BOOZ ALLEN HAMILTON

STUDY ON BENCHMARKING FOR BEST PRACTICES IN AIR TRAFFIC MANAGEMENT (EUROPEAN COMMUNITY)

GENERAL REPORT

31ST JANUARY 2003

PREPARED FOR:

DIRECTORATE-GENERAL ENERGY AND TRANSPORT

PREPARED BY:

BOOZ·ALLEN HAMILTON LTD.

7 SAVOY COURT

STRAND, LONDON WC2R OJP

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1 EXECUTIVE SUMMARY

This benchmarking study was a first attempt at capturing the various internal practices used by air navigation service providers (ANSPs) across the world and relating these practices with achieved and expected levels of performance. A total of 21 ANSPs participated in the study from Australia, Austria, Belgium, Canada, Denmark, Eurocontrol (MUAC), Finland, France, Germany, Italy, Ireland, Luxembourg, The Kingdom of the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and the United States of America.

The results of the benchmarking are based on the data and information collected by the Study Team from three main sources:

- Information in the public domain (mainly annual reports and aeronautical publications)
- A Benchmarking Questionnaire developed specifically for this Study and distributed to all the participants
- Information from Eurocontrol (PRU and CFMU data) made available by the providers

The outputs of the Study can be classified into four categories:

1) **Key indicators** that have been defined and validated to support the monitoring of improvements achieved by the providers both in terms of internal processes and performance
2) **Best Practices** that have been identified to support the development of targets and standards, if not for the industry as a whole, at least for the European ATM industry
3) Preliminary **insights** as to the possible drivers of performance and the possible **linkages** between inputs, internal processes, external factors, and performance
4) A **Framework** to institutionalise the benchmarking process, both at the industry level and at the individual service provider level

1.1 KEY INDICATORS

Key Indicators have been selected, which will contribute towards the basis of future economic and performance regulatory framework at the Community level. The selected key indicators cover those already defined and validated by Eurocontrol's PRC and other studies, as well as those which have been identified as part of this specific study.

1.2 BEST PRACTICES

At the level of benchmarking undertaken, it is not possible to identify clear, unique and unambiguous linkages between individual processes and performance. However, the study has identified best practices for individual processes through intra- and inter-industry comparison. These best practices will drive future performance, especially if they are accepted as industry standards, acknowledging that in some circumstances the best practice must be tailored to the specific external environment.

One of the key challenges for the industry is to balance increased integration with greater modularity. Higher modularity will mean that interfaces between providers must be better standardised, requiring a set of agreed compatible processes and systems, hence the importance of sharing best practices. Similarly, increased integration would mean that fewer independent processes and systems are used and that ultimately one specific set will become the standard, hence again the importance of identifying possible candidates for such a standard – or best practice.

Five high-level best practices have emerged from the Study highlighting key improvement opportunities consistent with the principal objectives of the Single European Sky initiative, both for the industry as a whole and for many individual providers in particular. Implementation of these best practices should lead to tangible improvements in the short and medium term. These best practices and their key attributes, as derived from the Study, are described in the following table:

BEST PRACTICE AREA	BEST PRACTICE ATTRIBUTES
Safety Management	Safety management process allowing for maximum accountability, transparency and awareness at all levels of the organisation, while continuously assessing the corporate performance and culture to further determine whether risk is being reduced to a level as low as reasonably practicable.
Customer Involvement	Highest degree of customer involvement, in the service delivery requirements definition and in the strategic and tactical decision-making process; customers are an integral part of the feedback loop as regards a provider's performance (quality and cost of service provided). A customer-oriented culture is pervasive throughout the organisation. Customers include all users as well as key external stakeholders (airports, local communities, military, etc.)
Scope of Service, Service Definition and Delivery	Very clear and well-articulated mission, values and objectives communicated and shared throughout the organisation; transparent organisational and financial structure (including accounting process for cost and resources allocation), embedded organisational flexibility and systematic processes to unbundle or outsource services as appropriate. Implementation of an accredited quality management process throughout the organisation. Market testing with a view to unbundling of services, which do not naturally lend themselves to monopoly provision.
Tactical Flexibility	Flexibility to open and close sectors supplemented by the ability to change the configuration of active sectors by adding more working positions in order to react to changes in traffic demand without fragmenting the airspace further. Flexible rostering combining team and individual-based rostering frequently reviewed.

BEST PRACTICE AREA	BEST PRACTICE ATTRIBUTES
	Tasking of individuals for stand-by readiness in the case of non-availability of rostered staff, providing the flexibility for supervisors to man working positions with appropriately rated staff. Flexible manning of rostered staff to adapt a sector to changing traffic conditions, in support of the operational concept. Maximum situational awareness in the cockpit made possible by the use of English as the only language in ATC for IFR flights and on international airports.
Integrated Strategic Management	Full integration of all functional areas (business planning, HR management, Operations Planning and Infrastructure Planning) into a comprehensive Strategic Management Process; this process should be iterative and closed-loop, using a combination of top-down and bottom-up processes, with the embedded ability to monitor success against targets and standards, to identify improvement opportunities. Implementation of a high level Air Navigation Architecture approach in support of such a process.

1.3 INSIGHTS FROM THE STUDY

Three high level insights have emerged from the Study:

- The **fragmentation of the industry** is reflected in the **large variances and disparities in practices and performances** across all domains of analysis, without any clear relationship between practices and current performance
- The **external environment** has a **significant impact on providers' performance and internal processes**: the providers' performance is primarily impacted by the operational environment, while internal processes are primarily impacted by the institutional environment
- Even though larger providers tend to be better equipped (in terms of organisation, systems and processes) to deal with (typically) higher levels of service complexity, potential scale economies appear to be prejudiced by structural and operational rigidity, which prevents capture of potential benefits of scale. This reflects in some disconnects between the long-term, strategic, organisational set-up of some providers and their short-term, tactical, operational flexibility.

One of the key insights from the Study is a clearer understanding of the impact of external factors on performance and internal processes. Previous benchmarking studies, in particular the one performed by Eurocontrol's PRU on cost effectiveness, have only been able to draw hypotheses as to the role of the external environment in explaining why some providers seem to under or over perform relative to expectations. For example, it is widely accepted that operational complexity is an important cost driver in delivering the service, but how this is related to internal processes has not been well substantiated.

The results of this Study in that respect are more clear: At provider level, the external environment (including both the operational and the institutional environment) in which the providers manage and deliver their services appears to be the overriding factor impacting differences in practices and performance. The operational environment tends to have a particularly strong influence on performance whereas the institutional environment tends to have a stronger impact on internal processes. However, these external factors do not fully explain the differences in practices and performance. In particular, the application of the best practices identified in this report will clearly help the future performance of the providers, irrespective of their specific external environment.

The analysis also leads to the identification of scale as a key driver of performance. In a similar environment in terms of operational complexity and institutional framework, a larger player tends to be better equipped to successfully handle complexity. However in Europe, in terms of cost effectiveness and cost of service, including delay costs, scale does not seem to give any clear advantage - there is even an inverse relationship between unit rates and delay costs.

This apparent **diseconomy of scale** might be explained by several factors:

- The ATM industry is not a market–driven industry. Therefore, there has so far been no incentive or opportunity for providers to capture economies of scale. Besides, the fragmented nature of the industry would not allow the bigger providers to reap the benefits of their scale as the organisation of service provision is mainly dictated by national boundaries.
- Another possible explanation might be that larger providers actually overspend and overuse resources in order to manage a large portfolio of activities not directly related to their core services. Such non-core activities would generate significant overhead costs that ultimately are charged to customers without directly benefiting them.
- There seems to be a disconnect for many providers between their overall organisational and managerial set up, and their operational set up. In other words, providers with a relatively sophisticated organisation and management structure do not necessarily have the tactical flexibility that players with a less sophisticated management structure may enjoy. This, in turn, impacts their cost effectiveness and their productivity.

Overall, the insights gained from the Study in terms of drivers for improvement are consistent with most of the European Commission's Single Sky objectives, namely:

- Promotion and support of a **high and uniform safety** standard, not only in terms of performance but also in terms of management process
- A better relationship of service provision with the **needs of users**, in particular through increased customer involvement

- Enhanced **technical and operational efficiency** through higher modularity and compatibility of structures, systems and processes, in order to reduce the negative impacts of fragmentation
- Appropriate **economic regulation** to ensure that the level of user charges is proportionate to the actual cost incurred for a given service whilst providing incentives for cost efficiency and performance improvement.

1.4 FRAMEWORK FOR INSTITUTIONALISING THE BENCHMARKING PROCESS

One of the key objectives of the study was to propose a mechanism for institutionalising the benchmarking process so that it can be used effectively to support the monitoring of performance and other improvements in practices in line with the proposed regulatory framework of the Single Sky.

In doing so, the aim was to answer three main questions:

i. Is benchmarking the appropriate tool to improve processes in ATM, both at the regulatory and the service provision level?

ii. What are the criteria, conditions and process to be followed for a successful use of a benchmarking tool in the ATM environment?

iii. How can such a benchmarking process be institutionalised, meaning how can it be translated into a structured process fully accepted by the ATM community?

In answer to the first question, it clearly appears that benchmarking can be a significant contributor to the improvement of ATM processes, at least as long as providers are in monopoly situations and the market remains highly regulated. In the absence of objective and fully transparent measures of performance, benchmarking is an appropriate tool to understand the key performance drivers by allowing comparison of providers across a wide array of domains that play a role in the service delivery.

In answer to the second question, three critical conditions must be met for the benchmarking process to be successful in its future applications:

- Providers need to take "ownership" of the process
- The ATM community needs to agree on a set of definitions and best practices
- Benchmarking has to be implemented at a lower level than the provider level, in order to lead to actionable results. Lower level means at least service level, and ideally service level within a given operational unit (i.e. ACC/APP/TWR level).

In answer to the third question, an institutionalised benchmarking process should have at least three core attributes:

- Standard requirements for data and information disclosure

- Agreed standards and targets against which to analyse the data and evaluate the various improvement and performance levels
- A framework that captures the levers and identifies ways available to the providers to make improvements in the various areas where such improvements are expected

Ultimately, the way the various dimensions of this institutionalised benchmarking process will be implemented will determine the overall maturity level of the benchmarking process itself. The ultimate goal is to progress from what is today still viewed and practiced as an essentially **administrative** exercise towards a more **managerial** and **decisional** approach, whereby benchmarking is part of a fully integrated managerial and decision-making toolkit.

2 INTRODUCTION

2.1 FOREWORD

This document forms the final general report for the study on benchmarking for best practices in air traffic management and has been prepared by Booz Allen Hamilton Limited with it subcontractors Lufthansa Consulting GmbH. It covers service provision in the European Community[1] and other States with developed infrastructure and processes. A Confidential Annex that captures all the results of the Study and that will be distributed exclusively to the participants to the Study complements this report. The results highlighted in this report have been sanitised to respect the level of confidentiality agreed with the participants. However, some references to specific providers are occasionally made to reflect the European Commission's willingness to encourage transparency and openness in the ATM community.

This study forms one of two initiatives launched by the European Commission to explore the application of benchmarking in ATM and identify those processes that work well in a given environment. The second study covers the Candidate Countries for the European Union and has been undertaken by Helios Technology Limited.

2.2 OVERVIEW

The overall aim of the study was to establish the basis for a comprehensive benchmarking of ATM by identifying best practices and explaining the processes behind good performances. In doing so, the study has explored the use of benchmarking as a tool for improving processes in ATM at both the regulatory and service provision levels.

This report reviews the main results as well as a synthesised description of the methodology used.

2.3 BACKGROUND

The importance of aviation in fuelling and supporting economic growth is well recognised. Despite the recent downturn, air transport is still seen as one of the most prominent sectors in the world economy, essential for promoting business and leisure and one which is expected to continue on a long term growth path.

In the European region, there has been significant concern raised regarding the ability of the air traffic management (ATM) sector to meet the projected capacity

[1] *Includes Norway and Switzerland in the context of the Single European Sky.*

requirements and it has long since been recognised that the current levels of delay, inefficiency and costs directly attributable to ATM are in need of urgent reform.

This view is strongly supported by airspace users, particularly the airlines. Under the process of liberalisation of the air transport industry within the Community, the airlines undertook considerable reform to improve efficiency and now emphasise that the ATM sector has, so far, not been subjected to this much needed process. Additional pressure comes from the society and other stakeholders, in particular passengers as they call for an efficient and reliable air transport system in all components, including ATM.

In 1999 the Communication from the European Commission on the creation of the Single European Sky concluded that, irrespective of the legal and economic structure of ATM providers, there is need to establish an adequate overall European regulatory framework to ensure that services meet the necessary levels of safety, interoperability and performance, particularly if they remain to be provided on a monopolistic basis. In support of this, and with the support of the European Council, a High Level Group (HLG) bringing together civil and military representatives of the Community Member States, together with representatives of Norway and Switzerland, was formed.

This Group worked intensively over a 12-month period to advise the European Commission on needs and solutions for reform of the ATM sector. Amongst its conclusions, the HLG in its final report dated October 2000 underlines that "there is wide agreement that the ATM organisation [in the Community] suffers from significant handicaps standing in the way of more efficient performance". The HLG recommended to "reinforce mechanisms to optimise the performance of European ATM as a whole" and that there is a need for an appropriate "regulatory framework to be established to cover the domains of safety, overall system performance, and required levels of service, airspace design, system design and economic aspects".

2.4 PURPOSE AND SCOPE

From a Community perspective the use of benchmarking is foreseen not only as a complementary approach to regulation of the ATM sector but also as a tool to verify whether the regulatory measures meet expected objectives in terms of increased safety, capacity and efficiency and reduced cost.

In view of this, the European Commission launched this study to undertake a comprehensive exercise of benchmarking in the ATM sector, promote its establishment on a permanent basis and advise on how such a process could complement and support Community legislative initiatives in this field.

The European Commission believes that the needed improvement at the operational and regulatory levels should be promoted by indicating best practices to the stakeholders and that a suitable mechanism to achieve this is through the identification of best performances by analysing the reasons for performance differences and, later on, preparing and implementing change. As such, required

improvements of performances in ATM would strongly rely on the analysis of internal processes and the opportunity to implement the necessary steps to adopt identified best practices.

This study therefore was aimed at establishing such a basis of comprehensive ATM benchmarking by achieving the following tasks:

- Conducting analytical benchmarking of ATM covering the Community area and other countries which have well developed systems including Australia, Canada, New Zealand and the United States.
- Identifying relevant best practices underlying observed current performance levels or expected future performance requirements
- Ensuring co-ordination with a parallel study undertaken for the candidate countries for the Community
- Exploring and specifying opportunities for the use of benchmarking as a tool for improving ATM processes both at the regulatory level and service provision level
- Ensuring that this benchmarking process takes due account of all stakeholders in the ATM value chain and, in particular, that relevant operational interfaces with airlines and airports are taken into consideration in the scope of the analysis
- Detailing relevant indicators for disclosure and highlighting legislation needed to support the permanent exercise of performance review and economic regulation
- Ensuring implications of external factors such as geographical, institutional and operational specificities are duly considered throughout the assessment
- Ensuring that stakeholders are adequately involved throughout the assessment and that further developments or initiatives are co-ordinated with Eurocontrol (in particular the Performance Review Unit - PRU)

From the onset, the study team recognised that with the set up of the Performance Review Unit (PRU) at Eurocontrol, the opportunity and the benefit of defining suitable metrics to compare performance across ATM in Europe has already been partly realised. However, if the work of the PRU is to remain valuable and provide solution to the needed improvement in performance of the ATM system as a whole, the focus of the effort will have not only to identify the differences in performance but also to help understand the reasons behind the individual performance variations through meaningful comparison and benchmarking. The output of this study is therefore also aimed at providing essential extension to the ongoing activities of the PRU.

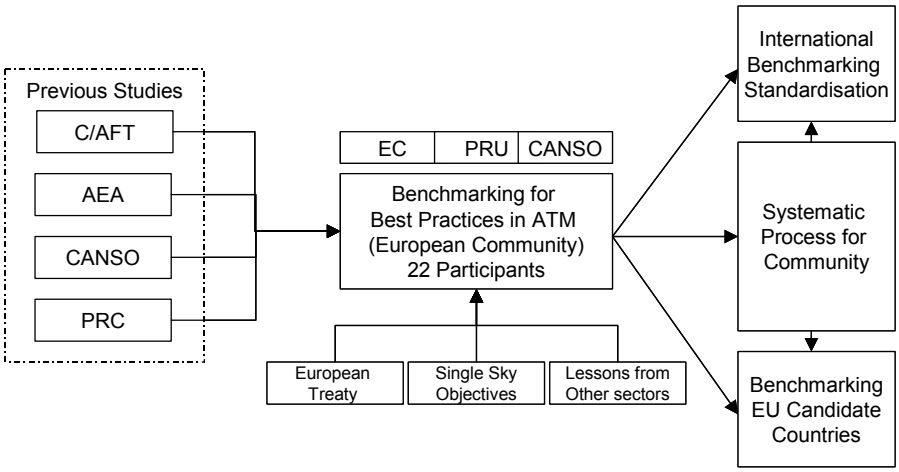


FIGURE 1: INTER-RELATIONSHIPS BETWEEN THE ONGOING TASKS

3 SUMMARY OF APPROACH AND METHODOLOGY

3.1 STUDY APPROACH

The study has proceeded according to a general approach described in the following chart:

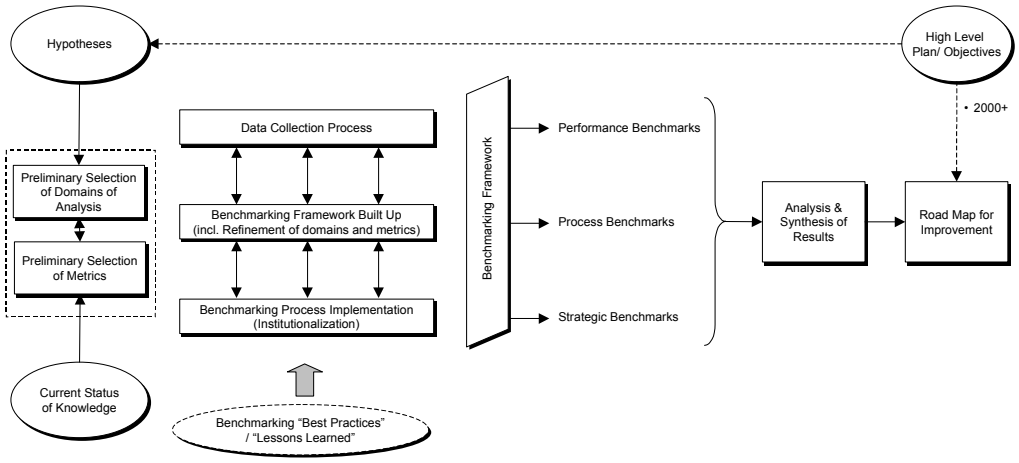


FIGURE 2: BENCHMARKING APPROACH OVERVIEW

This general approach was composed of three main phases:

Phase I

- Identification of relevant domains of analysis
- Definition of appropriate metrics (preliminary)
- Establishment of general data requirements

The selection of relevant domains of analysis has been the starting point of the study. For each of these chosen domains, specific dimensions to be benchmarked have been identified in order to focus the analysis on areas that are most relevant to future improvements.

Phase II

- Data Collection Process
- Benchmarking Framework Build-up
- Benchmarking Process Implementation

The three main work-streams developed in Phase II were progressed in parallel, since the development of one had implications on the others.

Lessons learned through experience of other benchmarking projects have assisted the study team in selecting the appropriate framework to be applied to each of the domains of analysis as identified in Phase I.

Phase III

- Analysis and Synthesis of Results
- Development of a Road Map for Improvement, in particular through the institutionalisation of the benchmarking process

The analysis of results in the second half of the study has been performed with the aim of investigating relationships between the various domains of analysis. These analyses have been essentially quantitative or qualitative, depending on the nature of the domain, although some of the analyses have required translation of qualitative results into quantitative indications.

Although basic statistical regression analysis methods have been used in such cases, their statistical representation should not be overestimated. The objectives of such analyses are to support "qualitatively" identified patterns, rather than give an accurate "quantitative" statistical representation of the situation.

The analyses performed have also opened further avenues that could be explored in future studies, particularly in the investigation of "cause and effect" relationships across the service delivery chain ("linkages").

Even though, detailed identification of the relationships between current performance and current practices would require a more specific study at operational unit level, best practices have been identified, whose implementation should play a significant role in driving improved future performance. The impact of external factors on the overall service delivery chain has also been assessed and incorporated in the overall benchmarking analysis.

The insights derived and lessons learned from the benchmarking process have been combined and translated into a general road map, which should guide the Commission in promoting best practices and performance improvements in the Community along the lines of the high-level objectives of the Single European Sky.

3.2 METHODOLOGY

The overall analysis used a combination of inputs from three primary sources:

- The Study Questionnaire
- The CFMU flight list
- Other data in the public domain (including other studies, Eurocontrol and PRU activities etc.)

These three sources have been used to produce a combination of performance, process and strategic benchmarking that has led to the definition and validation of quantitative or qualitative Key Indicators as well as some of some Key Legislative Enablers (KLEs). An overall schematic of the approach is shown in Figure 3 below.

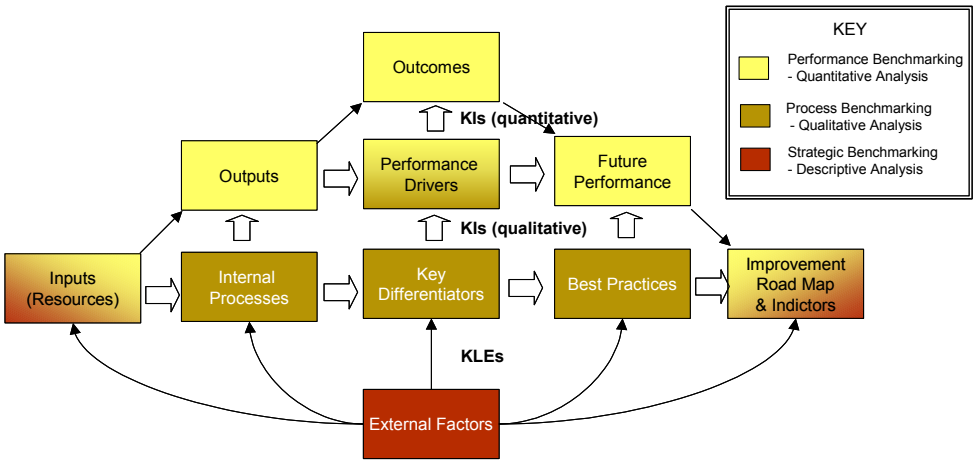


FIGURE 3: OVERALL ANALYSIS APPROACH

The overall approach follows the European Commission's hypothesis that the needed improvement at the operational and regulatory levels should be promoted by indicating best practices to the stakeholders and that a suitable mechanism to achieve this is through the identification of best performances by analysing the reasons for performance differences and, later on, preparing and implementing change.

