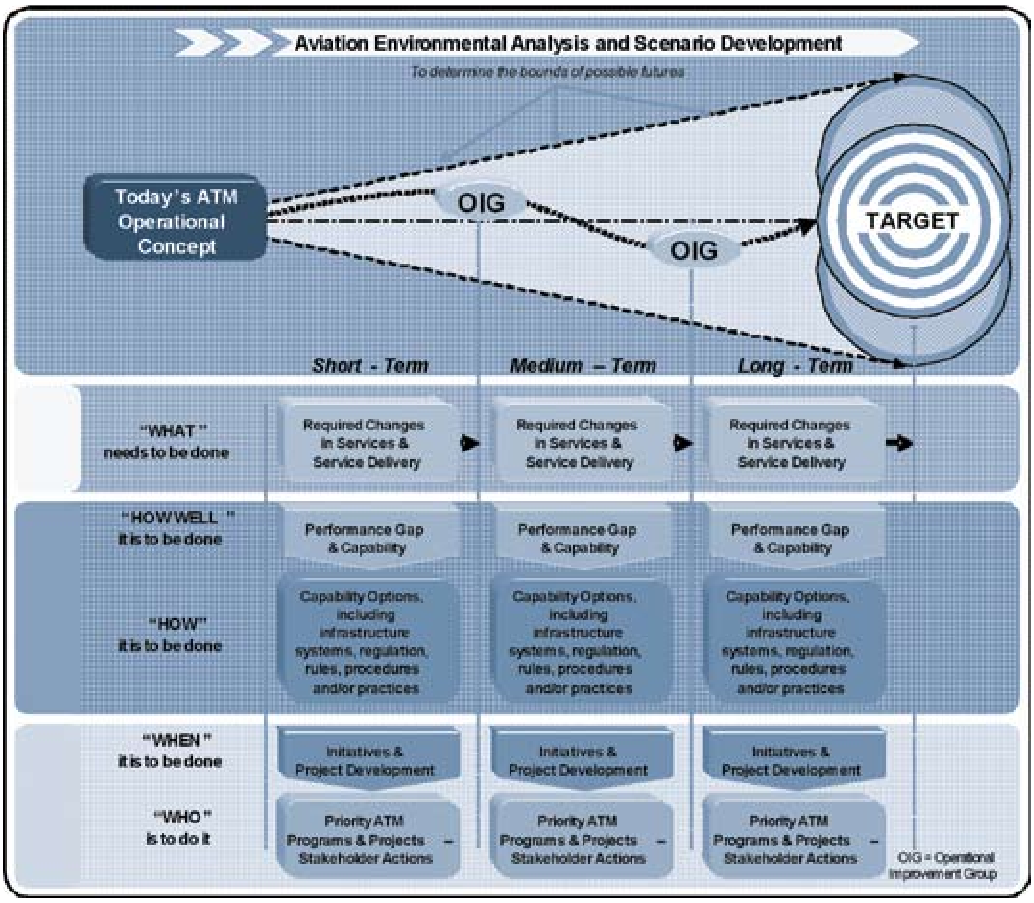

Figure A.2: ATM Strategic Management Process

FUTURE SCENARIOS

The ATM strategic management process starts with understanding and developing aviation industry scenarios over several periods (5, 10 and 15 years). This establishes the probable boundaries of change for the ATM operational environment. This is the "why" phase – determining the need for change. The work begins with an environmental scan which gathers all information and data for the purpose of strategic planning. This includes gathering and analysing information from internal and external sources including customer/community member needs and expectations, technology developments, marketplace dynamics, demographics, politics and social trends. There are 3 main parts to the process:

- **External Environment Scan** - an assessment of the political, social, economic, regulatory and technological environments that will impact on the future of ATM in Australia.
- **Internal Environment Scan** - ATM Community members looking within their respective organizations to assess their strengths, weaknesses, opportunities and threats (SWOT). It also involves a broader SWOT analysis of the ATM system.
- **Scenario Planning** - is an enhancement to the traditional environmental scanning and fosters thinking "outside the box" and the establishment of stretch goals. With scenario planning, the forecasts of several scans are merged to create a future scenario

STRATEGIC PLANNING

Strategic planning involves discerning 'what' must be done to achieve the required outcomes and levels of service. At this stage, it is possible to determine broad strategies for ATM enhancement. ATM strategic planning consists of:

- strategic direction setting which identifies high level, user-oriented system goals and performance objectives
- identification of potential value adding services and service changes at different stages over the next 15+ years, and
- strategies and initiatives required to deliver these performance outcomes and services improvements/changes.

DEFINITION

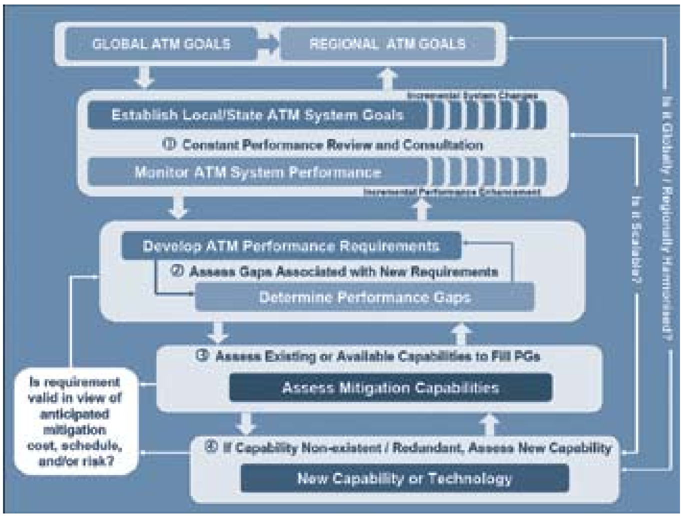

Figure A.3: Performance Management – Process Overview

At this stage, the performance assessment, gap analysis and mitigation process is engaged. Figure A3 illustrates the process. In general terms, performance management establishes "how well" the ATM system should perform at various evolutionary stages and "how" performance gaps may be addressed or mitigated.