As such, the required improvements in performance will strongly rely on the opportunity to implement the necessary steps to adopt identified best practices through the tracking of qualitative Key Indicators. The identified quantitative Key Indicators will then provide the mechanism to monitor impact and shortfalls on future performance, whereas the KLEs will provide the tools towards implementation of improved processes where identified.

3.2.1 Domains of Analysis

Six groupings of domains of analysis have been selected to reflect and segment the full chain of ATM service delivery. **Safety** is the overarching process and principal goal driving the service. **Inputs** are the resources used to produce the service through the development and implementation of **Internal Processes**. These "processed" inputs then translate into **Outputs** (from the provider's point of view), which are then translated into **Outcomes** (from the customers' point of view). **External Factors** impact the service delivery at various points, be it at the input, internal process, output or even outcome levels. These domains are illustrated in the following chart:

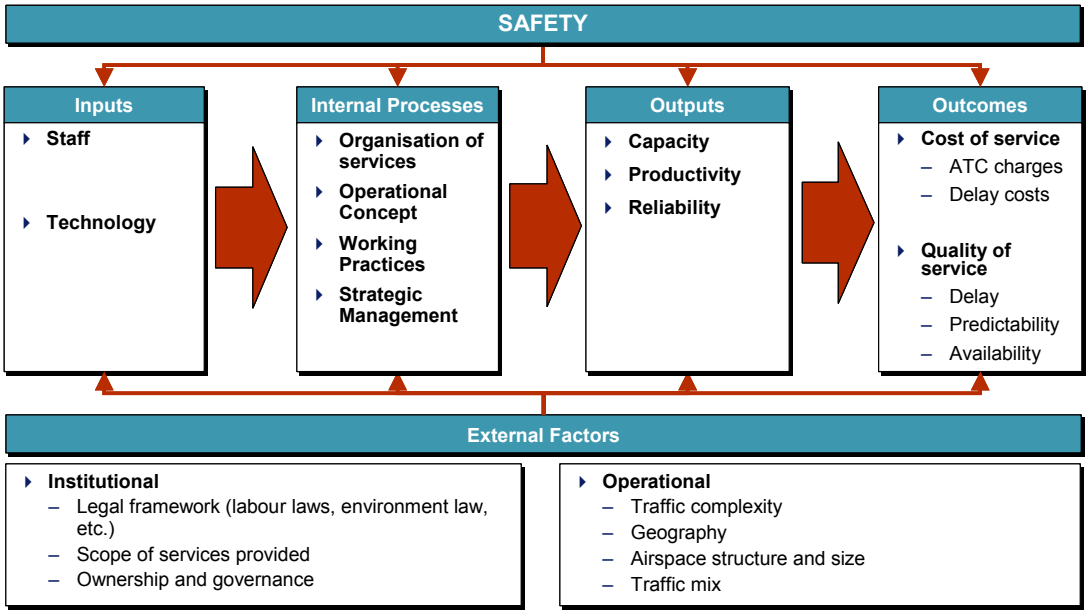


FIGURE 4: DOMAINS OF ANALYSIS

3.2.2 Analysis of Internal Processes

The internal process domain has been broken down into 21 key capability areas. A series of key indicators has been selected for each capability area. A set of up to five qualifications for each key indicator has been defined in terms of the range of practices that could be applied in each capability area or process. The range of reasonable practices was determined by comparison of the various practices applied within the ATM industry and, where appropriate, in other similar industries. The qualifications for these key indicators have been combined to form "Cluster Charts" for each capability area. These cluster charts capture the whole range of possible or actual practices as determined by the Study Team for each capability area. Providers have then been positioned along the various indicators, according to the data and information provided in response to the Study Questionnaire. The cluster charts have thus been used to derive an overall picture of industry-wide practices as well as to identify the variances in practices across providers.

Best practices have also been defined for most domains according to:

- Lessons learned from other industries and generally accepted management best practices
- High level objectives of the Single European Sky
- Proven success in ATM environment

The 21 capability areas are summarised in Figure 5. The related cluster charts have been put together in Appendix 1 to this report.

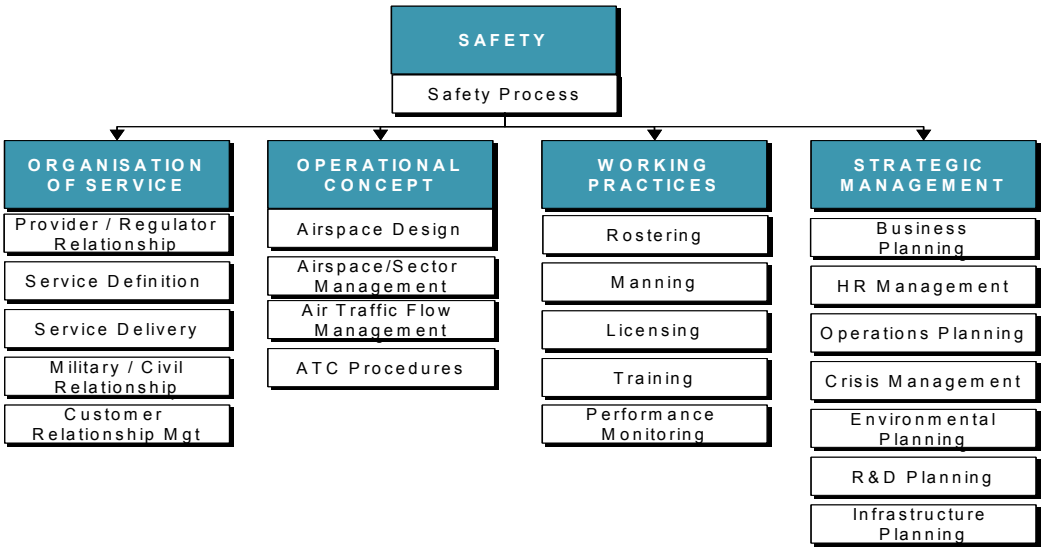


FIGURE 5: CAPABILITY AREAS

3.2.3 Analysis of External Factors

It has long been understood that factors outside the direct control of the service provider may affect service delivery and therefore performance. In order to try and understand the impact of these 'External Factors', two distinct analyses have been undertaken for the Operational Environment and Institutional Environment.

The criteria used for these two areas of analysis were mainly descriptive and are still subject to discussion and revision amongst the providers participating in the study.

At this stage the criteria are used to provide a first indication of the linkage of internal processes with the external environment and whether there is consistency throughout the industry.

For consistency and further analysis, fact sheets for each provider have been developed and have been attached in the Appendix 2 to this report.

3.2.4 Analysis of Inputs, Outputs and Outcomes

This analysis has allowed comparison of quantitative variables across the majority of participating providers and was designed to assess performance differences and, where possible, the reasons behind such differences.

All linkages across the service delivery chain were not directly measurable in this first iteration of the benchmarking framework, but some have however been identified and incorporated into this report and in the Confidential Annex.

4 SUMMARY OF RESULTS

The following paragraphs summarise the results of the study for each domain of analysis. Full details of these results are available in the Confidential Annex to this report, which is available to each participant of the study.

4.1 SAFETY

A very high degree of importance is given by providers to processes related to safety assurance, although some providers are in a transitional state towards meeting requirements for regional standards (ESARRs). Compliance with ESARRs still allows significant variation between the various organisational models, tools and processes used and some providers have capabilities which are significantly more sophisticated than any internationally recognised standard. Such providers have taken onboard lessons learned from other industries and it may be possible to further develop the safety culture as better systems and processes are validated for use in the specific environment. For example, some providers (ENAV, Airways New Zealand and Skyguide) have an adopted a total safety management system as an integral part of their overall total quality management system.

Overall, most value is to be gained through increased visibility of the use of different approaches to safety management to identify possible opportunities for further improvement on a provider-by-provider basis.

4.2 ORGANISATION OF SERVICES

4.2.1 Separation between Regulator and Service Provider

Generally, regulation is separated from service provision to some degree, either functionally within an organisation or organisationally. However, there is a wide variation in the approaches taken to the definition of the regulatory interface, supporting processes, inspections and audits, with much scope for harmonisation, including definition of a pan-European set of standards when a competent body, such as EASA, is created.

4.2.2 Service Definition

There is a strong legacy of the origins of the ANSPs as state-monopoly providers following the conventional integration model of service provision. In most cases, the mission and objectives are taken as given or derived directly from ICAO obligations with limited inclusion of staff and/or customers/stakeholders. The mission is mainly aimed at fulfilling sets of standard requirements rather than differentiation between providers and/or services. This is to be expected given the monopoly status of the majority of the services.

There is little actual unbundling of services, other than outsourcing of some ancillary activities, such as MET, and specific aerodrome ATC services. In some cases, the organisational structure of the ANSP facilitates the potential unbundling of services, e.g. business units aligned with services, whereas in others the structure hinders the potential for unbundling, e.g. multiple services delivered from single business units.

As yet, no service provider has branched out into the provision of services unrelated to ANS, although some providers have the freedom to do this. Where non-ANS services are provided, they have a strong link either: 1) to ANS (consultancy, training…); or 2) to the historic background of the ANSP (fire & rescue, ground handling…).

Transparency is limited in two main respects:

1) organisational units contribute to or deliver multiple services with blurred or indistinct boundaries.

2) even where audited accounts are published, cost allocation to services is very problematic, with techniques varying from provider-to-provider.

4.2.3 Service Delivery

Service delivery domains show a high degree of diversity across the industry.

There is no obvious common thread concerning, for example, outsourcing policy across the service providers; there is also no common thread across domains within a service provider, e.g. an organisation with a common outsourcing policy would not necessarily have a quality management system in place.

There are, however, some trends in specific domains: For example, there appears to be a move to focus on ATS rather than ANS with *non-core* services, e.g. MET being divested. Finally, quality accreditation is being implemented, even if only for specific services, such as AIS.

4.2.4 Customer Relationship Management

The industry is extremely polarised in its approach to customer relationship management. There are two extremes, with very few organisations lying in between:

- On the one hand, many providers allow for very little direct customer involvement in service definition. Great reliance is placed on institutional approaches in defining (global and regional) requirements. Services are defined and delivered in line with legal obligations at various levels, e.g. ICAO, regional or national.
- On the other hand, some providers (NavCanada, NATS, Airways NZ, AsA, DFS, Austrocontrol, IAA) solicit a high degree of customer involvement and feedback. The approach builds on institutional approaches but tailors requirements and services to meet specific local and customer requirements, specifically defined in licences or through service level agreements between providers and customers.

4.3 OPERATIONAL CONCEPT

4.3.1 Airspace Design

The majority of providers have implemented between 75 – 100 % of the ICAO Annex 11 airspace requirements; however, with more than 90 possible variations and the addition of national procedures for the use of airspace, the classification of European Airspace is far from being uniform. Since classification of airspace also serves the purpose of segregating IFR from VFR and military traffic, classification will always have to be tailored to specific situations in a given environment (congested areas on the ground and in the air, prevailing weather conditions, role of general aviation and importance of military interests).

Generally, regional harmonisation and service requirements constitute the majority of drivers for airspace design, while some providers also consider technical capabilities as a motivation for design change.

The results indicated that conceptual options (the possibility of conducting other than traditional concepts of operation such as Free Routing etc.) motivate only a minority of providers (Austrocontrol, NavCanada, DFS, IAA, Airways New Zealand, Air Services Australia and NAV Portugal).

In was also found the involvement of customers in the airspace design and classification is far from being commonplace.

4.3.2 Airspace/Sector Management

Most providers have the capability to change their sector configuration with very little time constraints. This capability is mainly an organisational flexibility issue (opening and closing of sectors) and does not necessarily exploit the more flexible technical capabilities that are often available in Centres.

The possibility of increasing the number of controllers in a sector to meet increasing demand does not to seem to be a viable option under present concepts of operation. The difference in the number of sectors open during rush hours compared to those in quiet hours varies between more than 85% to below 60 %. This practice of tailoring the number of active sectors constitutes an organisational and rostering challenge. Most providers have the technical means to allocate more work positions to sectors as required, however, this technical flexibility – with some exceptions such as Airservices Australia– does not seem to be widely utilised.

Nearly all providers are using the tools of the Flexible use of Airspace concept on a tactical level. It is unclear whether the concept itself is successfully applied beyond the responsibility of the providers and users. In particular, no conclusions can currently be drawn concerning the cross-border aspect of civil/military cooperation.

4.3.3 Air Traffic Flow Management

ATFM in Europe is highly standardised. With very few exceptions, it is executed through the CFMU with national support, mainly on ACC level through a normal sector position or dedicated Flow Management Positions (FMPs). NavCanada is using a similar structure with a national central flow to be introduced 2003. Other providers use or are planning flow management techniques concomitant with their specific requirements.

The conceptual tools (use of conditional routes, off – load routes, circumnavigation of congested areas etc.) have become common practice; it is noticeable, however, that most of these means are based on civil / military relations.

Customer involvement in ATFM is highly visible and is used beyond the level of CFMU in direct tactical decisions between ACCs and customers.

4.3.4 ATC Procedures

The main technology used for separation is, as expected, radar and, where coverage limitations require, procedural means, including manual position reporting. Automatic dependent surveillance techniques are used operationally in some oceanic and remote areas, where the local technology implementation allows, and is under development in other areas.

Transfer of Control, a sensitive area between ACCs in the past, no longer seems to be a limiting factor and silent transfers with little or no lead time required have become common practice. Some providers, however, only perform silent transfers within their own environment. Others (Luxemburg and Airways New Zealand) also perform silent transfers with the military. The lead time required varies from 15 minutes to less than 3 minutes. Longer times are typically required when oceanic interfaces are involved and for providers which operate in different long distance environments.

As regards to the preparation for emergencies, the handling of emergencies and unusual situations of aircraft varies from theoretical lectures in basic training to being an part of proficiency training, using simulators and results documented.

Although English is the principal language used for ATC, some providers use their own language to communicate with pilots of the same nationality.

4.4 WORKING PRACTICES

4.4.1 Rostering

The majority of providers base their rostering system on an individual basis rather than as a whole team. Some providers use a combination of individual and team-based rostering. There is sometimes a tendency to vary rostering principles from facility to facility within a provider's environment, driven by the flexibility required to meet and react to local traffic demand. For major ACCs in particular, software tools supporting the rostering process have become more and more common,

although some still develop such tools in-house, whereas other have utilised the application of customised solutions based on COTS products.

The interval between rostering cycles has decreased over recent years to take better account of seasonal and sub-seasonal fluctuations in demand levels.

The Personnel Factor[2] shows a wide spread from less than 3 to more than 10, indicative of the large variation in input assumptions and external factors from service provider to service provider.

Rostering of stand-by staff is not considered by some providers but is performed routinely by others. Providers might wish to look into this aspect and maybe draw on lessons from the airline industry which regularly uses stand-by crews to maintain service levels.

A limited number of providers roster standby teams, whereas others have an organised system based on individuals in place, while the remainder have no provision.

Annual working hours for ATC staff, and especially controllers, vary between less than 1,500 hours per year to more than 1,800 hours, with support staff generally working longer hours.

4.4.2 Manning

Flexible use of the rostered staff to react to changing traffic conditions seems to be limited largely to opening and closing sectors. As mentioned earlier, the use of additional staff in an already open sector is an exception rather than common practice. The variation of manpower applied to a sector between peak and quiet hours is low, typically at the level of one third and the usual approach is to open/close the complete sector rather than to change its manning. Minimum manning is generally prescribed, but supervisors have differing authority to go below the minimum.

4.4.3 Licensing

It has become general practice for licences or ratings to be limited to one facility and to be endorsed for multiple sectors. Combined licences are sometimes used where APP and TWR facilties are collocated. The number of ratings a controller can hold in a facility varies with the degree of complexity of the airspace; the more complex the airspace, the fewer the ratings that can be held. All providers have implemented programmes to assure that operations staff stays current.

[2] *P.F. is the factor, by which the number of ATCO on Duty must be multiplied to obtain the number of staff required to man working positions. The factor caters for leave of absence, instructions and training, sick leave, special projects and other reasons for absence*

4.4.4 OJT

Although the use of simulators in an operational environment – outside of ATC schools – has become more common, it is still not general practice. The balance of practical training versus simulator training is weighted very much in favour of practical training. The practicality of this approach hinges, to a degree, on the traffic levels experienced – sufficient traffic must be available to make the training meaningful but not so mush as to make it impractical.

Generally, simulators have become more and more important in the application of proficiency training and for training for unusual occurrences. Proficiency policy standards are widely accepted, with time limits specified to retain currency.

4.4.5 Performance Monitoring of Proficiency

The degree of proficiency monitoring varies from minimal to very comprehensive. It should be noted that performance monitoring has an impact on flight safety and is needed to assess the quality of training in a facility.

4.5 STRATEGIC MANAGEMENT

4.5.1 Business Planning

Relatively consistent business planning processes are in place across the industry with top-down and bottom up approaches. However, business planning is performed annually in most cases with limited updating or ability to iterate throughout the year, making the process still look very much like an "open loop". Business planning is often performed as a stand-alone process with limited interaction with other areas of planning (e.g. capacity planning).

Moreover, providers typically do not document or communicate their business plan. Overall there are:

- a limited number of publications for the general public (annual report only for most providers)
- limited level of detail
- highly variable frequency.

Relationships with other providers seem to a large extent driven by geographical and cultural considerations (neighbouring countries tend to cooperate more with each other) and to a lesser extent by technological considerations (some joint R&D/technology projects). Beyond that, very few providers have taken the initiative to develop strategic relationships with other parties, be it customers, suppliers or other ANSPs. This is probably a result of the traditional national fragmentation of the industry.

With a few exceptions, sourcing strategies are not applied in the industry, implying a general lack of sophistication in supply-side management.

4.5.2 Human Resources Management

Most providers use a range of Human Resources (HR) tools and processes. However, it seems that this has been a relatively recent trend as many providers are just starting to implement many of them.

In terms of labour relationships, the ATM industry is highly unionised, with an average of 80% of staff being members of a trade union (the figure is even higher for controllers), and an average of 6 different unions per provider. Most providers have integrated the unions into their decision-making process, either by having a representative on the Board, or by mutually agreeing working practices or by using working groups. Consultation is used by most providers as the main means of cooperation with unions.

Career development practices vary significantly across the industry: some providers have individual performance-based rewards, some others have individual objectives only, some have management and leadership training. This seems to be an area with some improvement opportunity in terms of managing controllers' careers more dynamically and more creatively.

As far as recruitment is concerned, a wide range of practices is applied, mixing bottom-up and top-down approaches to recruitment strategy and needs. This might partly explain why there are large differences in terms of the shortage of controllers across providers. Similarly, the mechanisms that providers use to measure recruitment performance are quite basic, which suggests some significant improvement opportunities.

Finally, most providers seem open to the recruitment of foreign controllers, provided it is allowed by legal or immigration laws; a minority identify local language and security clearance as restricting the hire of foreign controllers. There is some contradiction between the apparent openness to the hiring of foreign controllers without language constraints and the actual use of local language by some providers.

4.5.3 Operations Planning

Most providers use a combination of methods to forecast demand. However, forecasts do not cover all types of customers: usually it covers only scheduled commercial air transport, sometimes charter as well, and more rarely general aviation customers.

The level of resolution of the forecast is usually in line with industry-wide tools which allow demand to be forecast over a 5 to 10 year time horizon at regional, national and centre level.

Generally speaking, providers do not evaluate the effectiveness of their forecasts on a systematic basis although comparisons are made between predicted and actual traffic; it is as if forecasting was an open loop process with no real feedback or opportunity to validate the methods used.

In terms of capacity measurement and capacity requirement management, there are large variations in practices: from the use of simulation and/or historical data to the sector and/or centre level, and to the use of laboratory or operational simulation. This lack of standardisation probably reflects the lack of a clear definition of capacity and the lack of a clear method as to managing and measuring it on a European scale.

4.5.4 Crisis Management

Providers do not consistently apply the concept of crisis management planning; there does not seem to be any standard or agreed framework in that regard. A minority of providers have a comprehensive crisis management plan and organisation in place. The definition level varies widely from provider level down to sub-system level and neighbouring areas. Coordination with external parties also varies widely with most providers having limited defined procedures with external parties for crisis management.

4.5.5 Environmental Planning

Variations across providers have been observed in terms of the process used to take into account environmental impact and to monitor compliance. This probably reflects the lack of standard or agreed principles at industry level.

4.5.6 R&D Planning

The majority of providers do not perform any R&D to any great extent; for those, this is clearly not seen as part of the scope of activities necessary to deliver ATM services.

Those providers who are involved in R&D activities tend to dedicate significant resources and have a medium to long-term focus. Additionally, there seems to be a clear relationship between scale and complexity of operations and involvement in R&D work.

The main objective for those engaging in R&D is to improve operational efficiency or performance in the long-term. The underlying fundamental question is still open as to whether providers themselves are in the best position to do R&D or whether they would be better off sponsoring R&D through suppliers or other specialised organisations.

Ultimately, the drive towards more standardised systems and technologies should allow providers to pool resources together and drive an industry-level R&D effort

4.5.7 Infrastructure Planning

Infrastructure Planning, which traditionally was part of the technical branch and limited itself to technical improvement or replacement of legacy systems, has developed to include operational and business requirements, considering users as

customers. The organisational structure of the providers reflects this change of paradigm.

Given the financial impact of CNS/ATM infrastructure decisions, the long time lines to publish intended changes within the framework of ICAO, and the long depreciation times of systems, a well defined organisation is a precondition for success.

Unlike other planning processes (demand forecast, business planning), it seems that there is a management process to organise, close the loop and evaluate the success/effectiveness of infrastructure planning through post-project audits and other performance measurements. This is probably related to the fact that infrastructure planning is more closely connected with operations, therefore more in line with traditional organisational culture.

Due to the numerous interdependencies in modern aviation between ground and air, vendors and purchasers, providers and customers, the scope of infrastructure planning has been extended to include operational concepts as well as business planning.

4.6 INPUTS

4.6.1 Staff

Analysis of staffing across providers shows two clear groups: one consisting of larger providers (with over 1,500 employees) and one consisting of the smaller providers.

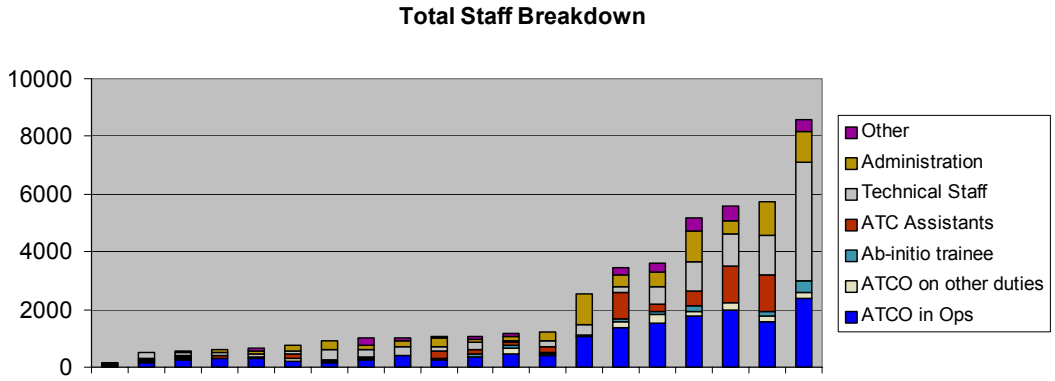


FIGURE 6: STAFF BREAKDOWN BY CATEGORY

For both groups, there is significant variation in the amount of resources used in various staff categories (i.e. relative proportions of technical staff, ATCOs on duty and Administrative staff, etc.) . Some providers do not use ATC Assistants at all and others show disproportionately low use of ATCOs in Ops (relatively to total number of employees). Some providers display a particularly high proportion of ATCOs on other duties.

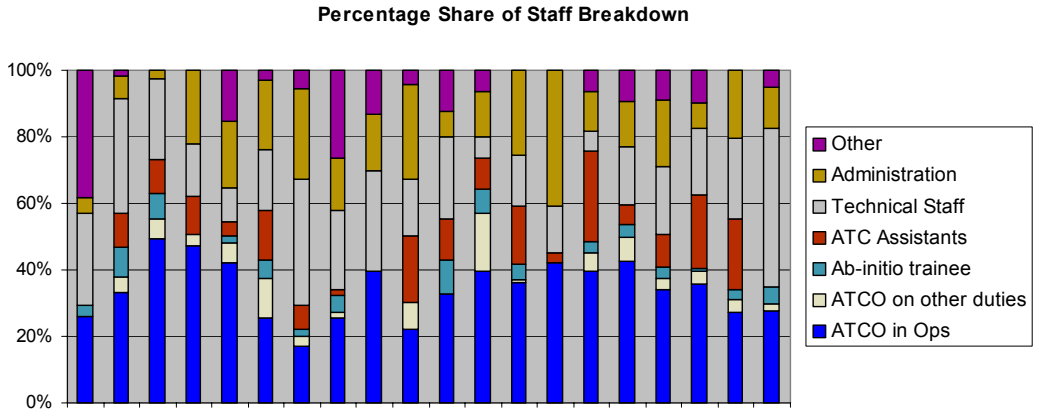


FIGURE 7: RELATIVE STAFF BREAKDOWN BY CATEGORY

In spite of the large differences in the proportions of specific staff resources used, a strong relationship exists between total staffing, total ATCOs in Ops and IFR flights handled. Total Staff and ATCOs in Ops also show a strong relationship with the number of Sectors handled.

4.6.2 Technology

4.6.2.1 Observations on surveillance functionality

While the majority of providers claim the use of advanced multiradar tracking with only two using simple multiradar tracking, there appears to be some discrepancy in the technical definitions. The term "multiradar tracking" seems to be generally used for any system that employs more than one radar, and the term "advanced" seems to be used to reflect the construction year rather than the tracking algorithm.

Automatic assignment of SSR – codes has become general practice, widely assisted by an adequate code management. Some six providers, also in the core European area, are not using an automatic code management system. In the light of code shortages, there seems to be room for improvement here.

4.6.2.2 Observations on flight data processing

All European providers, except one, receive all flight plan messages from the IFPS. Updates are generally based on radar, automatic messages, and manual inputs. Only a very few providers have their databanks updated by adjacent units. The distribution of flight plans varies from a limited distribution to a full data sharing.

Trajectory predictions are generally in use, based on fixed and flexible routings. Standard or advanced aircraft profiles are the basis of trajectory calculations.

There is some inflexibility through the "one fits all" algorithm of a centralised FPN system using routing systems, be they flexible or fixed. Future operational concepts would require a system that can accept routings independent from any routing system. The implementation of area navigation already points in that direction. With the advent of data link, the basis for trajectory prediction could then be the individual aircraft than a standard profile.

4.6.2.3 Observations on flow support tools

Sequencing and metering systems are becoming more common, limiting their early application to initial departure management and final approach sequencing. Three providers only envisage the use of tools in a more strategic way.

Tools like those used by the FAA – e.g. URET, CTAS, TMA, are not yet used in Europe, although one reason might be the limited airspace available for the individual centres.

4.6.2.4 Observations on data distribution & coordination

Air-ground data processing & distribution is still at its early stages. Coordination traditionally is a standard bottleneck for ATM capacity and all but three providers have automated or system supported coordination procedures in place. Back-up voice systems based on separate communication links available provide a logical option.

4.6.2.5 Observations on operational systems

The first generation of automated ATM systems is in the process of being replaced by a newer generation based on modular functionalities. This supports the stepwise implementation of advanced features, but might also lead to interface problems. The perception of a general architecture level above system architecture is not very visible amongst providers.

4.6.2.6 Observations on controller assistance tools

Implementation of workload monitors and task schedulers are not planned. One European provider, however, has a limited functionality in that field, while some non-European providers (Air Services Australia, NavCanada) already use these functions operationally. However, reducing controllers' workload by making inputs easier, and providing adequate display of vital information has become common practice.

4.6.2.7 Observations on navigation

With the implementation of Area Navigation, navigation has made an important step towards a better and more economical use of the airspace. All providers use the traditional means to support en route navigation. In their areas, some still use NDB for en route navigation, which seems to be based on requirements of different customers (Military and General Aviation).

Satellite navigation is becoming more acceptable, with an increasing number of providers using GNSS to support non-precision approaches either as overlay or stand-alone procedures. Around half the providers foresee the replacement of conventional navigation systems by satellite-based navigation. These intentions, however, are very cautiously voiced, mainly in connection with the ECAC navigation strategy.

Historical experience, such as NDB, shows that present systems will still be around for a long time. Changes can be expected should these means not be sufficient for the support of future operational concepts; however, this may require further regional co-ordination.

4.7 OUTPUTS

4.7.1 Capacity

The number of sectors does directly not correspond with the number of flights and this illustrates that sectors across individual providers have differing capacities and use different operational concepts. In some countries, providers apply sectors to handle more traffic than in others. The general trend shows that traffic increases in a steeper way than the numbers of sectors as one moves from the European peripheral providers towards the core European area.

A higher average sector load generally also corresponds to the distribution of delays. Some exceptions are noticeable, however, and some providers report a high sector load but few delays (Austrocontrol, IAA, NATAM). However, there are also providers with a high level of delays in spite of a high proportion of overflights. The results therefore indicate that delays attributed to some providers may mask downstream affects caused by other providers, since the European delay statistics only identify the most penalising sector. This seems to be particularly true where there is a larger level of crossing traffic, although the results could also in-turn suggest that larger providers are better able to handle operational complexity.

4.7.2 Productivity

It seems that providers in general have a large variation in manning per sector in their working practices, with an average of 17.5 controllers per sector.

As expected, providers show varying balances between average transit time and number of flights controlled per on duty controller hour. This is based on the size of

airspace, although the analysis seems to indicate higher overall workloads in some providers. Comparing the number of hours in position based on the rostered quantity with the position time including overtime hours as well, there is a difference of less than one percent. This indicates that the calculated part of the ops time available as position time is realistic. It differs among providers between 15% and 25%, indicating that between 75% and 85% of the available time can be used in position.

The amount of overtime necessary to achieve the operational results varies from 0 to 440, with the average being at 139,5 hrs/yr. The total amount of overtime produced by 12 providers amounted to 1674 hrs per year.

4.7.3 Reliability

Only some providers use indicators to monitor technical reliability (e.g. Naviair, Finnish CAA, Luxemburg, IAA, AENA, LFV, UK NATS), while some others are making progress towards monitoring. The remaining number of providers that have not been able to contribute to this part of the study suggests significant room for improvement in this area.

It is important to recognise that technical reliability can only be assessed over a period of successive years. In that respect, a snapshot analysis cannot provide an accurate reflection of performance. It is clear, however, that a uniform set of key indicators would aid future improvement in this area. The following figure highlights such possible indicators.

Grouping	Domain	Indicator and Metrics	Data Sources
Outputs	Reliability *The technical reliability of the system to meet the demand for services*	▸ Number of unplanned service outage hours vs. planned service hours per ATSU per year	▸ Equipment monitoring logs ▸ AIP
		▸ Number of planned service outage hours vs. planned service hours per ATSU per year	▸ Equipment monitoring logs ▸ AIP
		▸ Variation of number of unplanned outage hours per year	▸ Equipment monitoring logs

FIGURE 8: POSSIBLE INDICATORS FOR TECHNICAL RELIABILITY

4.8 OUTCOMES

Outcomes have been derived for the European providers from CFMU and CRCO data; the equivalent data was not available for the other providers.

CFMU data has been used to derive:

- Average delay and reason for delay
- Availability of service
- Predictability
- Cost of delay (using IATA approved figures for cost per minute of delay

CRCO data has been used to derive the price of service

- Unit rate

Outcome results and analysis has been divided into two domains:

- Cost of service (key indicators: delay cost and actual cost charged)
- Quality of service (key indicators: delay, availability and predictability)

4.8.1 Cost of Service

There is some relationship between unit rate and unit delay cost. For many providers, the higher the unit rate, the higher the delay costs seem to be. This is interpreted as reflecting possible diseconomies of scale for some providers.

4.8.2 Quality of Service

Using 2001 CFMU data to reconstruct delay distribution for each European provider, three dimensions of the quality of service have been captured:

- The **delay** itself (average delay per delayed flight)
- The **predictability** (characterised by the standard deviation of the distribution which gives a confidence level that, should a delay occur, it will be in a certain set of bounds)
- The **availability** of the service (characterised by the proportion of flights delayed below a certain threshold or target level of delay).

Combining these three dimensions identified patterns of performance in terms of quality of service for European providers only (as comparable data were not available for non-European providers):

- Results for availability are relatively uniform across providers, with average availability of 94%.
- Results for delays and predictability follow a similar pattern, which was to be expected, with providers showing the lesser delay per delayed flight being the most predictable and visa versa.
- Surprisingly, providers in the core area tend to fair better on predictability and delay per delayed flight than providers in the periphery, with an exception for one.

- However, in terms of percentage of delayed flights themselves, providers on the European periphery show an acceptable level of less than 1% delay, but this result deteriorates as one moves towards providers in the core area.

Analysis of the actual causes of delay as declared in the CFMU data reveals that ATC capacity accounts for the most delay events by far. Other delay events are, aerodrome capacity, weather, ATC equipment and ATC staffing. Although these are relatively insignificant compared to ATC capacity, they demonstrate some major variations across providers as to the possible focus areas.

4.9 EXTERNAL FACTORS

External factors have been split into two categories: Operational Factors and Institutional Factors. With the intention of analysing the impact of the external environment and assessing whether the internal processes used are appropriately aligned, descriptive analysis has been used to allocate each provider into a general category for the operational and institutional environment within which it functions. These categories must be viewed as a first iteration and may be subject some reallocation based of subsequent discussion amongst the providers. The overall aim of this analysis is to determine overall trends as opposed to the relative positioning of one provider against another.

4.9.1 Operational Environment

Providers have been grouped in five categories for the operational environment, to take into account the properties of traffic and airspace in various dimensions. These dimensions include qualitative as well as quantitative factors. Since these factors are all interrelated and influence each other, there is no method known to mathematically compute an operational complexity factor and the grouping is based on the Study Team's relevant experience and analysis with respect to:

- Traffic volume (its composition, dominating profiles, the distribution, and density), as well as airspace volume (its shape, structure, and the neighbouring airspace).
- Additionally, the geographical situation of the provider with regards to its location on the globe as well as its position with regards to traffic streams and orientation was considered.

The resulting five categories are as follow:

Category	Criteria 1: Airspace size and volume of traffic	Criteria 2: Distribution of traffic	Criteria 3: Traffic profile	Criteria 4: Airports and TMA profile	Criteria 5: Coordination requirements
Oceanic and low to medium volume of traffic	• Large area of responsibility • Low Volume of Traffic per Square KM	• Homogenous distribution of traffic over the whole area	• Traffic mostly overflights • Small percentage of climbing and descending traffic	• No major hubs in the area of responsibility	• Benigm Coordination environment (Ample Flying Time, well defined procedures)
Medium to high complexity and medium volume of Traffic	• Medium Volume of Traffic per Square KM	• Homogenous distribution of traffic over the whole area with some choke points	• Uniform flight profiles in the area • High percentage of overflights	• Only few major hubs in the area • Few TMAs to be served	• Coordination volume with neighbours higher than within area of responsibility
Medium to high complexity and high volume of traffic	• High Volume of Traffic per Square KM	• Traffic follows one or more main axis • Choke points spaced sufficiently apart	• Uniform flight profiles in the area • High percentage of overflights	• Several TMAs with more than one busy airport to be served	• High Coordination volume inside the area of responsibility and with neighbours
High compexity and combination of high volume of traffic in parts with low volume in other parts of the area	• Large area of responsibility • Combination of High Density and remote areas	• Traffic mainly concentrates on few areas • Technical challenge to serve remote areas	• Traffic mix with high percentage of climbing and descending traffic • Remote areas with mostly overflights	• Several TMAs with more than one busy airport to be served • Major hubs in the area	• Higher Coordination volume inside the area of responsibility than with neighbours
High compexity and high volume of traffic throughout	• High Volume of Traffic per Square KM • Military Airspace influences Routing of Traffic	• Traffic follows more than one main axis • Interdependency of Choke points	• Traffic mix with high percentage of climbing and descending traffic • Military Traffic is a factor	• Several TMAs with more than one busy airport to be served • At least one major hub in the area	• High Coordination volume inside the area of responsibility and with neighbours

FIGURE 9: OPERATIONAL ENVIRONMENT CATEGORIES

Providers have thus been allocated to one of these categories:

Category 1*	Category 2	Category 3	Category 4	Category 5
Airways New Zealand NATAM Nav -Portugal	Austrocontrol Belgocontrol FCAA IAA LFV Naviair NVNL	AENA ENAV Maastricht UAC	AsA FAA Nav Canada	DFS DNA NATS Skyguide

** With TMA operations only, Luxembourg Airport Authority belongs in a special group before Category 1*

Note 1: These groupings represent the Study Team's first attempt to group Providers according to the Operational Environment. In doing so, it must be remembered that the leading factor in developing these groupings has been the 'influence the Operational Environment may have on the administrative complexity at a Provider level, i.e., the possible requirement for more developed, sophisticated or flexible Internal Processes'. The operational complexity groupings do not therefore represent a measure of the actual complexity of the airspace itself, more a measure of the complexity of administering air navigation services within that airspace from a business perspective. The categories defined are therefore not comparable with the Eurocontrol classifications.

Note2: Further iteration of this exercise or use of this information should also take the following operational characteristics into consideration for any revised grouping:
Norway: NATAM provides services at 51 airports, which is higher than most other European Providers
Belgium & Netherlands: Airspace is of high complexity with a high traffic density and includes a high percentage of climbing and descending traffic
Maastricht: Airspace represents some of the most complex in Europe, with 7 major hubs in close proximity
USA: The FAA's area of responsibility encompasses oceanic areas over the Atlantic and the Pacific Oceans, remote areas with very little density, some with a difficult geographical environment (Alaska), areas with a very high traffic density as in the areas along the Eastern seaboard. The FAA also operates, in terms of traffic, the world largest en route centre (Cleveland, Ohio).

FIGURE 10: ALLOCATION OF PROVIDERS TO OPERATIONAL ENVIRONMENT CATEGORIES

A more detailed description of each category is given below

Category 1:

Relation of Airspace and Traffic	Distribution of Traffic	Traffic Profiles	Airports and TMA profiles	Coordination Requirements
Large area of responsibility Low Volume of Traffic per Square KM	Homogenous distribution of traffic over the whole area	Traffic mostly overflights Small percentage of climbing and descending traffic	No major hubs in the area of responsibility	Benigm Coordination environment (Ample Flying Time, well defined procedures)
Area > 2.000.000		Former complexity **Medium** or **Low**	1 Hub only	This does not preclude high coordination efforts with neighbours in other ICAO regions
Traffic < 750.000				
Density < 2				

Category 2:

Relation of Airspace and Traffic	Distribution of Traffic	Traffic Profiles	Airports and TMA profiles	Coordination Requirements
Medium Volume of Traffic per Square KM	Homogenous distribution of traffic over the whole area with some choke points	Uniform flight profiles in the area High percentage of overflights	Only few major hubs in the area Few TMAs to be served	Coordination volume with neighbours higher than within area of responsibility
Traffic < 1.000.000		A higher percentage of climbs and descends are acceptable, when traffic orientation is not complicated	1 major hub Less than 3 major TMA	This means that a good part of the traffic climbs / descends through the area
Density < 10				

Category 3:

Relation of Airspace and Traffic	Distribution of Traffic	Traffic Profiles	Airports and TMA profiles	Coordination Requirements
High Volume of Traffic per Square KM	Traffic follows one or more main axis Choke points spaced sufficiently apart	Uniform flight profiles in the area High percentage of overflights	Several TMAs with more than one busy airport to be served	High Coordination volume inside the area of responsibility and with neighbours
Traffic > 1.000.000	Domestic trunk routes do not coincide with international trunks	Former complexity varies between Medium and High, with High dominating	TMAs not necessarily in own area provided they are fed through it (Example Maastricht)	
Density < 5				

Category 4:

Relation of Airspace and Traffic	Distribution of Traffic	Traffic Profiles	Airports and TMA profiles	Coordination Requirements
High Volume of Traffic per Square KM Military Airspace influences Routing of Traffic	Traffic follows more than one main axis Interdependency of Choke points	Traffic mix with high percentage of climbing and descending traffic Military Traffic is a factor	Several TMAs with more than one busy airport to be served At least one major hub in the area	High Coordination volume inside the area of responsibility and with neighbours
Traffic > 3.5 Million Average Density < 1	Great variance in density	Military traffic proceeds on Altitude Reservations		
Segregation of civil military requires route harmonisation to provide room for both, which is supported by airspace available				

Category 5

Relation of Airspace and Traffic	Distribution of Traffic	Traffic Profiles	Airports and TMA profiles	Coordination Requirements
Large area of responsibility Combination of High Density and remote areas	Traffic mainly concentrates on few areas Technical challenge to serve remote areas	Traffic mix with high percentage of climbing and descending traffic Remote areas with mostly overflights	Several TMAs with more than one busy airport to be served Major hubs in the area	Higher Coordination volume inside the area of responsibility than with neighbours
High Density (Switzerland highest in Europe)	high degree of variation between centres of one provider (Germany between 3.6 and 17.5)		Greater London area with 5 airports	Caused by a great number of airports including major hubs, or due to short transit time (Switzerland)
Traffic between 1 and 2.5 million				

4.9.2 Institutional Environment

The organisational and legal status of the providers has also been classified into categories reflecting five broad institutional models, as described in the figure here below.

Model	Ownership	Governance structure	Authorisation/ mandate	Financial provisions	Audit/regulation
(1) Government Department	State	• Direct political control • Director General reporting to minister • Civil service structure	• (Constitution) • Parliamentary laws • Civil aviation regulations • Air navigation orders • AIP	• Inside State general budget provisions • Annual budgeting	• External audit by government auditor • Regulations set internally
(2) Government Agency or Authority	State	• Independent • Board of directors • Director General • Reports to Government Department • Civil service structure	As (1) plus: • Act of establishment	• Inside State general budget provisions • Annual budgeting	• External audit by government auditor • Regulations set internally
(3) State Enterprise	State	• Independent • Board of directors • CEO • Reports to Government Department • Civil service structure	As (2) plus: • Articles of association • Laws governing State Enterprises	• Inside State general budget provisions Financial accounting • P&L account • Balance sheet • Generates annual return	• External audit by government auditor • Financial audit by independent auditor • Regulations set internally
(4) Corporatised Entity	State as shareholder	• Shareholders • Supervisory board • Management board • CEO • Company/business structure	As (2) plus: • Articles of association • Laws governing State Companies	• Mainly independent of State • Financial accounting • P&L,Balance sheet • May generate dividends • Subject to company tax	• Financial audit by independent auditor • Regulations set externally • Compliance checked by external regulator
(5) (Part) Private Entity	General shareholders (can be a mixture of State and private or non-share capital company)	• Share (stake) holders • Supervisory board • Management board • CEO • Company/business structure	As (2) plus: • Articles of association • Laws governing Private Companies	• Independent of State • Financial accounting • P&L account • Balance sheet • Generates dividends • Subject to company tax	• External audit by government auditor • Regulations set internally

FIGURE 11: INSTITUTIONAL ENVIRONMENT CATEGORIES

Once again the providers are allocated to each category, using the data available and the experience and knowledge of the Study Team. These categories are shown in the following diagram:

Government Department	Government Agency	State Enterprise	Corporatised Entity	(Part) Private Entity
DNA LAA	FAA LFV MUAC (closest fit) NATAM	AsA • (shows some attributes of corporatised entity) NAV-Portugal NAVIAIR FCAA	Airways NZ AENA Austrocontrol Belgocontrol DFS ENAV IAA • (shows some attributes of state enterprise) LVNL Skyguide (very small private holding)	NATS Nav Canada

Note: As of 1st January 2003, NATAM transferred to a limited company named Avinor, with all shares owned by the Government. It should therefore be classed as a State Enterprise

FIGURE 12: ALLOCATION OF PROVIDERS TO THE INSTITUTIONAL ENVIRONMENT CATEGORIES

5 IDENTIFICATION OF BEST PRACTICES

Two levels of best practices have been identified:

1) At the industry level, the framework has also led to the definition of five high level best practices, which capture the key themes that should drive improvements in ATM service provision in the foreseeable future.
2) At a provider level, the Study framework has allowed detailed identification of best practices for each key indicator in the internal process domains (more than 50 in total).