Broadly the process involves:

- translation of the strategic performance objectives of the Operational Concept and Strategic Plan into ATM system goals
- alignment of those goals with global and regional goals, as appropriate
- review of ATM system performance
- assessment of performance gaps between current system and new requirements;
- determination of existing or available capabilities[18] to fill those performance gaps, and
- if required, assessment of new capabilities.

The definition phase establishes viable options – prioritizing potential projects through "rough order of magnitude (ROM)" analysis. It also establishes how services may be delivered using the identified mitigation options, in the form of either a Concept of Operation[19] or Concept of Use.

18 - A capability is not simply a new technology. It may be the use of, or a change to, existing rules, regulations, standards, procedures, practices, resource allocation and so on. It may also be reconsideration of the way in which current technology or facilities are utilised.

19 - The terms "Concept of Operation" and "Concept of Use" are loosely synonymous, the concept of operation focusing more on whole of system operation, and the concept of use looking at how specific components of a system may be operated. For example, use of "Flex-Tracks", with multiple operational components and interactions, would be described in a concept of operation – the use of a technology/capability such as ADS-B would be described in a concept of use.

IMPLEMENTATION

Implementation involves the discernment of what is required to introduce new capabilities and services in a safe and timely manner. Project definition and implementation are two principle components of the process and are defined as follows:

- **Project Definition -** detailed evaluation of operational, technical and economic feasibility of capability options before project proposals (including safety cases) are presented for ATM Community endorsement. Project definition is the precursor to strategic implementation.
- **Project Implementation -** project management and partnership arrangements between those ATM Community members involved in the project(s).

A4. Program and project implementation

If ATM community members are to achieve maximum benefits from ATM strategic planning, the project implementation process must be efficient and innovative. The implementation process must strike a balance between standardised and consistent project policy/planning guidance and allowing project teams flexibility on specific aspects of project implementation.

ATM PROGRAM/PROJECT PRIORITIZATION

Program/project prioritisation is achieved through a multi-stage, rough order of magnitude (ROM) process, building on the strategic implementation maps. The basic stages of the process are:

- assessment of the strategic impact of the initiatives to determine the significant steps toward achieving the associated ATM strategy
- stakeholder identification of the initiatives that are deemed to be of primary importance to their business
- assessment of the relationship between each initiative and other ATM strategies. This assessment identifies initiatives that contribute to the achievement of more than one ATM strategy, and
- assessment of interdependencies between initiatives based on the identification of common capability options. This rationalises the capability options [including communications, navigation, surveillance or other technical systems] and identifies potential program/project interrelationships.

Cost Benefit Analysis

It is intended that a standard cost-benefit analysis methodology, endorsed by all community members, will be used in developing program/project proposals. A project cost-benefit analysis may be developed for consideration from both a combined stakeholder and individual stakeholder view. Business case development is guided by a cost-benefit analysis process available to all community members. The business case should be based on a generic cost-benefit analysis template supported by a 'benefits summary' showing the influence of various factors on achieving benefits expressed in net present value (NPV) terms.

Safety Management

Safety is a fundamental and paramount expectation of the ATM system. The levels of safety applied to aviation are generally higher than other industries and reflect lower community tolerance and acceptance of error, particularly in relation to single events involving massive loss of life.

The management of safety advocated by ASTRA reflects world trends in safety practice, standards and research, and is aimed at meeting or exceeding air safety regulatory requirements and expectations. It has been agreed that when proposing changes to the ATM system beyond currently approved operational boundaries, project development under the ATM strategic management process will adopt a System Safety Approach (SSA) with its inherent Safety Case (SC). The intent is to explicitly demonstrate a commitment to safety beyond compliance.

The System Safety Approach

SSA is defined as "a systematic and explicit approach defining all activities and resources (people, organizations, policies, procedures, time spans, milestones, etc) devoted to the management of safety. This approach starts before the fact, is documented, planned and explicitly supported by documented organisational policies and procedures endorsed by the highest executive levels. SSA uses systems theory, systems engineering and management tools to manage risk formally, in an integrated manner across all organizational levels, across all disciplines and all system life cycle phases" (ICAO ATMCP 2003).

SC is defined as both the argument and the document that contends that the level of safety attained will satisfy the safety requirements. It intelligently and coherently argues the degree of safety achieved at any point of a system's life cycle by making rational and coherent reference to the documented results of the SSA.