5.1 HIGH LEVEL BEST PRACTICES

Based on our bottom-up assessment of best practices, **five high–level best practices** have emerged as being representative of key improvement opportunities under the principal objectives of the Single Sky initiative. The implementation of these best practices should lead to tangible improvements in the short and medium term. These best practices are described in the following table:

BEST PRACTICE AREA	BEST PRACTICE ATTRIBUTES
Safety Management	Safety management process should allow for maximum accountability, transparency and awareness at all levels of the organisation, while continuously assessing the corporate performance and culture to further determine whether risk is being reduced to a level as low as reasonably practicable.
Customer Involvement	Highest degree of customer involvement, in the service delivery requirements definition and in the strategic and tactical decision-making process; customers are an integral part of the feedback loop as regards a provider's performance (quality and cost of service provided). A customer-oriented culture is pervasive throughout the organisation. Customers include all users as well as key external stakeholders (airports, local communities, military, etc.)
Scope of Service, Service Definition and Delivery	Very clear and well-articulated mission, values and objectives communicated and shared throughout the organisation; transparent organisational and financial structure (including accounting process for cost and resources allocation), embedded organisational flexibility and systematic process to unbundle or outsource services as appropriate. Implementation of an accredited quality management process throughout the organisation. Market testing with a view to unbundling of services which do not naturally lend themselves to monopoly provision.
Tactical Flexibility[3]	Flexibility to open and close sectors supplemented by the ability to change the configuration of active sectors in adding more working positions in order to react to changes in traffic demand without fragmenting the airspace further.

[3] *Tactical Flexibility stands for the ability of an ANS provider and his units to react in real – time, or near real – time, to changing traffic conditions in term of demand, volume, orientation and composition. This capability is mainly reflected for the purposes of this study in the ability to change sector configurations, reallocating resources, and using conceptual tools in ATFM, as well as the cooperation with military aviation*

BEST PRACTICE AREA	BEST PRACTICE ATTRIBUTES
	Flexible rostering combining team and individual-based rostering frequently reviewed. Tasking of individuals as stand-by readiness in the case of non-availability of rostered staff, providing the flexibility for supervisors to man working positions with appropriately rated staff. Flexible manning of rostered staff to adapt a sector to changing traffic conditions, in support of the operational concept. Maximum situational awareness in the cockpit made possible by the use of English as the only language in ATC for IFR flights and on international airports.
Integrated Strategic Management	Full integration of all functional areas (business planning, HR management, Operations Planning and Infrastructure Planning) into a comprehensive Strategic Management Process; this process should be iterative and closed-loop, using a combination of top-down and bottom-up processes, with the embedded ability to monitor success against targets and standards, to identify improvement opportunities. Implementation of a high level Air Navigation Architecture[4] approach in support of such a process.

TABLE 1: HIGH-LEVEL BEST PRACTICES

5.2 DETAILED BEST PRACTICES

DOMAIN	KEY INDICATORS	BEST PRACTICE
SAFETY PROCESS	Safety Management Function	An independent office reporting directly to the head of the overall organisation, who is then accountable for safety performance The office should execute the safety policy for all safety related services
	Safety Management System	Provides audit of critical services, with defined indicators and also provides an ongoing assessment on the overall corporate performance and culture The safety culture should be monitored at each level of the organisation, with performance objectives for middle and senior managers

[4] ***Air Navigation Architecture is the visualisation of a virtual organisation containing a network of businesses collaborating in Air Navigation. It contains the infrastructure of ANS, assets of users, and interrelation with organisations sharing interests in the use of airspace, and procedures. The boundaries have to be continuously revalidated to decide over the inclusion of other transport systems and the role of customers as passengers and shippers. This architecture enables ANS to deduct and validate requirements for their infrastructure. It is a multi-faceted framework and forms a model of reality, describing the overall Air Navigation System***

DOMAIN	KEY INDICATORS	BEST PRACTICE
	Education, training and testing	Education, training and testing should be applied at relevant levels for all staff: - Every staff member should have basic awareness of the safety nature of the business and relevant issues through regular communication and workshops - Regular training should be applied to all safety related staff,: ATCOs, Assistants, Flight Data Personnel, Engineers - Regular testing should be applied to ATCOs as a minimum Future developments could include the application of ad-hoc testing
	Safety occurrence reporting process	Should allow mandatory, non punitive reporting of all safety related occurrences and should be automated wherever possible for consistent application
	Risk identification	Should be proactive as well as reactive with full transparency Regular assessments and audits should allow proactive and effective determination of risk potential risk areas; Staff and Infrastructure upgrades should have direct visibility at the board level
ORGANISATION OF SERVICES	Separation between provider and regulator	Clear separation, well-defined interfaces and comprehensive compliance checking
	Service definition (General)	Very clear and well-articulated mission, transparent organisational and financial structure and flexibility to unbundle services as appropriate
	Service definition - Clarity of mission	Statement of objectives and values (rather than a prescriptive mission) formulated through consultation with employees, customers and other stakeholders
	Service definition - Degree of service bundling	In the context of the Single Sky, to have in place a structure and processes that facilitate widespread unbundling of services, both core and ancillary
	Service definition - Organisation of non-ANS services	Freedom to provide any non-ANS service with functional and accounting separation from core services
	Service definition - Transparency	Maximum organisational and financial transparency
	Service delivery - Outsourcing	For outsourcing, it is not clear whether it is better to have centrally controlled processes or freedom for individual business/operational units to have the autonomy to make their own decision However, uniform decision criteria and rules should be applied
	Service delivery – Quality Management Process	To have an accredited quality management process implemented across the whole organisation
	Service delivery – Unbundling of services	In terms of future Single Sky objectives, those organisations that are unbundling services, e.g. from ANS to ATM, could be viewed as exhibiting best practice

DOMAIN	KEY INDICATORS	BEST PRACTICE
	Civil – Military Relationship	From a civil perspective , best civil-military relationship process offers maximum flexibility in terms of airspace, infrastructure and services to the civil ANSP and end-user this implies maximising civil control of these aspects this may not be best practice from the military perspective From that perspective, complete integration is considered best practice
	Customer Relationship Management	Highest degree of customer involvement in requirements definition, decision making and feedback with an institutionalised process in place to ensure that this occurs
OPERATIONAL CONCEPT	Airspace Design - Application of ICAO Annex 11 Standards	Maximum adherence to ICAO classification with little or no national supplements to the Use of Airspace should be considered as Best Practice. But – since classification of airspaces also serves the purpose of segregating „desired" (IFR) from „undesired" (VFR and military) traffic, classification will always have to be tailored to specific situations in a given environment (congested areas on the ground and in the air, prevailing weather conditions, role of General Aviation and importance of military interests).
	Airspace Design - Criteria and Drivers	Although regional harmonisation and service requirements should constitute the majority of drivers for airspace design, conceptual options to open opportunities for concepts of operation such as Free Routing etc should be considered
	Airspace Design - Customer Involvement	The involvement of customers including all users (General Aviation, Airlines and Military Aviation) of the airspace needs to be extended to include stakeholders and partners as airports, and local communities
	Airspace/Sector Management - Sector Configuration	When increase of traffic requires a change in sector configuration, common practice is to split existing sectors. Doing so adds to the overall number of sectors and thereby increases the existing fragmentation of the airspace. This organisational flexibility (opening and closing of sectors) does not exploit technical capabilities available that would require a change in the present concepts of operations. Authority to change sector configuration rests mainly at ACC level. It should be considered, however, to find a coordinated way to configure sectors in concert with the CFMU and neighbouring centres (within and between countries). Specially the time frames available, less than 5 minutes, would support a flexible cooperation.The flexible reallocation of working positions, possible through simple manipulations in the Operations Room, would support such a concept. Such a concept could also reduce the manning requirements due to the difference between open and closed sectors in the course of a traffic day

DOMAIN	KEY INDICATORS	BEST PRACTICE
	Airspace/Sector Management - Coordinating with Military Aviation through the tools of the Flexible Use of Airspace Concept	Unused military airspace should automatically be made available for civil use. In this context the cooperation between the tasking levels of the Armed Forces and a tactical level in the ATM organisation (FMP in ACC for example) could further improve the situation.
	ATFM - Provision of Service and Conceptual Support Tools	The central ATFM service complemented on tactical levels through flow positions (FMP) in the ACC seems to be Best Practice. In addition the conceptual tools (use of conditional routes, off – load routes, circumnavigation of congested areas etc.) should be supplemented through the use of cross border civil / civil corporation, delegation of air space between centres etc
	ATFM - Customer Involvement	The involvement of customers through cooperation on a tactical level with AOC and military tasking levels and command posts was identified as best practice
	ATC Procedures - Technology used to provide Separation	Main technology used for separation is Radar. Coverage limitations, previously compensated through the application of procedural means, could in the future be bridged through use of modern technologies like ADS/B
	ATC Procedures - Separation Minima	The applied minima, 5 – 10 NM en route, 3 NM in TMA, and 2.5 – 3 NM on Final seem to constitute best practices
	ATC Procedures - Silent Transfer of Control	Transfers of aircraft also when crossing international boundaries, probably through the support of Data Link, with little or no lead time requirement, have become best practice
	ATC Procedures - Preparation for Emergencies	Staff training in preparation for emergency situations should be part of proficiency training and of routine testing
	ATC Procedures -Use of Languages	In the interest of flight safety all means to support situation awareness in cockpits should be used. English should be the only language used in ATC for IFR flights and on international airports.
WORKING PRACTICES	Rostering - Methodology	Flexible rostering combining individual and team-based methodology. In the light of complexity of different ratings for various sectors in an ACC, the use of software tools might be advisable. With the help of such means, the frequency of roster updates could be increased and a fair work share between operations staff be achieved, while at the same time capturing all seasonal variation requirements
	Rostering - Stand-by Crews	Reliability of Service could be increased, by rostering a stand-by team to prevent delays caused by staff shortages
	Rostering - Annual working hours	A best practice in regard to annual working hours could not be clearly identified, but is suspected to be in the region of 1650 hours per year. The amount would inevitably vary in connection with local customs and procedures
	Manning - Flexible Manning of Sector Positions	Flexible use of rostered staff to adapt a sector to changing traffic conditions seems not to be a common practice, although in other parts of the questionnaire providers identify this as a viable option. This would have to be regarded in connection with the operational concepts applied, which normally prefer the opening or closing of sectors as an easier way of adapting

DOMAIN	KEY INDICATORS	BEST PRACTICE
	Manning - Minimum Manning	To mandate a minimum manning for ATSU by local management seems to be the best practice. It should be noted, however, that supervisors need to have the option to go below under certain, well-defined, circumstances
	Licensing - Provision of Licences and Ratings	It seems to be best practice that ATC staff obtain a license for the type of service they are supposed to deliver, endorsed through a rating for that facility and sector of that facility from which they are going to deliver the service. The question of holding more than one license is important only in an environment that delivers more than one type of service from the same location i.e. Aerodrome Control Service and Approach Control Service from an ATSU on an airfield or Area Control Service and Approach Control Service from an ATSU operating in a common ACC. Due to the requirements to maintain proficiency this would in many cases be too much a burden for the individual and challenge any rostering system to the extreme. A certain amount of training required for this cross-training would also have to be considered The number of ratings, a controller can hold in one ATSU, largely depends on local conditions and traffic complexity, a general best practice to fit all can not be identified.
	OJT Training -Relation of Simulator Training versus Life Traffic Training	OJT is normally executed to train a controller in a new ATSU/Sector or to maintain proficiency after a time of absence respectively to practice new procedures. Using simulators in support of this training is best practice. It requires a simulator, tailored to the particular facility. This would normally be achieved by reconfiguring an operational sector for training purposes – operational simulator. Some ATSU have such simulators remote from Control rooms, which requires the projection of real traffic as background traffic to a different location. In order to keep the right balance between training on simulators and with life traffic, a relation of approximately 20% simulator versus 80% on actual traffic generally seems to be the best practice
	OJT Training - Proficiency Training	Best practice is to assure proficiency of operational staff through well-defined proficiency programmes with documented tests. This programme should also contain the subjects of unusual situations and aircraft emergencies. This is particularly important where the proportion of military traffic is high. Monitoring the performance of operational staff and comparing it with others in the same organisation or even with others has become more and more of an accepted practice. Since this also has an aspect of Flight Safety, it should be considered as best practice.
STRATEGIC MANAGEMENT	Business planning process	Integrated and iterative top-down and bottom-up process, fully integrated in the decision-making process and interfaced with other planning areas (capacity, technology, etc.)
	Business planning documentation	Specific documents distributed to external audience, and updated frequently
	Relationship with other parties	Strategic partnerships with suppliers are an interesting, potentially best practice, approach but its actual success and benefits will only become measurable over the long term

DOMAIN	KEY INDICATORS	BEST PRACTICE
	Sourcing strategy	To have an explicit sourcing strategy in place aimed at improving quality, delivery lead-time and total cost of ownership of supplies, both ATM-related and non ATM related
	HR Management - HR tools and processes	To have a comprehensive accredited HR quality programme, comprehensive set of tools and processes, formal HR policies and procedures
	HR Management - Integration with other business areas	Function fully integrated with the rest of the business; close involvement of business units/areas
	HR Management - Labour relationships	"Convergence" mode; union sharing management vision for the future and discussions on change do not always focus on job security
	HR Management - Career development	Strategic resource planning; fully interactive and systematic process at all levels; staff development for employability; performance management on an individual basis
	HR Management - Recruitment	Manpower planning and skills requirements definition process at both corporate and business unit level in close cooperation as best practice; recruitment performance measurement
	Operations Planning - Demand forecasting	Combination of in-house and external sources; forecasts done for most types of customers, not only commercial air transport customers, ability to assess the effectiveness of the forecast on a regular basis (monthly) and to improve the forecasting tool accordingly; resolution covers short to long term at national, centre and sector level
	Operations Planning - Capacity measurement and requirement	Use of a combination of tools (laboratory or operational simulations, use of historical data at sector and/or centre level) to measure and manage capacity requirement
	Crisis Management	Having a plan in place and responsibility fully distributed throughout the organisation Having a dedicated crisis management unit or structure The plan should include different levels of application down to the sub-system level and should also include neighbouring areas The plan should include the coordination procedures with other external parties (military, customers, airports, other ANSPs, etc.)
	Environment Planning	Formal policy on environmental protection in place with relevant manuals and procedures, systematic application and appropriate training, monitoring through internal management and compliance with aviation and environment regulators
	R&D Planning (if applicable)	To have a fully separate R&D department (maybe outsourced) and a mechanism in place to evaluate value provided to the business. R&D should focus on short-to-medium term projects with clear benefits in terms of operational performance and with the target of meeting customer requirements Success of R&D projects should be measured based on a set of well defined criteria, both on an individual project basis (based on cost, delivered performance, quality and time targets) and on a portfolio basis (contribution to the overall portfolio of projects)

DOMAIN	KEY INDICATORS	BEST PRACTICE
	Infrastructure Planning - Organisation	The interdependencies require a supportive organisational structure, which enables infrastructure planning to stay abreast of operational concepts and planning as well as of scientific visions and R&D results. The structure should foresee that the rather short term planning cycles of business and operations (less than 3 years) provide the main input for the longer term planning cycles (longer than 5 years) of infrastructure. This might be achieved more easily in a matrix organisation with clear terms of reference than in a hierarchical structureInfrastructure planning should be linked to operations and business planning, based on ANA perception, within a dedicated department, and using a comprehensive set of tools and processes to assess success (individual reviews, in-house TQM procedures, post project audit, financial and time targets, etc.)
	Infrastructure Planning - Scope	The traditional scope of planning, being CNS/ATM focussed, needs to be extended to encompass those activities, which are driven through the interdependencies of the modern aviation industry Operational aspects, initiated through capacity forecasts and change of concepts, will drive the inclusion of avionics into the infrastructure planning This inclusion might conflict with the standard organisational lay out of providers and will have to be considered very carefully The cooperation with other providers and partners in industry of a multimodal configuration require the inclusion of airline and airport operational considerations as well as those of other stakeholders, sharing the same airspace (as military) as well a bordering own airspace (other providers) The cooperation on European level is only one means to support planning and does not replace bi- or multi-lateral activities.

TABLE 2: BEST PRACTICES BY DOMAIN

6 INTERPRETATION OF RESULTS

In the context of the benchmarking study, various analyses have been performed to identify any possible relationship between the various domains or capability areas throughout the service delivery chain. A selection of analyses is presented hereafter, which have led to interesting qualitative insights as to industry-level patterns and/or variations across providers. Most results consistently support three recurring patterns of the ATM industry:

1) The significant impact of the "institutional environment" on the providers' internal processes

2) A high level of fragmentation and disparities in inputs and outputs

3) The significant impact of the "operational environment" on the providers' performance

6.1 IMPACT OF THE INSTITUTIONAL ENVIRONMENT ON INTERNAL PROCESSES

Of the domains analysed for Internal Processes, the Safety Process domain shows the strongest relationship with the external environment. This overall pattern can be seen as an indication of the overall development of safety management processes within each provider, i.e., the more complex the operational environment or the more "corporatised" the provider, the more developed its safety process is likely to be. This relationship does not, however, give any indication on the providers' actual safety performance as it is not possible to capture the correlation with performance without access to safety records of each provider.

The relationship is strongest with the Institutional Environment. This shows the benefits of a corporate culture and institutional framework that allows for maximum accountability, transparency and awareness at all levels of the organisation, and supports the high level best practice identified in this area.

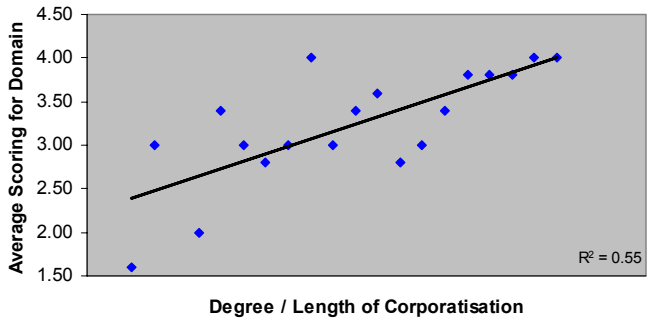


FIGURE 13: SAFETY PROCESS VS. INSTITUTIONAL ENVIRONMENT

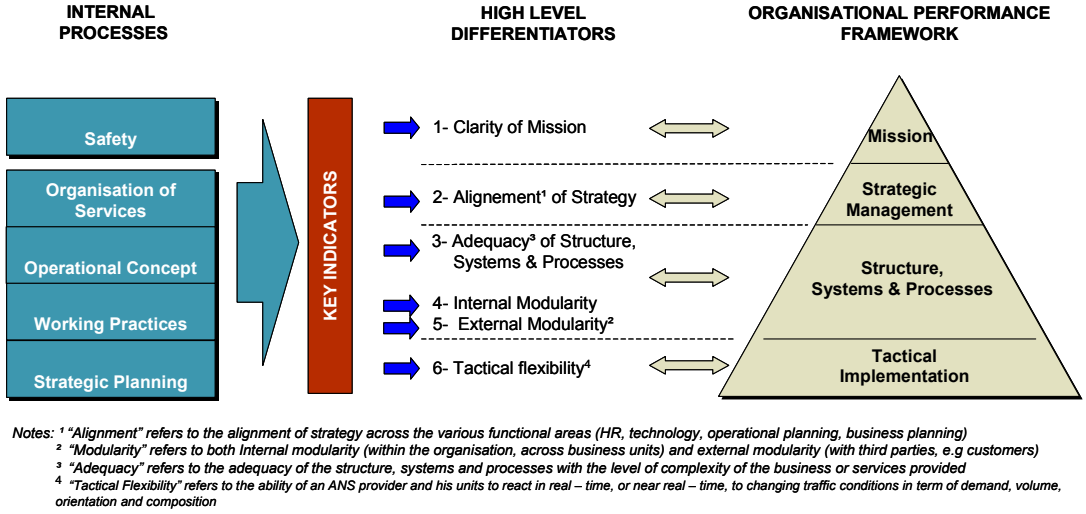
Similarly, the analysis shows weaker, but nevertheless, recognisable relationships between Organisation of Services and Strategic Management with the Institutional Environment. This is as expected as typically a change in the institutional environment will reach deep down into an organisation and influence various internal processes in different domains (service delivery, HR management, organisational interface, business planning, etc.).

The impact of the Institutional Environment was not expected to be relatable to operational processes such as the Operational Concept and Working Practices, and the results confirm this to be the case. In fact, of the internal process domains analysed, Operational Concept and Working Practices show the most variation, which is also, rather surprisingly, difficult to relate to the Operational Environment.

- Overall, the Operational Concept analysis shows room for improvement at industry level. The results show that providers may benefit from applying a more standard Operational Concept. For example, the relative inflexibility in changing sector configuration and closing or opening new sectors rather than increasing or decreasing their capacity shows that there is room for improvement. Modern technology can allow for a more flexible cooperation among controllers in the same airspace by identifying the controller working the traffic to everybody working in the same environment as well as making the control intention obvious to others.
- The fragmentation of European airspace is not only a result of the large number of different providers, given the geographical areas covered, but also of the increasing number of sectors. Operational concepts vary from centre to centre as well as provider-to-provider. A vision of a regional Air Navigation System containing all players, stakeholders, systems and procedures may merit further consideration. An architectural vision of such an environment in a modular composition would not only make the interactions within the industry transparent, and it would also allow for a more coordinated investment and infrastructure policy, not only on the level of providers but also airlines and airports alike.
- There are also many variations in Working Practices at industry level. The results show that the large differences across providers not only reflect different social environments but also indicate large variations in available manpower usage.
- Flexibility of supervisors to reduce manning, when no longer required, is generally limited to well-defined situations. It may be considered beneficial to arrange any changes in capacity in a coordinated way with adjacent units and central flow control. The variability of weather might also quickly lead to concentrations in location and times which are unpredictable on local level and the reduction to minimum levels should be a coordinated effort within a region rather than a local exercise.

In order to further understand specific patterns and results obtained for internal processes, an analysis of associated Key Indicators was rearranged along six selected **high level differentiators**, consistent with a standard organisational performance framework. These differentiators are:

- Clarity of Mission
- Alignment of Strategy across all functional areas
- Adequacy of the Structure, Systems and Processes with the level of complexity of business or service provided
- Internal Modularity (across the various units and areas of the organisation)
- External Modularity (with third parties)
- Tactical Flexibility



Notes: ¹ "Alignment" refers to the alignment of strategy across the various functional areas (HR, technology, operational planning, business planning)
² "Modularity" refers to both Internal modularity (within the organisation, across business units) and external modularity (with third parties, e.g customers)
³ "Adequacy" refers to the adequacy of the structure, systems and processes with the level of complexity of the business or services provided
⁴ "Tactical Flexibility" refers to the ability of an ANS provider and his units to react in real – time, or near real – time, to changing traffic conditions in term of demand, volume, orientation and composition

FIGURE 14: FRAMEWORK FOR KEY DIFFERENTIATORS ANALYSIS

This analysis shows there is a relationship between **Adequacy of Structure, Systems and Processes** and their **External Modularity**

- This can indicate that the more providers are open and tuned towards their outside environment, the more their structure, systems and processes are likely to be adequate to meet their customers' and other external requirements
- The results tend to show that external modularity is directly related to the way commercial practices are applied, and in particular the extent to which a provider is involving its customers into various aspects of its organisation

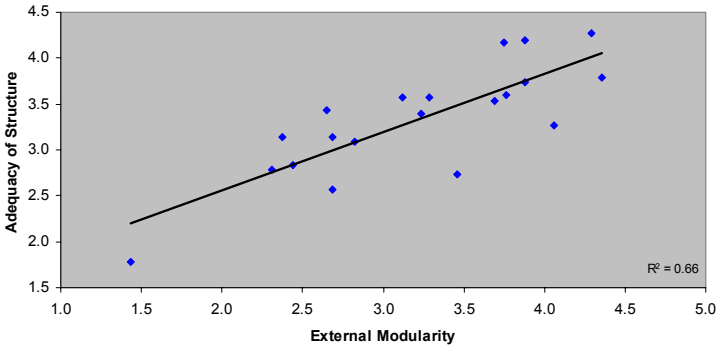


FIGURE 15: ANALYSIS OF ADEQUACY OF STRUCTURE, SYSTEMS & PROCESSES VS. EXTERNAL MODULARITY

There also seems to be a recognisable relationship between **Clarity of Mission** and **Internal Modularity**

- This tends to indicate that the clearer the provider's mission, the easier it is to organise and manage the various internal activities of the organisation
- A high rank on internal modularity can be explained by the fact that a Provider who ranks high in terms of internal modularity is expected to have gone through an in-depth review of its business/activity portfolio and to have invested in aligning the various parts of the organisation. This is apparent in organisations that have been through an extensive business process redesign. High ranking in smaller organisations may correspond to the focus of the organisation on a small set of core services.

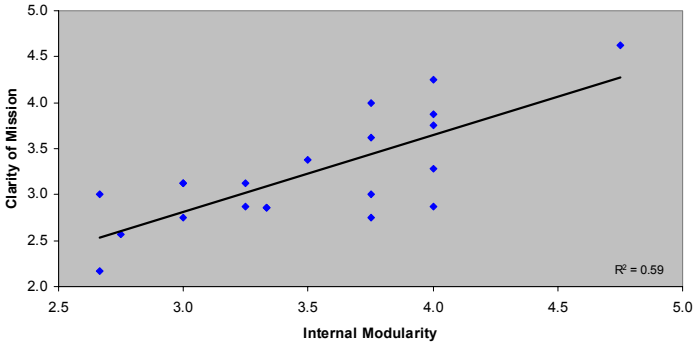


FIGURE 16: ANALYSIS OF CLARITY OF MISSION VS. INTERNAL MODULARITY

Overall this level of analysis further demonstrates how Internal Processes display a strong relationship with Institutional Environment. Providers which have been evolving in a commercially-driven / customer-focused institutional environment tend to display better internal processes, particularly in terms of:

- **Alignment** of their strategy across the various functional areas of the organisation (business planning, infrastructure planning, operations, HR management, etc.)

- **Adequacy** of their structure, systems and processes with the level of complexity of their business and services
- **External modularity** with third parties, in particular customers

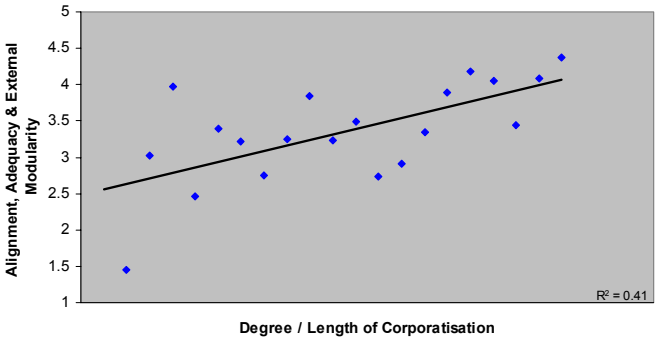


FIGURE 17: INTERNAL PROCESSES VS. INSTITUTIONAL ENVIRONMENT

However, results for **Tactical Flexibility** are very different from the results across the other key differentiators: for a majority of providers, there seems to be a disconnect between the providers' tactical flexibility in operations (or operational set up) and their organisational and managerial set up. In other words, those providers which have the most complete or sophisticated organisational and strategic management processes do not necessarily have the operational flexibility that providers such as the FAA tend to have. This shows that while it is important to have adequate organisational structure, systems and processes in place to cope with the **long-term, strategic requirements** of the service provision, it can lead to some disconnect with actual operational requirements and it can create some rigidities as far as **short-term, tactical flexibility** is concerned. This is once again very much in line with the finding of disparity in the Operational Concept and Working Practices domains.

6.2 DISPARITIES ACROSS INPUTS AND OUTPUTS

ATCO productivity can be approached from either an Input perspective (number of ATCOs per flights handled) or an Output perspective (hours in position). Either way, the analysis highlights significant differences in productivity, with apparently two different scale curves for smaller and larger providers.

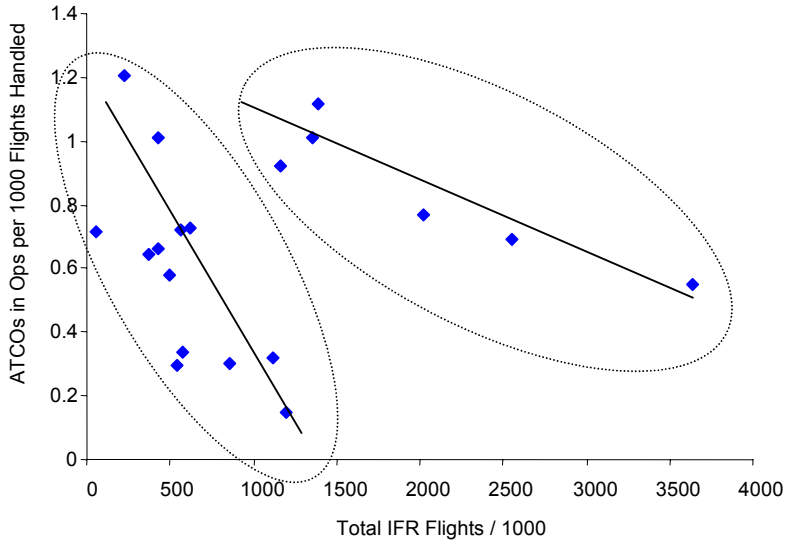


FIGURE 18: NUMBER ATCOS IN OPS VS. TOTAL IFR FLIGHTS

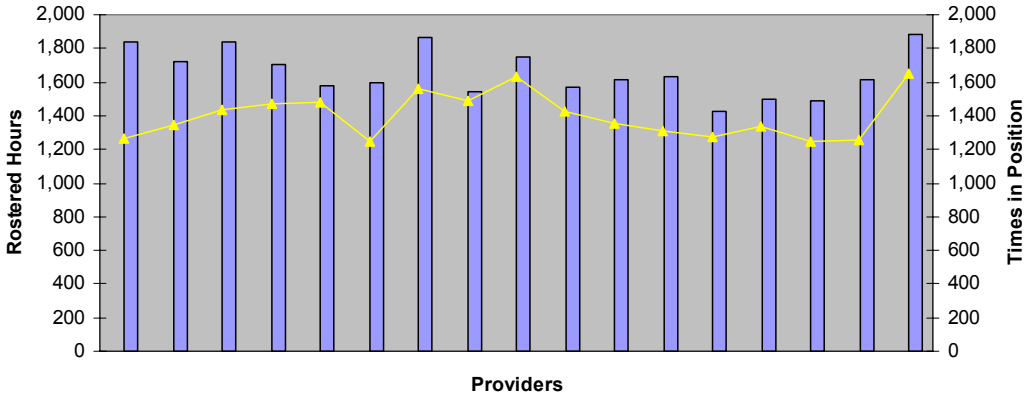


FIGURE 19: HOURS IN POSITION VS. ROSTERED HOURS [5]

ATCO unit costs, when weighted with comparative price level indices, show significant differences across providers (up to a factor of 5), without any clear relationship with the country's cost of living. Rather, this result has to be seen as indicating the large variation in controllers' professional and social status in each provider's country. This result therefore invalidates the notion that ATCO unit costs are related to the provider's country cost of living and could impede significantly the mobility of controllers from one provider to another in the future.

[5] *Hours in position constitute the genuine productivity and although these figures are logged, they are not yet readily available. The figure uses calculations and approximations since complete data sets were not available for evaluation. The entries assume a 30 minute briefing time and a 6 minute handover of position*

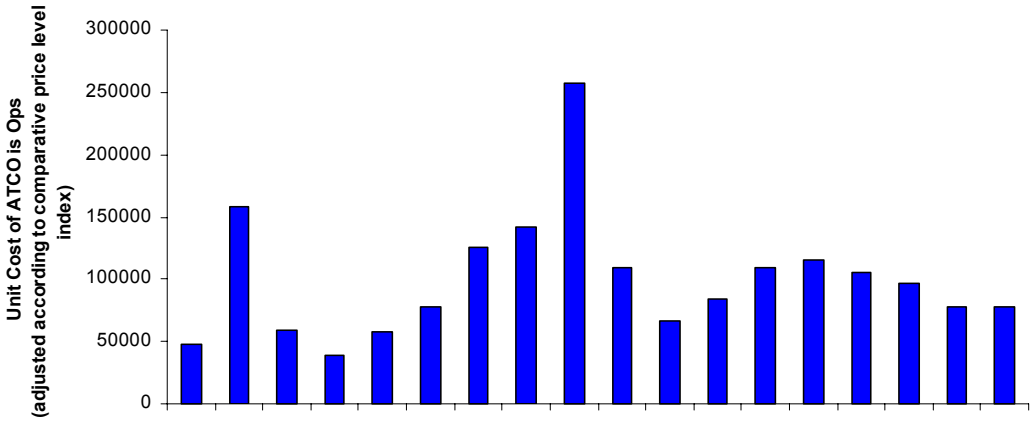


FIGURE 20: ATCO UNIT COSTS

The evaluation of applied technology shows a uniformly high degree of application of state-of-the-art technology. Here Eurocontrol's harmonisation effort through the EATCHIP and EATMP programmes shows notable benefit. The progress of automation in the flight plan processing domain, the centralised IFPS, and the links to ATFM through the CFMU allow an economical use of the airspace available. The highly developed surveillance systems with multiple radar coverage allow accurate positioning of aircraft and processing of this information for ATM purposes. Some differences do become apparent, in the processing of the acquired information further downstream, when it comes to linking flight plan to position information, SSR – Code Management, track projection, and distribution of a rectified picture of the traffic situation.

In terms of linkages between technology and performance, the technical environment does not seem to have any adverse affects on the delay situation. Generally speaking, European providers have a very modern technical infrastructure (although not as advanced as some non-European providers) capable of coping with the level of traffic. As the LCIPs show, more improvements, not only in the field of tools, are on the way. It is surprising to see, however, that the treatment of weather information is not given the importance its influence on the delay situation would justify. There seem to be gaps in the treatment of weather data processing and sharing. Only three European providers share this data on a wider scale while for overseas providers, giving weather a high importance, seems to be the norm.

Another area where improvement might support ATM development is the sharing of airspace data. In civil-military cooperation, the availability of military airspace is only useful when a sufficient timeframe to plan and route traffic can be used. Although the lead-time for using available airspace might be too short for a providers own traffic, traffic still under control of upstream centres could benefit from such development, if these units had the relevant data in time. Whereas the civil-military cooperation seems to work well on a tactical basis, longer term arrangements have yet to match the same level of cooperation. The sharing of airspace data could overcome some of the inconvenience caused by the lack of pre-

tactical civil/military coordination on a larger scale and a longer time horizon. In effect, only few providers use active modes on coordination.

6.3 IMPACT OF THE OPERATIONAL ENVIRONMENT ON PERFORMANCE

Based on the delay cost data collected from CFMU for the European providers in 2001, a strong relationship between delay costs and operational environment can be identified. This confirms the impact of the operational environment on providers' performance. However, it also shows that in order to understand the real drivers of delay costs and to quantify their impact, one needs to go beyond the operational environment considerations and understand the real linkages across the service delivery chain that drive delays and their associated costs for the customers. Such analysis could be the purpose of a future dedicated benchmarking study at industry level that would investigate delay costs at a more detailed level that the scope of this Study allowed.

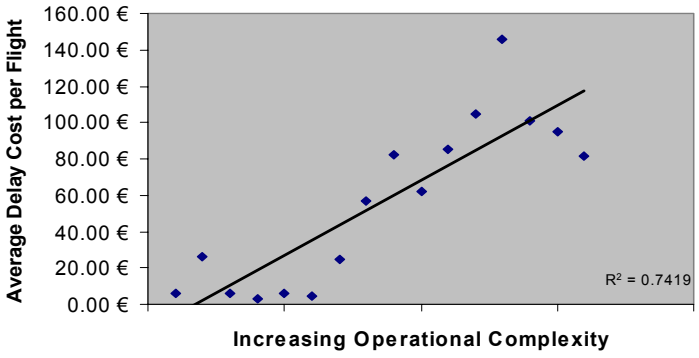


FIGURE 21: DELAY COSTS VS. OPERATIONAL ENVIRONMENT (EUROPEAN PROVIDERS)[6]

6.4 RELATIONSHIP BETWEEN PRACTICES AND PERFORMANCE

One of the key aims of the study has been to determine whether there are any clear relationships between internal processes and current performance, both in terms of outputs (from the provider's point of view) and outcomes (from the customer' s point of view).

The hypothesis was that this relationship might be difficult to find considering that most providers have only recently started to improve their practices and therefore it is probably too early to see the impact of such "better" practices on performance. Furthermore, the fragmented nature of the industry still allows providers to operate

6 *Delay costs are based on industry standard figures of 50 Euro per minute of delay incurred*

to a large extent as "black boxes", which means there are many ways to "offset" process inefficiencies in such a way that their effect on the performance itself is attenuated.

Another hypothesis was that the non-investigative nature as well as the scope and timeframe of the benchmarking exercise would bring some limitations in terms of establishing the relationship between internal practices and performance. The non-investigative nature meant that the Study Team would only be able to get information on "what providers did" rather than on "how well they did it". In other words, the providers' answers are taken at face value. The scope of the study meant that the analysis would have to stay at the ANSP level and therefore not necessarily focus on a level of detail that could generate significant insights into the key drivers of performance. Previous benchmarking experience in the air traffic industry has shown that, in many cases, the only way to really understand such "drivers" is to perform detailed analysis at the service and centre level.

These hypotheses have all been validated in the course of the project.

6.5 FRAMEWORK FOR LINKAGE ANALYSES

Understanding to which extent (i.e. quantitatively) the various outputs and outcomes are driven by specific endogenous or exogenous factors requires a level of depth and of investigation that goes far beyond the scope of this Study. However, the Study's approach can help drive such effort in the future, by offering a framework to map out the various linkages that exist throughout the service delivery chain and that are understood, qualitatively, to impact the various outputs and outcomes of the service.

The following charts display such a framework for the analysis of delay, technical reliability and staff productivity results, but the same framework can also be used for all the other measures of performance, such as cost of service and predictability or capacity.

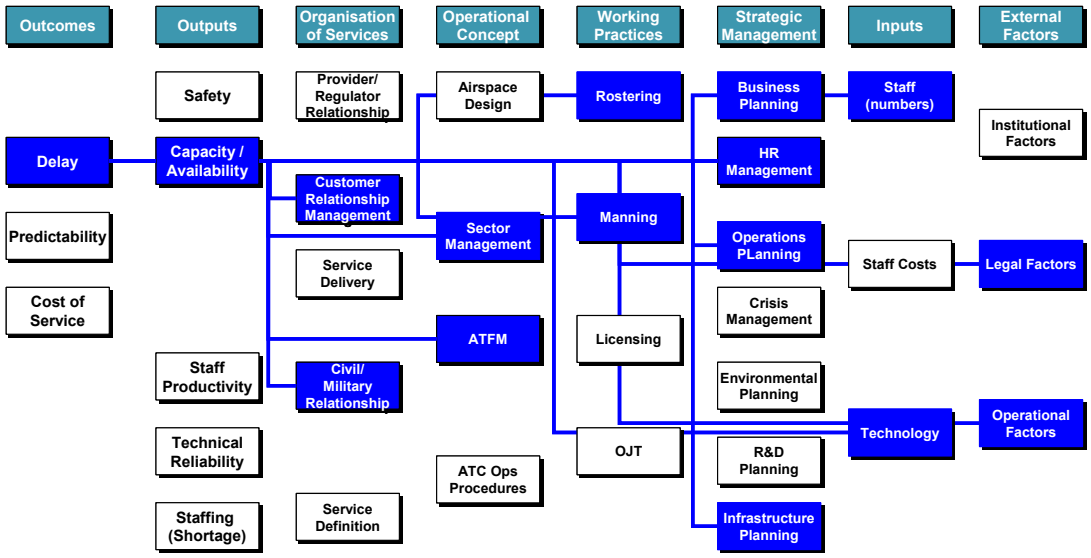


FIGURE 22: FRAMEWORK FOR DELAY LINKAGE ANALYSIS

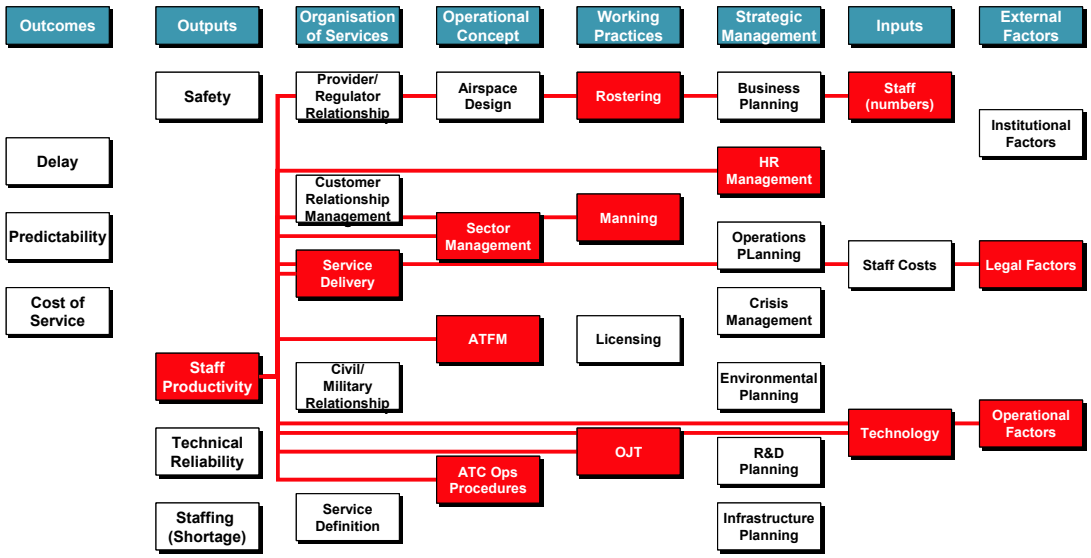


FIGURE 23: FRAMEWORK FOR STAFF PRODUCTIVITY LINKAGE ANALYSIS

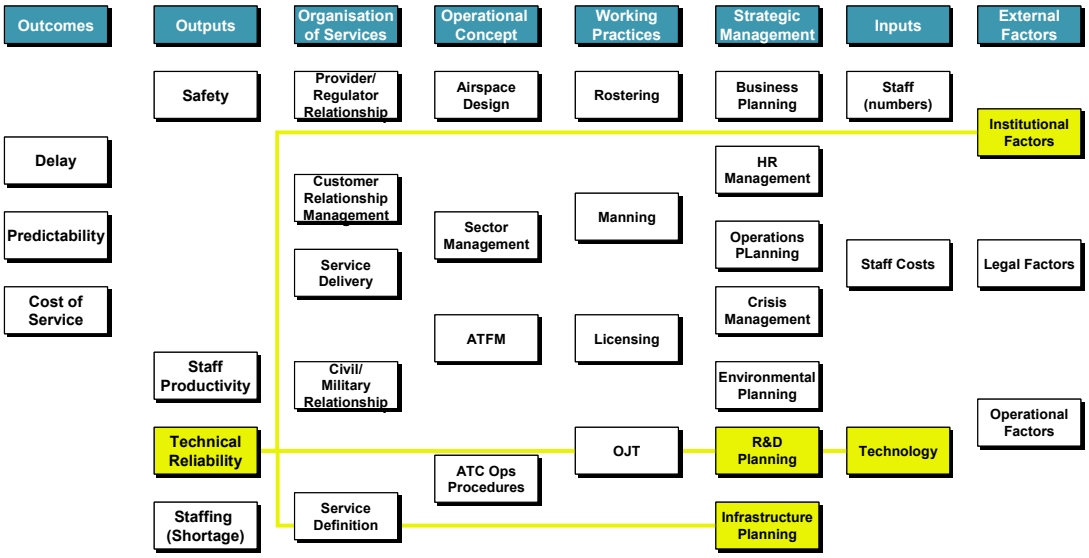


FIGURE 24: FRAMEWORK FOR TECHNICAL RELIABILITY LINKAGE ANALYSIS

7 INSTITUTIONALISATION OF THE BENCHMARKING PROCESS:

The objective of this section is to draw conclusions from this Study as to the opportunity for institutionalising the benchmarking process in a way that will support the achievement of selected targets and monitoring the improvement in practices and performance.