It should be noted that SSA is not a Safety Management System [SMS]. SSA refers to the multi- organisational-disciplinary life-cycle management of safety based on risk management. On the other hand, SMS is the name usually given to the way an

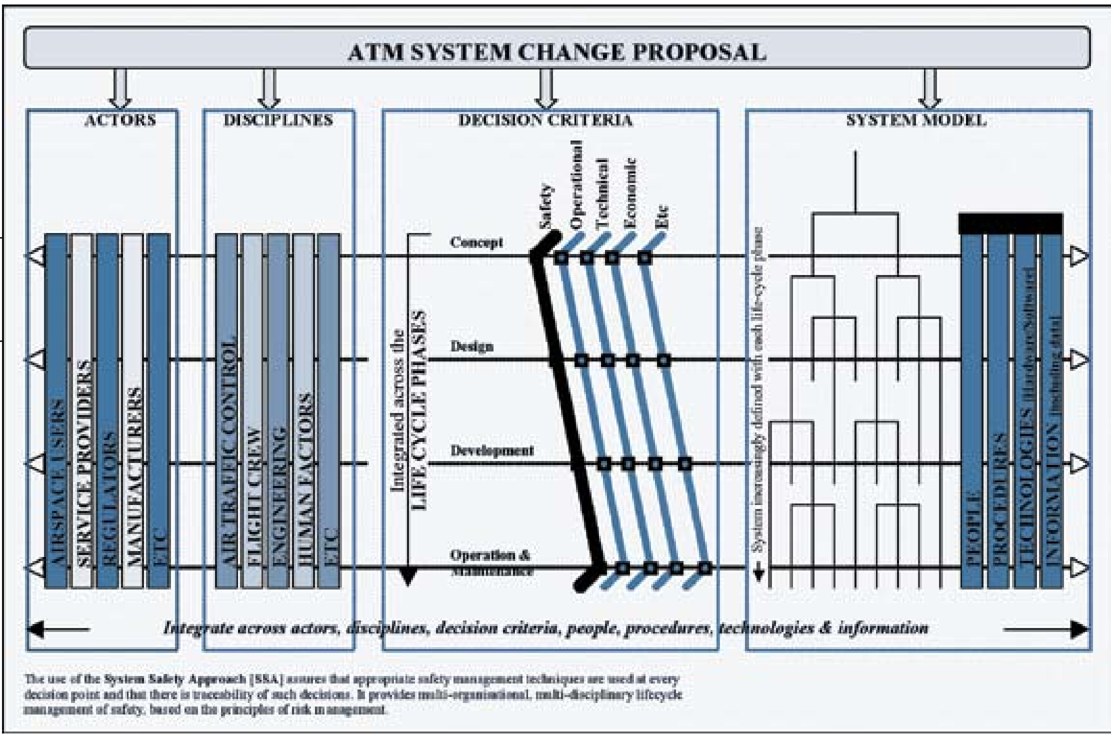

Figure A.4: The System Safety Model

organisation manages safety. It may, or may not, be based on SSA and there is currently no worldwide standard for a SMS. The SSA is taken for two reasons. Firstly, because safety is not a property of individual system components, but the system itself which is defined as the combination of people, procedures, technologies (hardware-software) and data, working together to perform a function in a particular environment. Secondly, because safety should be built into a system from the beginning and along all phases of a system's life: operational requirements, design, implementation and operation.

Safety Regulatory Change

Safety regulatory change must be substantiated by following the best regulatory practice and process established by the Commonwealth's Office of Regulation Review and integrated into the air safety regulator's rule making process. The process requires that:

- the problem be carefully defined
- several regulatory options be compared in light of the advantages and the disadvantages (not only economical) which would be imposed directly or indirectly on all parties
- the rationale for the proposed action be explicitly stated, and
- all parties be widely and publicly consulted before submitting the proposed change to the Minister and Parliament.

The most effective way to satisfy the air safety regulator's requirements is to incorporate them at the beginning of the strategic implementation process. Figure A4 shows that the SSA provides for timely and appropriate scrutiny from the beginning and through all phases of a system's life. Since the fundamental needs of the regulator do not change, it avoids the pitfalls of proceeding too far into development without appropriate clearance.

Regulation

The implementation of new ATM systems must be facilitated by the air safety regulator's timely development and promulgation of standards as well as provision of supporting operational and advisory material to users. The work to be undertaken by the air safety regulator during project implementation may include new regulations, new procedures, certification, advisory material and training.

Regulations, Procedures and Advisory Material

Aspects of ATM system development in Australia will require standards and new regulations. It is estimated that the development of a new regulation will take approximately 18 months to complete. These activities involves input from organisations outside the air safety regulator, such as the Attorney General's Department and the Department of Infrastructure, Transport, Regional Development and Local Government. New procedures and advisory material (if required) will be developed in conjunction with the regulations.

Certification

Certification refers to approval by a regulator of a new type of ground or airborne system. Certification occurs at the request of a manufacturer or service provider and is conducted on a case-by-case basis. These are two separate processes which may be conducted in parallel. If certification of both a ground and an airborne system is required and implementation is to be effective, the two processes will be developed and coordinated to ensure that both end products are compatible. The most efficient means of achieving aircraft certification in Australia for those systems which are designed to any of the air safety regulator recognised State standards, would be to wait for the certification by those States.

Once this is achieved, the systems may be utilised in Australia without the air safety regulator's input. This applies to both modifications and new aircraft. If, on the other hand, the air safety regulator is requested to certify a new system (ground or airborne) which has not been previously certified overseas, the situation becomes more complex. It is difficult to estimate the time required by the air safety regulator to provide the certification; however, it is reasonable to say that the air safety regulator's role in implementation may well be a limiting factor.

Program/Project Consideration & Endorsement

In addition to an agreed set of key ATM strategies, the endorsed Australian ATM Strategic Plan provides an initial set of potential ATM initiatives for further analysis. The ATM initiatives will be used by ASTRA to develop an ATM strategic implementation proposal (i.e. as part of a 5 year ATM rolling program) for consideration by executives of all key community members.

The proposal will contain a list of potential programs/projects, in priority order, supported by summary information – aim, scope, strategic importance, schedule – for each program/ project. Stakeholder responses to the draft ATM program/project proposal will be used by ASTRA to refine the ATM priority list and to obtain resources for agreed program/project proposals. ASTRA will coordinate the development of agreed project proposals for relevant stakeholder consideration. Project proposals should include:

- aim, scope, business case, risk management, legal, deliverable description and schedule details
- project management team details noting that the key roles will be played by community members with the major interest in the project outcome
- a description of the resources required and a breakdown of individual stakeholder resource commitments to the project, and
- a description of linkages to relevant R&D programs.

Legal Issues

The following material provides guidance for the legal aspects of project implementation. Whilst proposing legal regime options for project implementation, it also identifies the need to assess the legal aspects on a project-by-project basis.

Formal governance arrangement for joint projects

It is envisaged that some future ATM projects will be joint projects in the full meaning of the term, i.e. projects that involve a substantial financial contribution from more than one stakeholder organisation and are jointly managed. The most appropriate arrangement to link organisations for a specific task of this nature might be a formal contract (especially in the event that significant sums of money or public/private partnerships are involved). In other cases, cooperative working arrangements may be delivered by a Memorandum of Understanding (MOU) between participating community members.

Measures to control exposure to financial risk

Another consideration in relation to joint ATM projects involving significant financial commitments from more than one stakeholder is the financial risk arising from the joint nature of the proposal. The financial implication of any change initiative should be fully examined by participating community members before project endorsement.

Communication & Information Access

All program/project information, including scope, performance, schedule, non disclosure agreements, milestones and progress reports, is to be made available to all authorised community members on a need to know basis.

Project Monitoring & Reporting

It is anticipated that individual ATM stakeholder organisations will have their own internal arrangements for program/ project monitoring and reporting. In addition to the internal ATM stakeholder program/project monitoring and reporting, program/project managers will provide a progress report to ASTRA on a quarterly basis. This reporting will be used to monitor the progress of ATM developments against the Plan and as an input to strategic planning.

Project Management Procedures

To support the programs/projects identified by ASTRA, community members have agreed that standard project management practices will be applied.

appendix b
atm community expectations

As indicated in Chapter 3, each of the ATM community members has certain expectations of the ATM system. The extent to which these are met, both individually, and in total, represents the performance of the ATM system; and the extent to which these are met across the range of expectations represents the value generated [or destroyed] by the ATM system.

ATM Community Expectations and ICAO

The expectations listed below have been taken directly from the ICAO ATM Global Operational Concept. They are interrelated and cannot be considered in isolation. Furthermore, **while recognizing that safety is the highest priority, the expectations are shown in alphabetical order**.[20] They form an input to the development of the Australian ATM Performance Framework.

Access and equity: - A global ATM system should 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. The global ATM system should ensure equity for all airspace users that have access to a given airspace or service. 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 defence considerations or interests dictate by providing priority on a different basis.

Capacity: - The global ATM system should exploit the inherent capacity to meet airspace user demand at peak times and locations while minimizing 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.

Cost effectiveness: - The ATM system should be cost-effective, while balancing the varied interests of the ATM community. The cost of service to airspace users should always be considered when evaluating any proposal to improve ATM service quality or performance. ICAO guidelines regarding user charge policies and principles should be followed.

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.

Environment: - The ATM system should contribute to the protection of the environment by considering noise, gaseous emissions, and other environmental issues in the implementation and operation of the global ATM system.

Flexibility: - 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.

Global interoperability: - The ATM system should be based on global standards and uniform principles to ensure the technical and operational interoperability of ATM systems and facilitate homogeneous and non-discriminatory global and regional traffic flows.

Participation by the ATM community: - The ATM community should have a continuous involvement in the planning, implementation, and operation of the system to ensure that the evolution of the global ATM system meets the expectations of the community. The ATM community is more fully defined in Appendix A.

Predictability: - Predictability refers to the ability of the airspace users and ATM service providers to provide consistent and dependable levels of performance. Predictability is essential to airspace users as they develop and operate their schedules.

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 to the ATM system. In implementing elements of the global aviation system, safety needs to be assessed against appropriate criteria, and in accordance with appropriate and globally standardized safety management processes and practices.

Security: - Security refers to the protection against threats, which stem from intentional (e.g. terrorism) or unintentional (e.g. human error, natural disaster) acts affecting aircraft, people or installations on the ground. Adequate security is a major expectation of the ATM community and of citizens. The ATM system should therefore contribute to security, and the ATM system, as well as ATM related information, should be protected against security threats. 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 shall provide responsible authorities with appropriate assistance and information.

20 - Source: ICAO Global Operational Concept: Document 9854

Australian ATM Community Member Expectations

Whilst the global expectations form the basis for establishing an overall global ATM strategy, specific expectations of the ATM community within Australia need to be identified and taken into account in determining the performance requirements of the Australian ATM system. The following is not an exhaustive list, but shows, in general terms, key considerations of some of the community members.