In doing so, the following provides answer to three main questions:

1) Is benchmarking the appropriate tool to improve processes in ATM, both at the regulatory and service provision level?
2) What are the criteria, conditions and process to be followed for a successful use of a benchmarking tool in the ATM environment?
3) How can such a benchmarking process be institutionalised, meaning how can it be translated into a structured process, which is fully accepted by the ATM community?

7.1 RATIONALE FOR AN INSTITUTIONALISED BENCHMARKING PROCESS

In answer to the first question, it is clear that benchmarking provides an appropriate mechanism towards the systematic improvement of processes and performance in ATM, at least as long as providers are in monopoly situations and the market remains highly regulated. In the absence of objective and fully transparent measures of performance, there is no better opportunity to understand the key performance drivers than comparing providers across a wide array of domains that play a role in the service delivery.

7.2 CRITERIA AND CONDITIONS FOR SUCCESS

In answer to the second question, three critical conditions must be met for the benchmarking process to be successful in its future application:

i. Providers need to take "ownership" of the process
ii. The ATM community needs to agree on a set of standards and best practices
iii. Benchmarking has to be implemented at a lower level than the provider level, in order to lead to actionable results. Lower level means at least service level, and ideally service level within a given operational unit (i.e. ACC/APP/TWR level).

The "ownership" issue is the most important one. All previous benchmarking exercises have to some extent been imposed onto the providers. In return, they have responded in a very administrative fashion, as a way to "comply" with a request rather than an opportunity to truly drive internal improvements.

The feedback indicates that the majority of providers contributing to this Study clearly agree with the objective of making the framework a valuable tool for themselves, but a few have still participated somewhat reluctantly to the Study. This is unfortunate as the quality of the outputs of a benchmarking study is to a large extent driven by the quality of the inputs across the participants.

In terms of agreeing on a set of standards and practices, this is a task that will take time but one that is necessary in order to develop more efficient and effective (both in terms of quality and cost) ATM services in Europe and worldwide. For that purpose, the ATM community needs to designate an international coordinating body to drive such standardisation. It is therefore recommended that such a body have the following characteristics:

- Representative of all providers worldwide
- Not commercially driven
- Working in close cooperation with all stakeholders (Regulators, users, trade unions, etc.)
- Dedicated to improving the air navigation service provision worldwide in terms of safety, efficiency and economic viability
- Being a recognised forum for all providers to contribute to and agree upon industry-wide standards and practices

The final condition to be met is to perform the benchmarking at the appropriate level of detail. This Study was performed at the Provider Level only and the limitation of this was clearly understood when establishment of the linkages across inputs, outputs, internal processes and external factors was attempted. Because these linkages are extremely complex, the only way to really capture the whole chain of causes and effects is to narrow down the scope of the "object of reference" of the benchmarking and perform an in depth analysis. In other words, to understand for example the drivers of staff productivity, one needs to take a "sample" of all the processes involved as well as the underlying inputs and external factors, and then analyse the mechanisms of causes and effects within that sample to be able to first draw hypotheses then to validate them on a larger scale.

The combination of these three requirements (ownership, agreed standards and level of detail) leads to the conclusion that two benchmarking processes should co-exist:

- The first one, which to at large extent is already in place, is a relatively general benchmarking framework aimed at taking a snapshot of all the key elements of the providers' performance and practices: this consists of the Information Disclosure Framework that has been developed by Eurocontrol, which should now be complemented with the benchmarking framework that has been developed for this specific study. The combination of the two frameworks should allow an appropriate regulatory body to have a clear picture, taken

annually, of the current practices and performance. It is recognised that some more work needs to be undertaken to fully integrate the two frameworks, but a large part of the work is already done as a direct result of this study.

- The second benchmarking process should include some specific, one-off analysis into a given domain or dimension, with the participation of a few providers only (2, 3 or 4 maximum), in order to get the analysis and insights down to the necessary detail and depth. The problem with this type of benchmarking is that it is much more difficult to institutionalise because each has element has to be customised for the application. Besides, the overall value from such select analysis can only be driven by the willingness of individual providers to take the commitment to perform such exercise. In this respect, it would be difficult for an outside organisation, even with regulatory authority, to enforce such process. However, the current project undertaken by PRU with the FAA and comparing specific centres fits into this category, which shows such initiatives are possible.

Overall, the Study Team believes that the institutionalisation of the benchmarking process will only be successful if providers take ownership and integrate the procedure into their portfolio of management and decision-making tools.

7.3 ATTRIBUTES OF AN INSTITUTIONALISED BENCHMARKING PROCESS

An institutionalised benchmarking process should have at least three core attributes:

i. Standard requirements for data and information disclosure
ii. Agreed definitions, standards and targets against which to analyse the data and evaluate the various improvement and performance levels
iii. A framework that captures the levers and identifies ways available to the providers to make improvements in the various areas where such improvements are expected

7.3.1 Requirements for Data and Information Disclosure

The data requirements should support directly the Key Indicators identified and validated in the course of the study (please refer to list of Key Indicators in Section 8 for further details, including the cluster charts as detailed in Appendix 1). The study has validated that the domains of analysis identified provide a robust, structured framework, which allows representative analysis of the industry. It should therefore be used as the basis for any future exercise. Sub-domains for inputs, outputs and outcomes should incorporate some dimensions covered by the PRU activities. In particular, it is important to add cost effectiveness to the outputs' sub-domains.

The frequency of the data collection should be annual for the data. This seems to be the right frequency because it allows reflection of material changes in the way the provider has been managing its business, gives enough time to implement some structural improvements and avoids any seasonal bias.

7.3.2 Agreed Standards and Targets:

It is also very important that the data requirements be agreed and set internationally, in such a way that providers can put into place their own process to track the data internally on a systematic basis and then make them readily available.

One important pre-requisite to the standardisation is the harmonisation of definitions across providers. A lot of effort has already been put in that direction, both by Eurocontrol and CANSO, but more needs to be done and an international terminology should be agreed upon at the earliest opportunity. For that purpose, there is a need for an independent international body to position itself as the repository and ultimately the driver of such common body of definitions.

7.3.3 Progress Monitoring and Improvement Framework

Once the data requirements and the data collection process are set, the key issue is to track and monitor progress against benchmarks or targets. This can be achieved by integrating benchmarking as a fully-fledged management support tool by the provider and as a legislative instrument by the Commission. In that respect, it is critical that the benchmarking process be understood and used by providers and by the Commission as a continuous process. The continuity is critical in order to build process maturity and organisational learning.

The benchmarking process should also allow for enough time to communicate after data collection. Data collection is often seen as a one-way process by the providers, and they have so far felt disconnected from the interpretation and analysis of data. That is why providers are and will always remain eager to understand how the data will be used and why.

In fact, one of the main aims of the ongoing benchmarking process framework is to ensure buy-in from relevant stakeholder groups and, in that respect, transparency is a key part to the success of such framework. Participants to any future benchmarking process need to see the returns from the exercise in terms of identifiable impacts and a clear prioritisation for strategic focus.

Therefore, the body responsible for undertaking the systematic analysis of the data provided needs to have credible evidence for the identification of improvement opportunities to make up for seen shortfalls in performance. The transparency element will lead to ownership of the improvement opportunities, where service providers will not only see the variances in performance amongst participants, but will also be able to identify reasons for such variations (in terms of shortcomings in linked internal processes) for themselves. The qualitative cluster charts, which will compare and contrast the internal process capabilities across the providers will hence provide a key tool in this framework.

However, these cluster charts are not enough to drive improvement. What is required is to have for each key indicator or target practice a clear road map describing how a provider can improve on a given dimension. This means that at least the levers of improvement will have to be identified and ideally an

improvement methodology should also be made available to the providers. This, however, can only be done once the linkages across the various domains are understood and validated, which is not the case yet.

The next step for the Commission should be to launch some specific initiatives around key performance and practice areas with the goal of identifying the levers that would help a provider to improve its performance or practice in the relevant areas. For example, as an illustration, if shift patterns (duration, starting times, etc.) are identified as a key lever to improve controller's productivity, then options as to how to modify a shift pattern should be proposed to the providers and a road map to achieve such modification should be proposed. This however can only be done once the link between shift pattern and ATCO productivity is clearly established and validated.

Clearly, the institutionalisation of the benchmarking process will only be successful if it adds value to all stakeholders:

- To the providers by helping them improve their practices and performance and monitor their progress against relevant standards and realistic targets
- To the regulatory authority by giving them an instrument to support both the permanent exercise of performance review and economic regulation through the definition of representative indicators
- To the customers, by ensuring that everything is done to deliver an increasingly safer and more efficient service and that the resultant impact is duly considered
- To the employees, by giving them the opportunity to learn and to develop new skills, while highlighting current shortcomings

As such, this current study is to be seen as the beginning of a new process through which providers, regulators and other stakeholders will be able to refine their understanding of the current industry practices and performances, while being able make the necessary systematic improvements.

The institutionalised benchmarking framework should therefore lead to a more prescriptive type of benchmarking going forward, oriented predominantly towards decision-making. For service providers specifically, benchmarking should trigger a set of concrete actions to improve current performance and implement best practices. (see figure below).

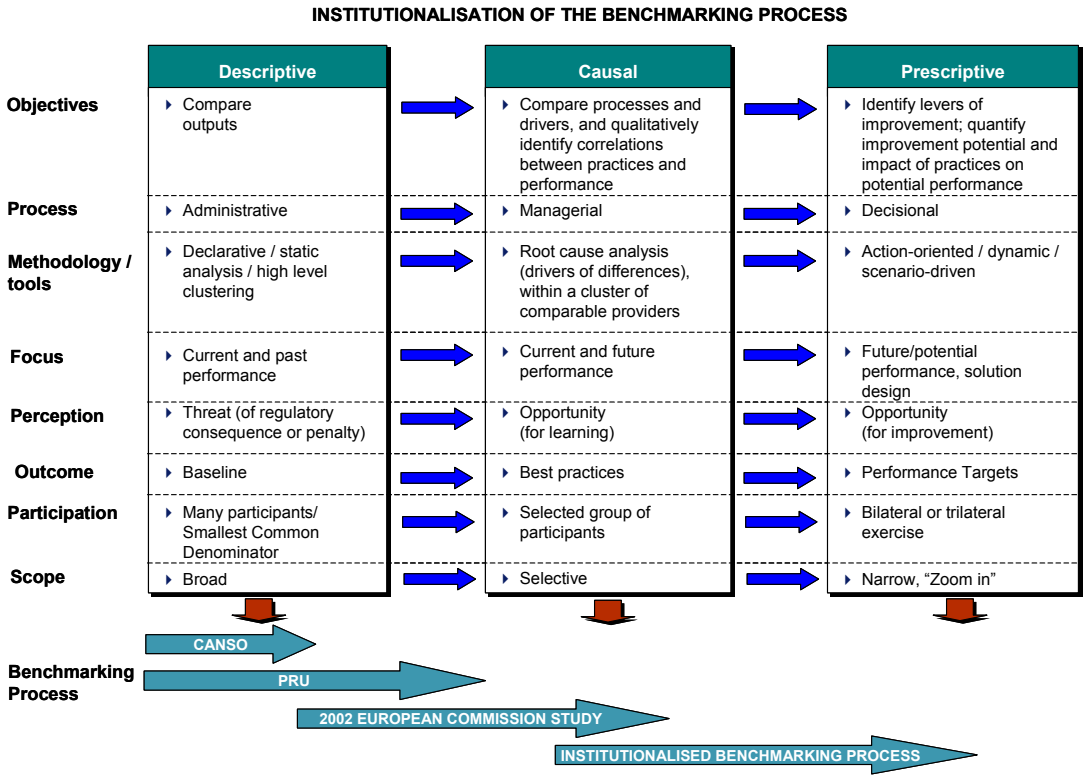


FIGURE 25: INSTITUTIONALISATION OF THE BENCHMARKING PROCESS

Ultimately, the way the various dimensions of the institutionalised benchmarking process will be implemented will determine the overall maturity level of the benchmarking process itself. The ultimate goal is to progress from what is today still viewed as an essentially administrative exercise towards a more managerial and decisional approach, whereby benchmarking is part of a fully integrated decision-making process, as illustrated in the picture here below.

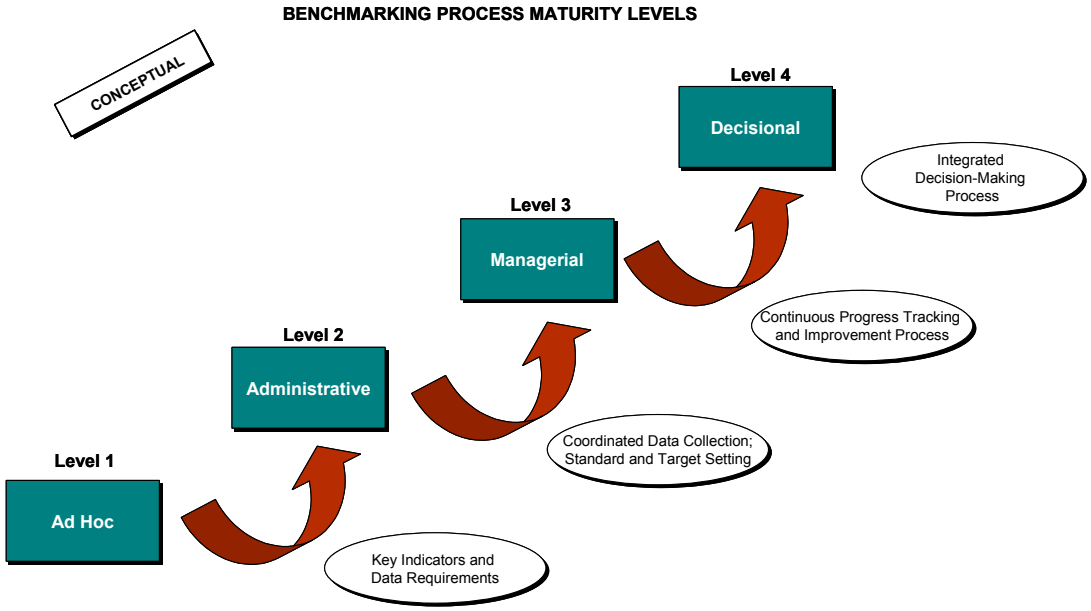


FIGURE 26: BENCHMARKING PROCESS MATURITY LEVELS

8 KEY INDICATORS AND KEY LEGISLATIVE ENABLERS

8.1 KEY INDICATORS

Key Indicators (KIs) have been selected for all domains of analysis. They should form the basis of the future framework for benchmarking in ATM. The following table details indicators based on the selected domains of analysis. This list is exhaustive in detailing those KIs defined, identified and validated during this study, or other studies, all of which are relevant for application within the benchmarking framework, depending on the specific area being investigated.

Whereas key indicators for Inputs, Outputs and Outcomes are mainly quantitative, key indicators for Internal Processes are mainly qualitative. They have been captured in the form of "cluster charts" that show the range of possible positions in a given capability area. These cluster charts have been used to position the providers and cluster them accordingly. They are a useful tool to identify industry-level patterns as well as the variations in practices across providers. These charts are attached in Appendix 1 to this report and essentially form the basis of a future questionnaire for analysis of internal processes.

GROUPING:	DOMAIN OF ANALYSIS:	SUB-DOMAIN:	METRICS AND INDICATORS:	REQUIRED DATA SOURCES: A: AVAILABLE, EO, ECAC ONLY	COMMENTS.
Safety – *Fundamental objective of the Air Navigation Service*	Safety - *Provision of safe separation of aircraft*	Safety Occurrences (quantitative Key Indictors)–	• State annual traffic volume per movement • State annual traffic volume per flight hours • Total accidents in the State with associated level of damage and fatalities • Total accidents per phase of flight, flight rules, type of operations and class of airspace, with either direct or indirect contribution from ATM • Total accidents per category of accident: mid air collision, CFIT, collision between aircraft, collision between an airborne aircraft and vehicle /another aircraft on the ground, collision on the ground between aircraft and vehicle /person obstructions(s), with either a direct or indirect contribution from ATM • Total number of incidents in the State classified into severity level, phase of flight, flight rules, type of operations and class of airspace, with either a direct or indirect contribution from ATM • Total number of incidents per State per specific category in incidents: separation minima infringement, inadequate separation, near CFIT, runway incursion where avoiding action was necessary, runway incursion where no avoiding action was necessary, runway excursion by aircraft, aircraft deviation from ATC clearance, aircraft deviation from applicable ATM regulation • Total number of ATM specific occurrences in the State classified according to severity • Total number of ATM specific occurrences per specific category: inability to provide ATM services (ATS, AMS, AFTM), failure of communication function, failure of surveillance function, failure of data processing and distributing function, failure of navigation function, failure of ATM system security	SRC Doc 2 (A, EO) ESARR 2 data disclosure (EO)	ESARR 2 due to be implemented as part of Single European Sky, based on provisions of Council Directive 94/56/EC of 21 November 91. States have started implementation of ESARR 2 from 1/1/2000.

GROUPING:	DOMAIN OF ANALYSIS:	SUB-DOMAIN:	METRICS AND INDICATORS:	REQUIRED DATA SOURCES: A: AVAILABLE, EO, ECAC ONLY	COMMENTS.
		Safety Process (qualitative Key Indicators) -	• Safety Management Function • Safety Management System • Education, training and testing • Safety occurrence reporting • Risk identification process	Database for this Study EAMTP Safety Policy (A, EO) ESARR 3 (A, EO) ESARR 4 (A, EO) ESARR 5 (A, EO) SRC Doc 8 (A, EO)	This area is better analysed using process benchmarking, see relevant cluster chart for further details on criteria to be used.
Outcomes – *The results of the service for the providers' customers*	Cost of Service – *The cost incurred to the customers through using the service*	ATC Charges (quantitative Key Indictors) -	• Cost per service unit per provider for en route services • Airspace division level between en route and approach services per provider • Cost per service unit per provider for approach services • Airspace division level between approach and aerodrome services per provider • Cost per service unit per provider for aerodrome services • Total cost per aircraft type against distribution of aircraft weight category per provider	ICAO Manual of Airport and Air Navigation Tariffs (A) Eurocontrol CRCO (A, EO) PRU and EEC analysis (A, EO)	For a stakeholders view of cost effectiveness, it is not sufficient to focus on the service unit cost but also flight applicability of the unit costs and the corresponding impact for reference a/c in relation to a given traffic mix.
		Airline Delay Costs (quantitative Key Indictors)–	• Total ground delay costs per service provider using industry standard costs for ground delays • Total airborne delay costs per service providers using industry standard costs for airborne delays	ITA: Cost of Air Transport Delay in Europe (A) IATA statistics (A)	Actual cost incurred to airlines needs to be attributed per service provider.

GROUPING:	DOMAIN OF ANALYSIS:	SUB-DOMAIN:	METRICS AND INDICATORS:	REQUIRED DATA SOURCES: A: AVAILABLE, EO, ECAC ONLY	COMMENTS.
	Quality of Service – *The quality of the service provided from the customer's point of view*	Delay (quantitative Key Indictors) -	• Total min. of departure delay vs. total no. of flights • Total no. of delayed flights vs. total no. of total number of flights • Total min. of departure delay vs. total no. of delayed flights • Total mins. of gate to gate delay vs. total no. of flights • Total mins. of TMA delay vs. total no. of flights • Total mins. of arrival delay vs. total no of flights • Weekly mins. of ATFM delay by volume of traffic • Weekday vs weekend mins. Of ATFM dealy by volume of traffic • Average arrival delay per delayed flight • Number of traffic flow regulations per sector (as recording to CFMU), with category (capactiy, ctrl. workload, staffing, etc.) • Evolution of average blocktime per airline at hubs • Total number delayed flights having same 'most penalising regulation' per provider airspace controlled • Total number delayed flights having same 'most penalising regulation' outbound from major airports per category • Total number of delayed flights having same' most penalising regulation' to major airports per category • Total number of delayed flights having same 'most penalising regulation' between major city pairs per category • Distribution of delay per volume of traffic between major city pairs.	PRU and EEC analysis (A, EO) CFMU Flight list (A, EO) Airline Blocktime Information OOOI data of airlines able to provide information Actual time of departure Actual time of arrival	Analysis is required to allocate causes of delay on a provider specific basis.