CUSTOMER [AIRSPACE USER] EXPECTATIONS

General airspace user [the ATM customer] requirements and priorities are for an ATM system that:

- first and foremost, is safe[21]
- provides predictability – i.e. imposes either little or no delays, or predictable delays – whether they be traffic management slot, arrival holding, or taxiway delays – and therefore does not add variability to schedules
- maximises the utilisation of aircraft [and airport] assets;
- is cost effective – i.e. has low user [total] costs in the form of both 'direct' user charges and 'indirect' delay and other ATM related costs including equipage
- is efficient – i.e., allows for efficient flight profiles, including optimal tracks and flight levels, and
- in the case of military, business, and general aviation, provides equitable access – i.e., the ability to use the ATM operating environment to achieve their respective operational and/or business outcomes.

In the existing air traffic control domain, customers are aware, but do not necessarily agree, that their services will be subject to airport scheduling to ration demand to available runway capacity (where limited), and slot departure delays when capacity is degraded due to weather or other "unavoidable causes". Broadly, they expect ATM tools/automation – exploiting air derived data and emerging technologies or capabilities – to be the prime means of increasing airspace or airport capacity, making capacity more flexible, and reducing ATM unit costs. They do so on the basis that ATM automation should fully exploit current aircraft capabilities first and then introduce sound business cases for any future avionics requirements. Thereafter, they have a variety of expectations as to how a future ATM system should operate, including:

- Airspace capacity designed with a level of headroom that ensures no regular delays
- Predictable queuing/holding times at busy coordinated airports, with arrival management tools exploiting modern 4D-FMSs obviating the need for regular stacking
- Flow and traffic management processes operating to smooth (not delay) flows so as to ensure even loadings across the network, particularly at airspace bottlenecks, and
- Broad availability of real-time data on demand and capacity that allow airlines to tactically avoid most delays.

PROVIDER [ANSP AND AIRPORT] EXPECTATIONS

Providers of services within both the air traffic control and air traffic management domain – including air navigation service providers, airports, meteorological service providers and flight information service – also have expectations of the ATM system. These include:

- A framework that allows their respective businesses to grow
- A reasonable return on their investments, and
- Effective interchange of data and information from the customer, to allow effective response to customer expectations.

  Note: - The ATM network is a complex network of diverse actors that requires a mutual understanding of respective operations, requirements, drivers, constraints, etc to enable performance expectations to be met. This can only be achieved in relationships that go beyond conventional customer-supplier relationships, e.g. where a customer has a choice of supplier. In such a relationship, ANSPs expect airspace users to play an active role in recognising the current limitations of ATS provision and the implications of their operating characteristics on "ATM performance". In return, ANSPs offer a level of customer-focus that actively involves airspace users (particularly airlines) in capacity planning processes. This highlights a dichotomy in the concept of having the user community included as part of the ATM system, helping to develop and operate it, but on the other hand wishing to preserve their rights as customers of the system.

21 - "Safe" is a relative term. The actual expectation is more likely that the system is "not unsafe" – i.e., recognising that safety is about risk identification, management and treatment, to reduce the likelihood of an accident or serious incident to "as low as reasonably practicable".

22 - Some may question whether or not weather always constitutes an "unavoidable cause" as there are a number situations where simple solutions [such as accurate nowcasting] would obviate a constraint.

INSTITUTIONAL [REGULATORY AND GOVERNMENT POLICY] EXPECTATIONS

The institutional framework is structured around the need to sustain the value generated by the ATM system and, in particular, the indirect and catalytic values.[23] As has been witnessed in the recent past, that value is destroyed if a serious safety incident or accident occurs, if a national or regional security incident occurs, or if serious environmental events occur. As has also been seen in recent times, it is also threatened when the financial viability of an airspace user is challenged [e.g. if a State airline threatens bankruptcy]. It is reasonable, therefore, that institutional authorities would have significant expectations that the ATM system is:

- Defensibly safe – that is, it is tolerant of incidents from a "public perception" point of view, rather than a purely engineering risk management perspective
- Defensibly secure – again from a public perception rather than technical viewpoint
- Environmentally sustainable, and
- Financially and economically stable.

MANUFACTURING INDUSTRY AND SUPPLIERS

The manufacturing industry is a critical part of the value chain and expects that the ATM system will allow normal commercial growth. It may be argued that market differentiation is essential to survive in an industry as [apparently] closed as the aviation sector. It may be counter-argued that such differentiation leads to seams, lack of standardisation and lack of interoperability which stifles the ability of the ATM system to expand and thereby stifles the opportunity for growth in aviation manufacturing industries. Thus, there is a two-way expectation set between the ATM system and the aviation manufacturing industry. Manufacturers expect:

- a minimum set of globally applicable standards
- universal application of that standard set, and
- early consultation of ATM requirements to allow harmonised development of solutions within globally applicable standards sets.

In turn, the ATM system expects the manufacturing industry to:

- adhere to global standards
- develop any new standards through recognised global standards bodies, and
- collaborate to develop interoperable solutions where standardised systems are not viable.

PUBLIC EXPECTATIONS

The public – particularly the travelling public – have both explicit and implicit performance expectations of the ATM system. The implicit expectation is always safety, because ultimately it is the travelling public that will suffer the consequences of an unsafe system, or an otherwise safe system that is operated unsafely. That said, as long as the travelling public perceives aviation in Australia to be generally safe, it is rare that a prospective passenger will question the safety of an operator at the time of purchasing a ticket. So, in most cases the implicit expectation of safety is turned into an explicit requirement through State regulatory processes. The same is generally true of public expectations of national security and environment though, in the case of the latter, public expectations can become quite explicit particularly in relation to noise pollution in the vicinity of airports. Most of the explicit expectations of the travelling public relate to cost [affordability] and predictability [schedule and timeliness]. These expectations are reflected back to the public in different ways by the airspace user community, e.g. by airlines in their schedules and fare structures.

GENERAL

Ultimately, the extent to which members of the ATM community can satisfy or facilitate the expectations of other members of the ATM community determines the extent to which the ATM system can satisfy the expectations of the broader air transport and general public domains. In the same way that the ATM contribution to the Air Transport Value Chain is interlinked, there is a clear interlinking of the chain of expectations in the ATM system.

23 - Catalytic value is currently estimated at around a trillion US dollars globally - 250 billion Euros [USD$350Bn] |

This appendix discusses airlines specifically; however, the principles apply equally to business aviation, general aviation, or military aviation and each of these stakeholders can effectively substitute their own user group in the following discussion.

Business Trajectory Management

An airline is a business and the environment in which it operates must enable the user to act as a business and achieve its best business outcome. Aircraft operated by the airlines are sophisticated business tools through which they conduct their business. In the case of an airline it is the sale of their product: seats and/or cargo space to be moved safely between departure and destination at the time customers want the person(s) or cargo to be moved.

One of the most important assets for an airline is its schedule. Safeguarding its integrity is vital in order to be able to continue to offer a marketable product. No less significant is the ability to respond to customer demand that is unpredictable over time, should an airline decide to offer this kind of service. Airlines need to continually revise their schedules in response to competitor initiatives, or to follow market demands, while maintaining operational integrity. The key decision criteria are profitability and operational feasibility.

The measure of success for the future ATM network is the responsiveness and adaptability to the various needs (and capabilities) of the airline operators. Greater and longer-term network awareness enables the airline operator to react to disruptive events (including weather) quicker and in a coordinated way. Airlines need a lot of autonomy in planning and conducting a flight. Airline operation in the context of the ATM operational concept can be divided into two basic tasks: scheduling, which occurs years and month before the actual flight and operations control, which begins days before takeoff and culminates on the day of operation.

An airline needs predictable operations and a fixed schedule is preferred. However, in reality, plans are often changed. Deviations from the schedule due to unfavourable weather, passenger behaviour or unexpected maintenance events are more the rule than the exception. These disruptive events cause flight delays, cancellations, aircraft swaps and the use of reserve crews to minimise the impact on customers. Schedule disruptions are often beyond the control of the airline. This underlies the request for flexibility of operation - to be able to react to a continually changing situation(s).

From an airline perspective, trajectory management concerns not only operational management of one flight. It concerns the ability to create and maintain a schedule that provides a sustainable business outcome. This is the basis on which an airline enters discussions on trajectory management within ATM. In addition to the traditional ATM 4-D notion of trajectory management, airlines add business sustainability. The airline does not enter the collaborative decision making process as an equal partner; the decision making process is necessarily weighted towards the need for a positive business outcome for the airspace user. Without this the value chain collapses.

Accordingly, from a business perspective, a trajectory is defined as the representation of the business intention of an airspace user in respect of a given flight with an integrated schedule. This so-called business trajectory guarantees the best business (or individual) outcome for the airspace user. At the airspace user's discretion this may be a minimum time, minimum cost or any other trajectory as required by the airspace user. Obviously, general aviation or the military have the same kind of "business" intention, even if the terminology is different. The emphasis is on intention. Constraints arising from environmental considerations can be incorporated into the business trajectory by the airspace user or externalised as appropriate.

The trajectory is "owned" by the airspace user and may be modified only on the basis of collaborative decision making between the airspace user and service provider[s] or when conflict management requires a temporary deviation. Unlike the operational trajectory, the business trajectory extends from schedule development to post-flight schedule review.

Operational Trajectory Management

The operational trajectory extends from the earliest identifiable position in space or time relevant to the flight concerned (e.g. overnight parking from which the aircraft will be towed to the gate) to the last position of the given flight, or to the first identifiable position of relevance to a follow on flight scheduled for the same airframe. It is expressed in both space (3D) and time and is referred to as 4D. The trajectory is built from, and updated with, the most timely and accurate data available (AOC, FMS, etc.). In an ideal system, all copies of the same trajectory existing anywhere in the system will describe the exact same series of positions/times on the ground and in the air.

It is intended that airspace design will not impose additional constraints on the trajectory. For example, en-route and terminal, lower and upper etc. airspace are divisions in the current system as a legacy of earlier shortcomings and operational patterns and/or a frequency management imposed constraint. The changing way an aircraft operates in different phases of flight is reflected in the characteristics of the trajectory. In other words, the trajectory will no longer be constrained by legacy airspace divisions and hence can remain at all times as close as possible to the business intentions of the airspace user.

The fact that the trajectory represents the business intention of the airspace user is the primary guideline along which trajectories are managed and refined from the earliest planning phases through to the tactical flight execution phase.

Through a collaborative and layered planning process, the trajectories are adjusted, keeping the main guideline, but with the objective of minimising the number of potential conflicts on the day of operation and to prearrange traffic in and out of capacity constrained airports. Maximum flexibility for the airspace users will remain all through the planning phase and during flight execution.