GROUPING:	DOMAIN OF ANALYSIS:	SUB-DOMAIN:	METRICS AND INDICATORS:	REQUIRED DATA SOURCES: A: AVAILABLE, EO, ECAC ONLY	COMMENTS.
		Predictability (quantitative Key Indictors)–	• Difference between scheduled and optimum gate to gate time • Standard deviation of arrival delay per major airport • Standard deviation of each delay component vs. causes of delay in each component between major city pairs • Taxi-in variation time at major airports • Taxi-out variation time at major airports	CFMU Flight List (A, EO) PRU analysis (A, EO) Airline OOOI data	Analysis needs to focus on downstream effects to understand impacts on a provider specific basis and their ability to deliver a predictable service.
		Availability (quantitative Key Indictors)–	• Total time of unplanned service distribution per provider as result of manpower shortage • Number of flights delayed, rerouted, cancelled or diverted as a results of manpower shortage • Total time of unplanned service disruption per provider as result of unplanned outage of critical systems • Number of flights delayed, rerouted, cancelled or diverted as a results of unplanned outage of critical systems.	CMFU Flight List (A, EO)	Analysis should allow comparison between providers and their ability to guarantee availability of the minimum service.
		Flight Efficiency			These Outcomes parameters are difficult to measure in a quantitative form and are better addressed in a qualitative analysis of internal processes.
		Flexibility			
		Equity			

GROUPING:	DOMAIN OF ANALYSIS:	SUB-DOMAIN:	METRICS AND INDICATORS:	REQUIRED DATA SOURCES: A: AVAILABLE, EO, ECAC ONLY	COMMENTS.
		Environment			
Outputs - *Results of the internal activities which lead to the outcomes*	Capacity – *The effective capacity produced by the service providers and made available to the customers*	Capacity (quantitative Key Indictors)–	• No. of flight flights handled by the ATSU per hour per year • Number of flights handled by the sector per hour per year • Average available capacity produced vs. declared capacity • Percentage of flight handled subject to delay • Runway capacity produced vs. declared capacity per major airport per hour per year • Evolution of ATSU capacity with demand	Database for this Study	The dynamics of capacity produced by service providers has to be better understood to assess causes and effects.
	Productivity- *The number of service units made available by a unit of production*	Productivity (quantitative Key Indictors)–	• Total number of ATCO in OPS hours on duty per total number of ATCOs on OPS per ATSU • Average time controlled per flight • Number of flights per flight hours controlled • Number .of flight movements per on duty controller hour per ATSU • Kms controlled per on-duty controller hour per ATSU • Average rostered hours per year vs average time in position per year • Average rostered hours per year vs average overtime per year • Runway capacity produced vs. declared capacity for major airports	PRU analysis (A, EO) Database for this Study	The impacts of ATCO productivity require more detailed assessment to understand variance of impacts between working practices between providers.

GROUPING:	DOMAIN OF ANALYSIS:	SUB-DOMAIN:	METRICS AND INDICATORS:	REQUIRED DATA SOURCES: A: AVAILABLE, EO, ECAC ONLY	COMMENTS.
	Reliability - *The technical reliability of the system to meet the demand for services.*	Reliability (quantitative Key Indictors)–	• Number of unplanned service outages vs. planned service hours per ATSU • Number of planned service outages vs. planned service hours per ATSU	Outage Logs of ANSPs	Reliability of the systems elements needs to be assessed to determine impacts on overall performance and possible needs for investment between providers.
Internal Process – *Internal activities undertaken by the service providers to assess the variance of processes used and determine processes that lead to strong outputs.*	Organisation of Services – *The way various services are organised and managed by the service provider (taking each service as a single entity)*	Service Providers and Regulator Relationship (qualitative Key Indicators) -	• Independence of regulation and service provision • Degree of separation of regulation and service provision • Organisation of regulation – service provision interface • Processes supporting regulation – service provision interface • Frequency of regulatory inspections and audits	Database for this Study Annual Reports (A), PRU Analysis (A, EO)	This area is better analysed using process benchmarking, see relevant cluster charts for further details on criteria to be used.
		Service Definition (qualitative Key Indicators) -	• Clarity of mission and objectives • Degree of unbundling • Organisation of non-ANS services • Organisational transparency • Financial transparency	Annual Reports (A), PRU Analysis (A, EO) Database for this Study	
		Service delivery (qualitative Key Indicators) -	• Outsourcing Policy • Coordination between service units • Clarity in service provision • Quality management process	Annual Reports (A), PRU Analysis (A, EO) Database for this Study	

GROUPING:	DOMAIN OF ANALYSIS:	SUB-DOMAIN:	METRICS AND INDICATORS:	REQUIRED DATA SOURCES: A: AVAILABLE, EO, ECAC ONLY	COMMENTS.
		Civil/military relationship (qualitative Key Indicators) -	• Institutional relationship • Structural relationship • Tactical relationship	AIPs, Annual Reports (A), PRU Analysis (A, EO) Database for this Study Eurocontrol Report 01-00-06	
		Customer Relationship Management (qualitative Key Indicators) -	• Degree of customer input/involvement in service definition • ANSP - customer relationship • Processes for customer involvement in service definition • Process used to capture customer satisfaction • Scope of customer satisfaction process	Database for this Study	
	Operational Concept – *The way the core ATM service is managed and operated by the service provider*	Airspace Design (qualitative Key Indicators) -	• Application of ICAO Standards • Criteria and Drivers • Customer Involvement	AIPs Database for this Study	This area is better analysed using process benchmarking, see relevant cluster charts for further details on criteria to be used.
		Airspace / Sector Management (qualitative Key Indicators) -	• Changing sector configuration • Time .constraints for changing sector configuration • Difference between minimum and maximum manning • Reallocation of working positions • Release of military airspace for civil use	AIPs, ICAO 7030/4 Database for this Study	

GROUPING:	DOMAIN OF ANALYSIS:	SUB-DOMAIN:	METRICS AND INDICATORS:	REQUIRED DATA SOURCES: A: AVAILABLE, EO, ECAC ONLY	COMMENTS.
		Air Traffic Flow Management (qualitative Key Indicators) -	• Provision of service • Mechanisms and conceptual support tools • Customer involvement	AIPs, PRU Analysis Database for this Study	
		ATC Procedures (qualitative Key Indicators) -	• Applied technology to provide separation • Longitudinal separation • Radar separation • Silent transfer of control • Lead time required for transfer of control • Preparation for emergencies • Use of languages	Database for this Study	
	Working Practices – *The practices that drive the way operational staff resources are used in delivering the core ATM service*	Rostering (qualitative Key Indicators) -	• Applied rostering system • Provision for standby staff • Working hours for ATCOs • Working hours for Flight Data Staff • Personnel Factors for ATCOs • Personnel Factor for Flight Data Staff	Database for this Study	This area is better analysed using process benchmarking relevant cluster charts for further details on criteria to be used.
		Manning (qualitative Key Indicators) -	• Control positions - rush hour vs. normal • Support positions - rush hour vs. normal • Reaction to changing traffic demand • Regulation and authority of supervisors to reduce manning	Database for this Study	
		Licensing (qualitative Key Indicators) -	• Combination of ratings available • Minimum time in position to maintain currency	Database for this Study	

GROUPING:	DOMAIN OF ANALYSIS:	SUB-DOMAIN:	METRICS AND INDICATORS:	REQUIRED DATA SOURCES: A: AVAILABLE, EO, ECAC ONLY	COMMENTS.
		OJT and Monitoring (qualitative Key Indicators) -	• Relation of Position and Simulator training • Procedures to maintain proficiency • Monitoring tools, processes and indicators used	Database for this Study	
	Strategic Management – *The way the service provider plans ahead the various resources and procedures to deliver the core ATM service*	Business Planning (qualitative Key Indicators) -	• Business planning process • Business planning documentation • Relationship with other parties • Financial planning and budgeting • Sourcing strategy	Database for this Study	This area is better analysed using process benchmarking, relevant cluster charts for further details on criteria to be used.
		HR Management (qualitative Key Indicators) -	• HR tools and processes • Integration with other business areas • Labour relationships • Career development • Recruitment	Database for this Study	
		Recruitment (qualitative Key Indicators) -	• Recruitment / retention measurement • Recruitment of foreign Controllers	Database for this Study	
		Operations Planning (qualitative Key Indicators) -	• Demand forecasting process • Forecasting resolution • Effectiveness measurement • Available capacity measurement • Required capacity measurement	Database for this Study	

GROUPING:	DOMAIN OF ANALYSIS:	SUB-DOMAIN:	METRICS AND INDICATORS:	REQUIRED DATA SOURCES: A: AVAILABLE, EO, ECAC ONLY	COMMENTS.
		Crisis Management (qualitative Key Indicators) -	• Crisis management plan • Definition level • Interface management	Database for this Study	
		Environmental Planning (qualitative Key Indicators) -	• Process for incorporating environmental impact • Compliance monitoring	Database for this Study	
		R & D Planning (qualitative Key Indicators) -	• Organisation of R & D • Drivers for R & D projects • Success measurement • Resource commitment	Database for this Study	
		Infrastructure Planning (qualitative Key Indicators) -	• Organisation and management of infrastructure planning • Success measurement • Scope of infrastructure planning	Database for this Study	
Inputs – *Resources committed by service providers*	Staff – *Number and type of staff available to manage the organisation and deliver the services*	Staff (quantitative Key Indictors)–	• No. of staff per category • Relative breakdown of staff per ANS charge per provider • Salary and associated costs per category per provider adjusted to cost of living • Number of staff per 1000 flights controller vs number of flights • Number of ATCOs in OPS per flights per 1000 flights controlled vs. number of flights • Number of "active"controllers vs. number of overhead staff per provider • Number of Staff vs number of sectors • Number of ATCOs in OPS vs number of sectors	PRU Analyses (A, EO) Database for this Study	Staff allocation should be transparently distributed between the en route, approach and aerodrome user charges and analysis needs to assess the effectiveness of staffing for each specific operational environment

GROUPING:	DOMAIN OF ANALYSIS:	SUB-DOMAIN:	METRICS AND INDICATORS:	REQUIRED DATA SOURCES: A: AVAILABLE, EO, ECAC ONLY	COMMENTS.
	Technology – *The amount and type of technology and infrastructure available to manage the organisation and deliver the services*	Technology (quantitative Key Indictors)–	• Achievements vs. EUROCONTROL technology targets (ECIP) • Degree of technology implemented vs. degree of technology used per provider • Variation on technology implementation vs. ACC	ECIP (A, EO) Database for this Study	Analysis needs to take into account the actual technology implementation and technology capability variation amongst providers. The ECAC references levels(attempted previously by EEC) form a key part of this analysis.
External Factors – *Factors where service providers have no control but which impact the way their services are performed or applied*	Institutional Factors – *External factors pertaining to the institutional environment in which service provider must perform*	Descriptive	• Impact of the ownership structure • Impact of the governance structure • Impact of the authorisation / mandate for provision of services • Impact of financial provisions • Impact of audit and regulation • Overall degree of corporatisation per service provider	AIPs (A) Annual Reports (A) Balance sheets (A) Database for this Study	Compressive descriptive material required on a State by State basis to determine possible impacts on performance.
	Operational Factors – *External factors pertaining to the operational environment in which service provider must perform*	Descriptive	• Impact for airspace size and volume of traffic • Impact of the distribution of traffic • Impact of the traffic profile • Impact of the airports and TMA profile • Impact o the coordination requirements • Overall impact of operational complexity	AIPs (A) CFMU Reports (A, EO) Charts and Maps (A) Database for this Study	Compressive descriptive material required on a State by State basis to determine possible impacts on performance.

TABLE 3: KEY INDICATORS

8.2 KEY LEGISLATIVE ENABLERS

KLEs are based on those high-level best practices that are representative of both the principal objectives of the Single Sky Initiative and of the biggest improvement opportunities for the industry as a whole as well as for many individual providers. The Study Team believes that the implementation of these best practices can lead to tangible improvements in the short and medium term and, as such, the KLEs are used identify and define opportunities for Community instruments to ensure, under the auspices of the Single European Sky, that:

- Air navigation services provided ensure uniform high safety standards for the air traffic
- Airspace is organised and managed efficiently and safely to meet needs of both civil and military users and allow equitable, non discriminatory allocation of the resources between all users
- The technical and operational solutions secure and increase safety standards, the overall capacity of the system, and full efficient use of capacity available
- The performance of the air navigation services system as a whole at the European level is constantly examined to check the effectiveness of the measures and propose further measures.

These KLEs are complementary to the Single European Sky proposals 2001/0235, 2001/0236 and 2001/0237.

KLE	DOMAIN OF ANALYSIS	GOAL	DESCRIPTION
Safety Management	Safety Process	Further develop the safety performance and culture across the Community	*Further development of guidelines to Safety management process allows for maximum accountability, transparency and awareness at all levels of the organisation, while continuously assessing the corporate performance and culture to further determine whether risk is being reduced to a level as low as reasonably practicable.*
Customer Involvement	Organisation of Services	Increase and coordinate customer input and feedback across the Community	*Guidelines to ensure the highest degree of customer involvement, among other things in the service delivery requirements definition (in particular in the airspace design and classification process) and in the strategic and tactical decision-making process. Guidelines should ensure customers are an integral part of the feedback loop as regards provider's performance for outcomes (quality and cost of service provided) and that a customer-oriented culture is pervasive throughout the organisation. Customers should include all users as well as key external stakeholders (airports, local communities, military, etc.)*
Scope of Service, Service Definition and Delivery	Organisation of Services	Harmonise the mission and organisation of ATS provision, through the facilitation of the definition and delivery of services, according to operational requirements on a Community scale.	*Guidelines for a well-articulated mission to be communicated and shared throughout the organisation; implementation of transparent organisational and financial structures (including accounting process for cost and resources allocation) and embedded organisational flexibility and systematic processes to unbundle or outsource services as appropriate.* *Requirements for implementation of an accredited quality management process throughout the organisation* *Guidelines for the unbundling of services which do not naturally lend themselves to monopoly provision.*
Tactical Flexibility	Organisation of Services	Increase coordination of tactical flexibility on a Community scale	*Guidelines for the flexibility to open and close sectors supplemented by the ability to change the configuration of active sectors in adding more working positions in order to react to changes in traffic demand without fragmenting the airspace further.* *Further increase situational awareness in the cockpit by using English as the only language in ATC for IFR flights and on international airports.* *Guidelines for the use of flexible rostering combining team and individual-based rostering frequently reviewed, and the tasking of individuals as stand-by readiness in*

KLE	DOMAIN OF ANALYSIS	GOAL	DESCRIPTION
			the case of non-availability of rostered staff, providing the flexibility for supervisors to man working positions with adequately rated staff. *Guidelines should allow the flexible manning of rostered staff to adapt a sector to changing traffic conditions, in support of a defined operational concept*
Integrated Strategic Management	Operational Concept	Improve the planning and implementation of resources on a Community scale	*Guidelines for the integration of business planning, HR management, Operations Planning and Infrastructure Planning into a comprehensive Strategic Management Process; this process should be an iterative, closed-loop process, both using a combination of top-down and bottom-up processes, with the embedded ability to monitor success against targets and standards in order to identify improvement opportunities. Implementation of high level architecture approach in support of such processes in the area of infrastructure planning*
Information Disclosure	All	Systematic benchmarking of service provision / development and implementation of improvements	*Continuation of the benchmarking process through an appropriate body to identify reasons for economic and performance variances and detail/implement opportunities for improvement across the industry*
	Inputs, Outputs, Outcomes	Economic and performance regulation for ANSPs	*Expansion of PRU activities in line with the development of economic and performance guidelines for the provision of air navigation services within the Community.*

TABLE 4: KEY LEGISLATIVE ENABLERS

9 OVERALL CONCLUSION

9.1 INTERPRETATION OF RESULTS IN THE CONTEXT OF THE SINGLE SKY INITIATIVE

Under the framework for the creation of the Single European Sky, the European Parliament and the Council of the European Union have accepted that the Community Framework provides a means of establishing common rules to optimise use of the airspace as a whole and the performance of the air navigation services on which this depends, and that, *inter alia*:

- The air navigation services provided must ensure uniform high safety standards for the air traffic
- Use of airspace must be organised and managed efficiently and safely to meet needs of both civil and military users and allow equitable, non discriminatory allocation of the resources between all users
- The rules must cover provision of air navigation services, air navigation equipment and systems with the associated procedures
- The technical and operational solutions must secure and increase safety standards, the overall capacity of the system, and full efficient use of capacity available
- The performance of the air navigation services system as a whole at the European level must be constantly examined to check the effectiveness of the measures and propose further measures.

The overall results of the Study support most of the objectives, particularly in the following areas:

9.1.1 Ensuring High Uniform Safety

Under the Single Sky Initiative, verification of compliance, for air navigation service providers and other relevant operators, will remain a task for the Member States and certificates of compliance should be mutually recognised by all Member States in order to allow air navigation service providers and other relevant operators to provide services in a Member State other than where they obtain their certificates.

This process will ensure compliance of standards in line with recognised obligations.

In particular, compliance with the ESARRs will enable a uniform application of minimum requirements for safety management. However, the study has shown that full compliance with the ESARRs will still allow some variation in the internal processes used and that there will remain opportunity for further improvement based on Community guidelines for identified best practices in **Safety Management**.

The overall safety of services may be further increased by the transfer of related better practices across the other domains for internal processes as each domain has an influence on the overall safety of services provided.

9.1.2 Meeting the Needs of Users

The organisation of the airspace must be improved to more effectively meet the needs of the users and the creation of a European flight information region in the upper airspace is desired as well as reconfiguration of such airspace into control areas across national boundaries. This is to provide for a more efficient use of airspace, systems and manpower, thus reducing the costs for airspace users.

User input in both the current and future organisation of service provision should be facilitated to the highest degree to allow coordinated approaches to service delivery and the strategic and tactical decision making processes. Implementation of Community guidelines for best practice in **Customer Involvement** should ensure uniform application of customer relationship management processes allowing customers to be an integral part of the feedback loop to ensure equitable and non discriminatory application of resources.

9.1.3 Organisation of Services

The rules applied by the national supervisory authorities must be coordinated on a Community scale to allow mutual recognition and facilitate a more effective organisation of airspace, services, equipment and systems. Community guidelines based on best practice in **Scope of Service, Service Definition and Delivery** should allow a clear harmonised approach allowing organisational and financial transparency across service providers, facilitating the unbundling / bundling of services in line with the specifics of the local environment, Community objectives and the needs of the users.

9.1.4 Technical and Operational Efficiency

As the air traffic management network is a complex, highly interactive structure involving large numbers of systems and components and operational processes, the Single Sky Initiative seeks to facilitate the definition and adoption of Community specifications defining the technical and operational constituents of the air traffic management network in view of complexity.

In this respect, the analysis shows clear opportunities for improvement through the development of Community guidelines for a coordinated approach to **Tactical Flexibility**. Development of guidelines for key elements of a Community operational concept should allow more consistent and effective application of the opening and closing of sectors, together with increased cooperation amongst controllers, which should now be achievable as a result of technological investments over recent years. Similarly, guidelines for rostering and manning of controllers, together with the conditions for capacity coordination on a tactical basis should allow more consistent application of working practices in relation to a specific environment.

Further, strategic planning of technical and operational improvements can be better coordinated through the implementation of Community guidelines for best practice in **Strategic Management**. The harmonised adoption of more integrated 'closed loop' business planning, HR management, operations and infrastructure planning process should allow the ability to plan, implement and monitor success, against targets on the local and Community scale.

9.1.5 Performance of the Overall System

Under the Single Sky Initiative, user charges should provide remuneration for the facilities and services provided by the air navigation service. As such services by their nature, can only be provided by air navigation service themselves, the level of user charges should be proportionate to the cost incurred, taking into consideration the objective of economic efficiency.

The systematic implementation of benchmarking will allow the performance of the overall system to be monitored and effects of specific external environments further quantified to ensure any incentives or penalties are fairly applied. As such, **Information Disclosure** requirements at Community level to allow systematic benchmarking to be progressed should be developed in line with the outputs of this study.

9.2 COMPARISON WITH NON-EUROPEAN PROVIDERS

The inclusion of non-European providers into the Study has been very valuable in several respects.

First of all, it has allowed capture of major differences in operational environments experienced by providers in other regions. For example, traffic patterns are very different, which explains and there is a much greater impact and focus on VFR for non-European providers partaking in the study.

Secondly, the case of several non-European providers has indirectly highlighted the impact of the so-called "network effect" on European operations. Due to the overall density of traffic over core European countries combined with the level of fragmentation of the service provision in these countries, there is an extremely high level of interdependency and of complexity in Europe that does not exist in other parts of the world. This would also make it very difficult to compare a large non-European provider with a group of European providers and it is recommended that care be taken to ensure any future comparisons duly consider network effects.

However, it is clear that this relative independence seems to have given non-European providers early freedom to innovate and more flexibility to change their operating models in line with requirements of the service. Interestingly, most of the non-European providers covered in the Study have had very good scores in the area of Internal Processes, which tends to illustrate their recent transformation into more commercially-driven /customer-focused organisations.

Finally, non-European providers seem to display a culture of openness that is still lacking in Europe. Most European providers are still fairly hesitant on the open sharing of information, which illustrates that the legacy of monopoly government organisations is well entrenched in many providers.

9.3 GENERAL LEARNINGS AND POSSIBLE NEXT STEPS

9.3.1 General Learnings

- This Study has shown the benefits of a continuous benchmarking process in order to track the various practices and performance levels as well as to monitor the improvements achieved in various areas. The results clearly demonstrate that this benchmarking project should not be a one-off exercise.
- The Study has also brought forward the need to investigate specific areas further with a more comprehensive view, in order to be able to make significant improvements in the overall understanding of the air navigation service provision dynamics. This is particularly valid for the concepts of Complexity and Capacity. The Study has shown that until these two concepts are clearly defined and investigated, there will be significant limitations to any collective and regulatory effort to set some industry-wide standards and performance targets. This task cannot be left to the providers or even Eurocontrol, which have too many vested interests or have too much of an insider's view. This should be undertaken as much as possible by an outside organisation, possibly in academia.
- Large variations in practices and in performance have been identified. However, at this stage, no clear relationship has emerged between the two. This is mainly due to the fact that such relationships require a deeper level of analysis than the provider level (at least service if not centre level), to be correctly captured. This is also due to the fact that many providers have been experiencing significant changes in internal practices over the last few years, the impact of which has not yet been reflected in their current performance. Such impact is likely to become more obvious over the next few years.
- Finally, the benchmarking process itself, as experienced by the Study Team, has shown that many providers do not have a proper reporting process capturing data relevant to their business. This is clearly an area where an institutional benchmarking process would help by standardising data requirements and data collection processes that providers could incorporate into their own internal management toolkit.