An airspace user will generate a 4D-business trajectory to express their intentions as mentioned above. This trajectory may be available many months before the day of operation and is refined over time. Initially it is used for strategic planning, resource allocation and the early stages of conflict management. This business trajectory is shared with the various partners.

The airspace user is the exclusive owner of this business trajectory, which is designed to guarantee the best business outcome for its owner. Subsequent changes to the business trajectory made inevitable by traffic synchronisation or other strategic interventions will nevertheless be limited to the minimum and introduced as part of collaborative decision making. In fact, the performance of the ATM network will be measured in part by how small the changes to the "original" business trajectory are.

By the day of operation, the original business trajectory will have evolved with the consent of the airspace user to the trajectory that the airspace user will accept to fly. This trajectory will have been arrived at on the basis of constraints issued by the ANSPs when necessary and the airspace user's decisions on HOW to take the constraint(s) into account. Constraints shall be expressed in a way leaving maximum flexibility for the airspace users to choose the method of complying with them. This is an iterative process, as shown in Figure C1.

Elements of Operational Trajectory Management

FLIGHT DECLARATION

The flight declaration, or notice of intent, provides basic flight information advice in advance to the aerodrome operators and, as appropriate, ATM Service Delivery Management providers. When prescribed, the flight declaration will comprise, as a minimum, the following elements:

- estimated System Entry Time (ESET) at the departure aerodrome
- flight identification
- aircraft type, and
- estimated System Exit Time (ESXT) at destination aerodrome.

FLIGHT CONFIRMATION

Flight confirmation is provided by Airspace User Operations to a designated ATM Service Delivery Management provider and confirms that a flight will occur. This confirmation is the basis for the provision of service by a designated ATM Service Delivery Management provider and establishes the contract between the airspace user and the service provider. The confirmation is to be made at an agreed parameter time prior to the Estimated System Entry Time for the flight. The flight confirmation confirms the basic information provided by the flight declaration and allows for further refinement of this information.

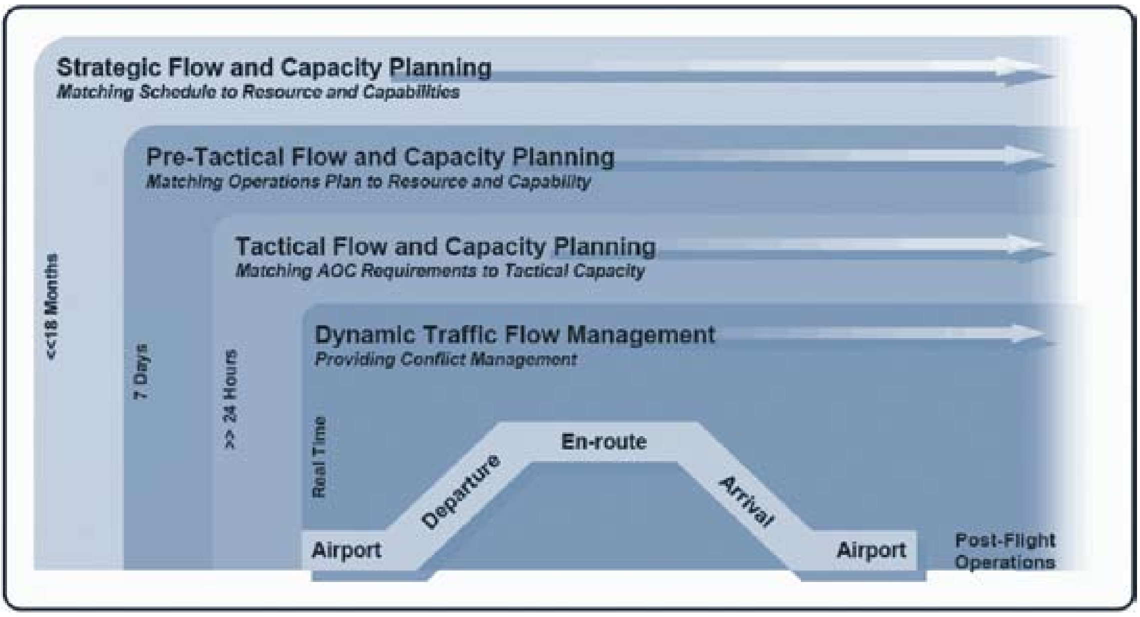

Figure C.1: Layered Planning

PROVISION OF USER PREFERRED TRAJECTORY

The UPT provides a detailed statement of intent for the flight and is provided to the designated ATM Service Delivery Management service provider to open an operational dialogue between the designated ATM Service Delivery Management service provider and the Airspace User Operations. The following additional information is provided with the User Preferred Trajectory:

- aircraft unique signature
- aircraft and flight crew capabilities
- identification of where ATM Service Delivery Management-provided collision risk management is required in relation to the User Preferred Trajectory[24], and
- a statement of operational preference.

On receipt of the User Preferred Trajectory, the designated ATM Service Delivery Management provider assesses the impact that the ATM system configuration, physical environmental compliance, collision risk management and pre-tactical demand/capacity management will have on the User Preferred Trajectory. This assessment determines what, if any, modifications to the User Preferred Trajectory are required to ensure that it overcomes the identified constraints.

The designated ATM Service Delivery Management provider, while taking into account the stated operational preference, when appropriate, modifies the User Preferred Trajectories for the departure and the arrival aerodromes and incorporates known en-route constraints. The Airspace User Operations will revise aspects of the User Preferred Trajectory to obtain the best business outcome.

TRAJECTORY COMMENCEMENT AND CONCLUSION

The flight trajectory commences with the aircraft's first movement from its parked position. The aircraft progresses along its trajectory and concludes when the aircraft stops at its designated parking area and powers down (i.e. gate to gate operations).

OPERATING RULES

Operating rules impact on User Preferred Trajectories and may:

- Mandate procedures and requirements for carriage of equipment in parts of the ATM environment to support safety and physical environmental considerations.
- Include noise abatement measures to minimise impact on noise sensitive areas during the departure, arrival or taxiing phases of flight, or when conducting engine tests. Similarly there will be operating rules that will ensure compliance with restrictions associated with politically and culturally sensitive areas.
- Include measures to minimise aircraft emissions relating to aircraft profile and performance that may negatively impact on the local aerodrome environment, or result in damage to the atmosphere.
- Facilitate sequencing to aerodromes by prescribing operating patterns for arriving and departing aircraft, as well as runway and taxiway occupancy where no aerodrome risk reduction service is provided.

Other rules define the aircraft's relationship to weather, in particular the relation to cloud base and in-flight visibility.

24 - Catalytic value is currently estimated at around a trillion US dollars globally - 250 billion Euros [USD$350Bn] per year in Europe alone.

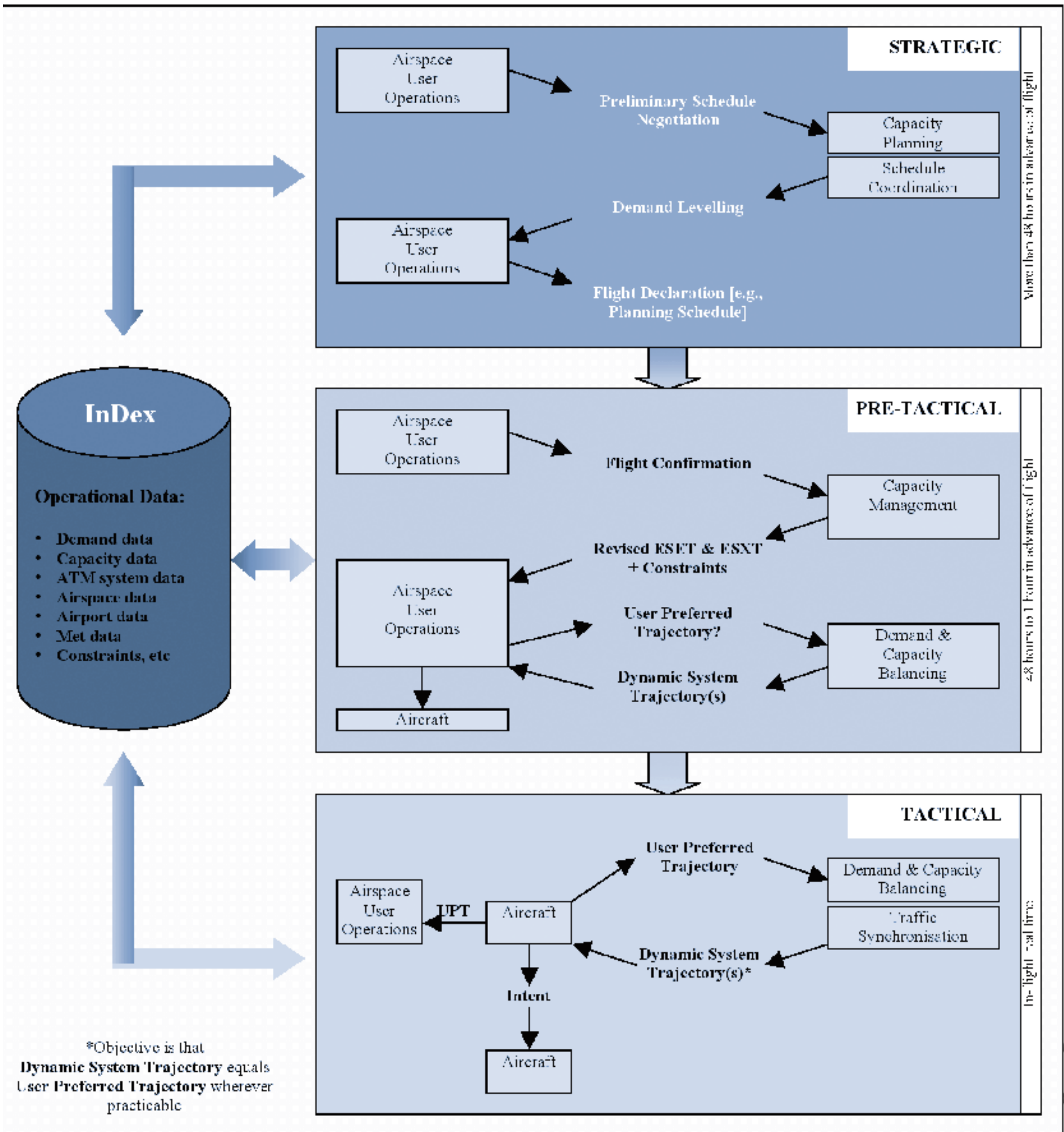

Figure C.2: User preferred trajectory