9.3.2 Possible Next Steps

For the European Commission:

The following steps should be initiated:

- Harmonisation of the Study benchmarking framework with Eurocontrol EID's framework
- Selection of priority areas for definition or standardisation (capacity, operational complexity, general definitions, etc.)
- Set-up of an infrastructure for the continuation of the benchmarking process ("institutionalisation")
- Initiation of a legislative framework that will build upon the results of the benchmarking and of the identified high level best practices
- Extension of the application of the benchmarking framework to providers in the enlargement countries

For the Providers:

The following steps should be initiated:

- Coordinated selection of providers to take part in the identification and validation of key drivers through analysis at the service and/or centre level
- Identification of individual areas for improvement based on the analysis of identified best practices and benchmarking results in the context of their own specific strategic priorities
- Set up a reporting process adapted to the new benchmarking data requirements
- Development of an model to incorporate an institutional benchmarking process into their own managerial and decision-making process

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Appendix 1 to the Final Report

Study on Benchmarking for Best Practices in Air Traffic Management

CLUSTER CHARTS

31st January, 2003

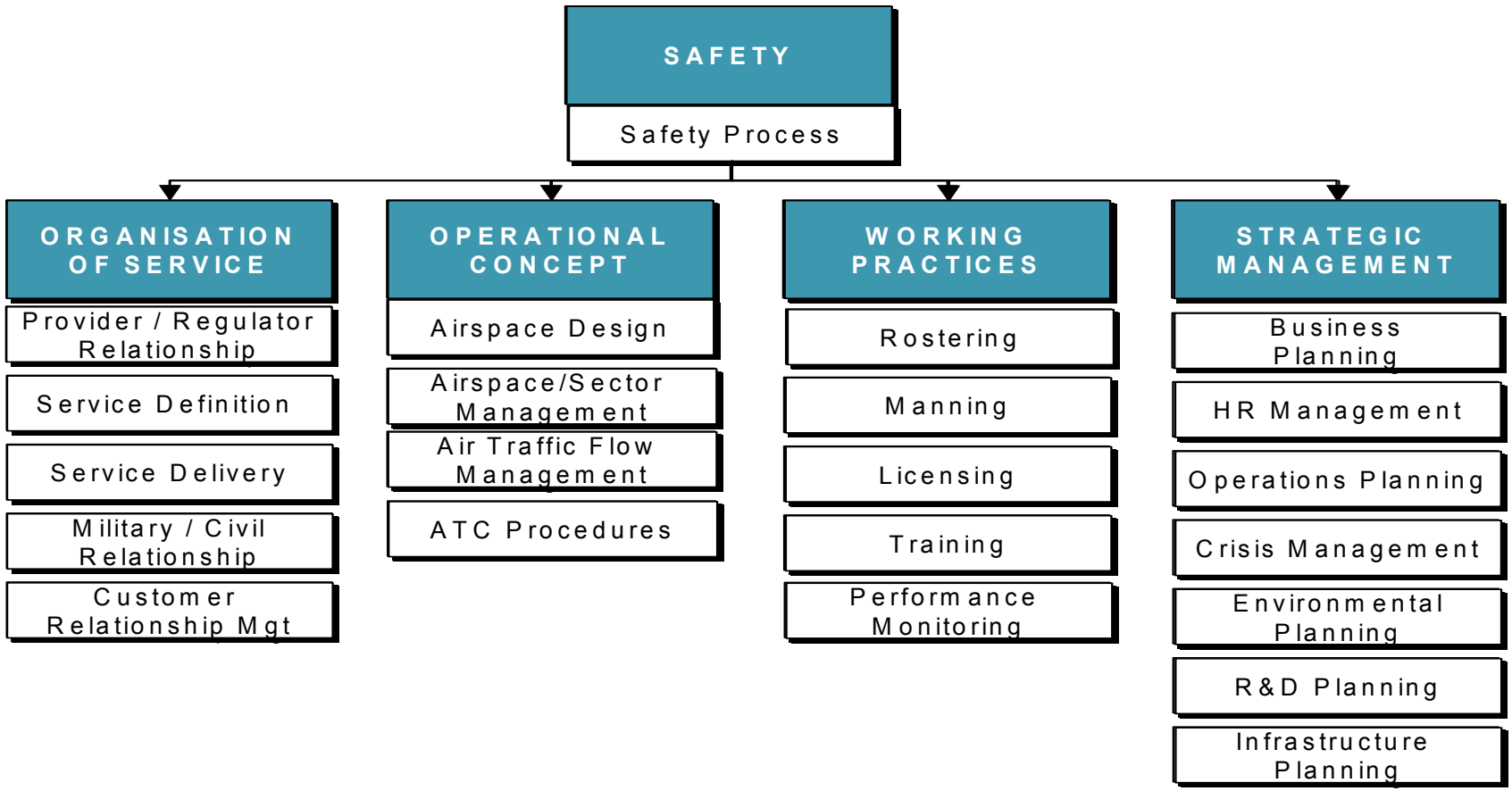
Introduction

- The main focus of the Study and its results has been the qualitative benchmarking of Internal Processes – something which has not been attempted before

- 21 key capability areas have been identified in the domains of Internal Processes, and a series of Key Indicators have been selected for each capability area

- The qualifications for these Key Indicators combine to form the 'Cluster Charts' for each capability area.
  - These cluster charts have been developed to capture the whole range of possible or actual practices as determined by the Study Team.
  - By positioning the Providers across the Cluster Charts, they provide illustration on the variance of individual processes and how individual implementations compare across the industry. They therefore provide visibility of potential development opportunities, which Providers can then further develop based on their individual experiences and the local environment.
  - The Cluster Charts form the basis of a future Questionnaire for Internal Process

Cluster Charts for 21 capabilities areas within Internal Processes



Safety Process

Indicators	A	B	C	D	E
Safety Management Function	• No dedicated function but covered across line management	• Dedicated function covering main services	• Dedicated function for all safety related services	• Category C Capability • Fully independent • Reporting directly to the Head of the Organisation	
Safety Management System	• No specific system implemented	• Provides information on concepts & policy • Basic monitoring	• Provides information on concepts & policy • Provides audit of critical services • Use of specific tools	• Category C capability • Defined indicators	• Category D Capability • Assesses corporate performance & culture
Education, training and testing	• High-level understanding of concepts • Routine communication of issues	• Category A • Routine Training of ACTOs • Workshops	• Category B • Routine training of all safety related staff • Routine tests for ATCOs	• Category C • Routine tests of all safety related staff • Ad-hoc testing of ATCOs	• Category D • Ad-hoc testing of safety related staff
Safety occurrence reporting process	• No formalised channels	• Confidential reporting or Voluntary reporting only	• Category B • Mandatory reporting	• Category C • Automated mandatory reporting	
Risk identification process	• No formal process	• Reactive only	• Reactive only • Transparent accountability	• Proactive and reactive	• Category D • Transparent accountability

Provider / Regulator Relationship

Indicators	A	B	C	D	E
Independence of regulation and service provision	• Same institution responsible for all ops & regulation activities • Same line management for ops & regulation • Same governance lines for ops & regulation	• Same institution responsible for most ops & regulation activities • Separate line management for ops & regulation • Same governance lines for ops & regulation	• Same institution responsible for most ops & regulation activities • Separate line management for ops & regulation • Separate governance lines for ops & regulation	• Separate institutions responsible for ops & regulation, little overlap • Institutions have same reporting lines at government level	• Separate institutions responsible for ops & regulation • Institutions have independent reporting lines at government level
Degree of separation of regulation and service provision	• Same institution responsible for all ops & regulation activities • Ops and regulation integrated into same functional units throughout the organisation	• Same institution responsible for most ops & regulation activities • Ops and regulation in separate functional units throughout the organisation	• Same institution responsible for most ops & regulation activities • Organisation set up to ensure functional separation of ops & regulation	• Separate organisations for ops & regulation with limited overlap in some areas	• Separate organisations for all ops & regulation
Organisation of regulation – service provision interface	• No clear interface or demarcation between roles and responsibilities • Overlap of ops & regulatory activities • No central coordination	• Interfaces organised on an ad-hoc basis at both strategic and operational levels • No central coordination	• Well-defined strategic or operational level interfaces • Ad-hoc interfaces at the other level • No central coordination	• Well defined strategic and operational interfaces • No central coordination	• Specialist function within ANSP dedicated to managing interface with one or more of the regulators
Processes supporting regulation – service provision interface	• No clear processes other than setting strategic or political objectives	• Review and approval of strategic level objectives and requirements • Inspections at operational level	• Review and approval of strategic level objectives and requirements • Compliance monitoring against requirements • Inspections and audits at operational level	• Review and approval of all processes, procedures and requirements • Comprehensive compliance monitoring and audit at all levels at discrete intervals	• Continuous and well-defined oversight process at all levels
Frequency of regulatory inspections and audits	• No regular independent inspections or audits at operational level. • Strategic level assessment of plans and procedures only	• Fixed calendar of operational audits and inspections on an infrequent basis	• Fixed calendar of operational audits and inspections on frequent basis	• Fixed calendar of operational audits and inspections on frequent basis plus ad-hoc random inspections	• Continuous and ongoing oversight process

Service Definition

Indicators	A	B	C	D	E
Clarity of mission and objectives	• No clear mission statement other than general principles in line with Chicago Convention obligations • Limited communication internally and externally	• Clear mission statement in line with general Chicago Convention and/or other principles, e.g. ECAC • Mission communicated internally and publicised externally	• Clear mission statement differentiating ANSP from others • Mission statement developed with input/buy-in from staff • Mission delineated extensively to stakeholders	• Clear mission statement differentiating ANSP from others developed with input/buy-in from employees and key stakeholders	• Mission defined through declaration of objectives and values derived through consultation with employees and key stakeholders
Degree of service bundling	• Complete bundled portfolio of ANSs is provided following the Conventional Integration Model	• Some non-ATM services are provided by third party providers, e.g. MET, AIS, SAR	• Some non-ATM services are provided by 3rd parties • Some ancillary services are outsourced, e.g. fixed communications	• Some non-ATM services are provided by 3rd parties • Some ancillary services are outsourced • Some ATC services are unbundled, e.g. APP and TWR	• Most non-ATM and ancillary services are provided by 3rd parties • ATC services are extensively unbundled
Organisation of non-ANS services	• No non-ANS services are provided	• Non-ANS services limited to those with strong links to ANS • No clear separation of non-ANS and ANS services	• Non-ANS services limited to those with strong links to ANS • Functional separation of non-ANS and ANS services • Informal separation of accounts	• Non-ANS services limited to those with strong links to ANS • Functional and accounting separation of non-ANS and ANS services	• ANSP free to provide any non-ANS services • Functional and accounting separation of non-ANS and ANS services
Organisational transparency	• Clear organisational & functional structure • Functional units map onto multiple operational units • Operational units map onto multiple services	• Clear organisational & functional structure • Functional units map directly onto individual operational units • Operational units map onto multiple services	• Clear organisational & functional structure • Functional units map directly onto individual operational units • Operational units map directly onto individual services	• Clear organisational & functional structure • Functional units map across multiple services	• Clear organisational & functional structure • Functional units map directly onto individual services
Financial transparency	• Bespoke accounting or budgeting procedures • No published accounts • Total costs allocated between services using simple rules of thumb	• GAAP • Audited accounts, not published • Total costs allocated between services using simple rules of thumb	• GAAP • Audited, published accounts • Direct costs allocated using specific drivers • Ad-hoc overhead allocation • Any cross-charging is readily identified	• GAAP • Audited, published accounts Costs allocated using formal methodology, e.g. ABC • Cross- charging readily identified • SLAs for internal trading	• GAAP • Externally audited accounts • Costs allocation is fully traceable and transparent, including overheads • No cross- charging • SLAs for internal trading

Service Delivery

Indicators	A	B	C	D	E
Outsourcing policy	• General policy to perform all activities in-house • No outsourced services	• No overall policy. Individual units have freedom to outsource on an ad-hoc basis based on their own criteria	• No overall policy. Individual units have freedom to outsource based on standard criteria, e.g. general economic and efficiency factors, CBA	• Policy restricts outsourcing to non-core activities. Individual units have freedom to outsource these activities on an ad-hoc basis based on their own criteria	• Policy restricts outsourcing to non-core activities. Individual units have freedom to outsource based on standard criteria, e.g. general economic and efficiency factors, CBA
Coordination between service units	• No clear process	• Defined in operations manuals	• Letters of agreement	• Centrally administered procedures	• Combination of letters of agreement and centrally administered procedures
Clarity in service provision	• Wide range of services, including non-aviation, delivered by ANSP • Significant deviation of services from ICAO specifications	• Wide range of aviation services delivered by ANSP including non-ANSs • Compliance with ICAO specifications	• Focus on whole range of ANS and closely associated services • Compliance with ICAO definitions • Units deliver wide range of multiple services	• Focus on ATM and closely related services services • Compliance with ICAO definitions • Units deliver wide range of multiple services	• Focus on ATM and closely related services services • Compliance with ICAO definitions • Units focus on well-defined service bundles • Unbundling facilitated
Quality management process	• No quality assurance or management procedures in place	• In-house procedures followed with no external accreditation	• Some parts of organisation have quality certification related to specific activities	• A wide range of the ANSP organisation has quality certification covering multiple services	• The entire ANSP organisation has quality certification

Civil Military Relationship

Indicators	A	B	C	D	E
Institutional relationship	• Defence/military takes full control for all air navigation service matters	• Coordination between relevant ministries • Separate organisations responsible for civil and military service provision • Limited coordination at operational level	• Coordination between relevant ministries • Separate organisations responsible for civil and military service provision • Coordination between civil and military service providers	• Coordination between relevant ministries • Integration of military into single civil service provider	• Civil authorities take full control for all air navigation service matters through delegation at government level
Structural relationship	• Separate infrastructure • Separate services	• Cross-use of infrastructure • Separate services	• Cross-use of infrastructure • Cross-provision of services	• Cross-use of infrastructure • Integrated services	• Integrated infrastructure • Integrated services
Tactical relationship	• Permanent allocation of air space • Direct funding/subsidy for provision of services to military	• Permanent allocation of some airspace • Flexible use of other airspace on a day-to-day basis • Reimbursement by the military for use of civil infrastructure and/or vice versa	• Flexible use of all airspace on a day-to-day basis • Reimbursement by the military for use of civil infrastructure • Reimbursement by civil for use of military services/ infrastructure	• Flexible use of airspace on a tactical level • Reimbursement by the military for use of civil infrastructure/services • Reimbursement by civil for use of military services/ infrastructure	• Flexible use of airspace on a tactical level • Integrated infrastructure/services

Customer Relationship Management

Indicators	A	B	C	D	E
Degree of customer input/involvement in service definition	• No customer involvement in the service definition process at local level. Reliance on the EATMP or other international process)	• Specific customer input at strategic level (e.g. participation in ANSP board) • Limited direct consultation with main customers at operational levels on specific issues	• Specific customer input at strategic level (e.g. participation in ANSP board) • Direct consultation with main customers on wide ranging issues at operational levels	• Specific customer input at strategic level (e.g. participation in ANSP board) • Direct consultation with all customers at operational levels	• Customer involvement as ANSP shareholder • Direct consultation with all customers at operational levels
ANSP – customer relationship	• No specific definition of relationship other than ICAO obligations	• Relationship defined in national legislation in general terms	• Relationship defined in the licence/authorisation of the ANSP or in the legislation of its establishment	• Relationship defined in the licence/authorisation of the ANSP or in the legislation of its establishment • Contracts/SLAs with specific customers in place or planned	• Contracts/SLAs with the majority of customers oin place or planned • Customer relationship plans implemented
Processes for customer involvement in service definition	• No formal local mechanism (other than through the EATMP process)	• Ad-hoc consultation at local level • Information feedback provided to customers	• Formal, regular consultation at local level	• Formal, regular consultation • CDM at either strategic or technical and operational levels	• Formal, regular consultation • CDM at all of strategic, technical and operational levels
Process used to capture customer satisfaction	• No formal local mechanism other than ad-hoc reaction to complaints • Reliance on EUROCONTROL mechanisms, e.g. PRC	• Regular surveys and questionnaires	• Regular surveys and questionnaires • Institutionalised complaint handling procedures	• Regular surveys and questionnaires • Institutionalised complaint handling procedures • Regular workshops with customer management	• Regular surveys and questionnaires • Institutionalised complaint handling procedures • Regular workshops with customer management and line aircrew
Scope of customer satisfaction process	• No formal local mechanism other than ad-hoc reaction to complaints	• Restricted to main commercial customers (airlines and airports)	• Includes all commercial customers (airlines and airports)	• Includes all commercial customers (airlines and airports) and general aviation or the military (I.e. some exclusion)	• Addresses all types of customer

Airspace Design

Indicators	A	B	C	D	E
Application of International – ICAO – Standards	• Mainly implemented (75 – 100% adherence) with few exceptions • Few national supplements to the Use of Airspace		• 100 % adherence to ICAO classification • Few national supplements to the Use of Airspace		• 100 % adherence to ICAO classification • No national supplements to the Use of Airspace
Criteria and Drivers	• Regional Harmonisation • Service Delivery Requirements		• Technologicall Drivers additional to A		• Conceptual Drivers additional to C
Customer Involvement	• No clear process (occasional involvement)		• Selected Customers are involved		• All customers are involved

Airspace / Sector Management

Indicators	A	B	C	D	E
Changing Sector Configuration		• Sectors can be combined either horizontally or vertically or in both dimensions • Technical means are available • The authority on central level		• B with authority on local level	
Time Constraints for changing Sector Configuration		• Less than 30 minutes prewarning required		• Changes possible within 5 minutes	
Difference between Minimum and Maximum number of open Sectors		Reduction by up to 40-59%	• Reduction by 60 – 74%	Reduction by 75 – 84%	• Reduction by 85+%
Reallocation of Working Positions i.e. Technical Flexibility	Reallocation possible with System support but with some adaptable tools (display or communication) missing		• As previous with all tools		• C plus identification of controller
Release of Military Airspace for Civil Use	• Very few options for the release of military airspace	• Unused military airspace is released for civil use on an as requested basis		• Unused military airspase automatically released for civil use	

Air Traffic Flow Management

Indicators	A	B	C	D	E
Provision of Service		• Provision of ATFM on regional level (CFMU in Europe) • Flow Control supported through Sector Positios		• Provision of ATFM on regional level (CFMU in Europe) • Flow Positions (FMP) in ACC	
Mechanisms and Conceptual Support Tools	• Use of conditional routes and airspace, Use of off – load routes to circumnavigate congested areas • Tactical co-ordination in line with the FUA concept (Europe only)		• Transfer of blocks of airspace between centres		• Ad – hoc delegation of airspace between centres also cross - border
Customer Involvement	• Involvement on a strategic level (planning) • Defining the rules		• Involvement on a tactical level (through CFMU)		• In addition to A and/or C • Involvement on a tactical level (direct through ACC) • Agreeing on alternate routings

ATC Procedures

Indicators	A	B	C	D	E
Applied Technology to provide Separation		• Radar Separation		• Radar Separation supplemented by new Technology (also on an experimental basis)	
Longitudinal Separation	• Enroute 10 minutes + • Approach 5 minutes + • No timed separation on Final • Crossing border as enroute or more		• Enroute 5 minutes + • Approach 3 minutes + • No timed separation on Final • Crossing border greater than enroute but up to 10 minutes		• Enroute 5 minutes + • Enroute separation also expressed in distance • Approach 3 minutes + • No timed separation on Final • Crossing border equals enroute
Radar Separation	• Enroute 10 NM + • TMA 3 NM + • Final 3 NM		• Enroute 10 NM - • TMA 3 NM + • Final 3 NM		• Enroute 5 NM - • TMA 3 NM • Final 2.5 NM • CAT III 10 NM-
Silent Transfer of control	• Not yet implemented	• Intra ACC co-ordination and between own ACC	• Between ACC, APP and TWR • plus B	• With military ATC and with A/D units • Plus C • Data Link	• Crossing international boundaries • Data Link
Lead time required for ransfer of control	• 15 minutes+ between own centres	• 1o minutes between centres • Shorter between ACC and APP/TWR	• 5 minutes	• 3 minutes or less • No lead time required • Fully automated	
Preparation for Emergencies	• Procedures are taught and where available practised in simulators		• Procedures are part of proficiency training		• Procedures are part of routine testing
Use of Languages	• English is used for non – nationals, but mother tongue is used for nationals also at international airports		• English is used for non – nationals, but mother tongue is used for nationals in the IFR service		• English is the only language used for IFR service

Rostering

Indicators	A	B	C	D	E
Applied Rostering System	• Combination of Team and Individual based rostering • Frequently reviewed		• Independent of Season • Team based		• Seasonal variations • Individual based
Provision for Standby Staff	• Depending on the availability of individuals (ATC staff normally on other duty or available in their off-time)		• Organised system with Individuals on call		• Staff routinely rostered for standby
Working Hours ATCO	• Less than 1500 hrs/yr	• 1500 - 1650 hrs/yr	• More than 1650 hrs/yr		
Working Hours Flight Data	• Less than 1500 hrs/yr	• 1500 -1650 hrs/yr	• More than 1650 hrs/yr		
Personnel Factor ATCOs 24 hrs requirement	• More than 9	• More than 7.5	• More than 6.5	• 6,5 or less	
Personnel Factor Flight Data Staff 24 hrs requirement	• More than 9	• More than 7.5	• More than 6.5	• 6,5 or less	

Manning

Indicators	A	B	C	D	E
Control Positions Rush hour / normal	• 0		• 1		• 2
Support Positions Rush hour/normal	• 0		• 1		• 2
Reaction to changing traffic demand (Busy/Low) Configuration Changes	• Opening / closing sectors		• Opening / closing sectors • Extention of dimensions (horizontally and vertically)		• C + increasing / decreasing manning in existing sectors
Regulation and Authority of Supervisors to reduce below minimum	• Prescribed by local Management		• A + Authority of supervisor to go below at own discretion		• A + No authority of supervisor to go below ,or in well defined situations only

Licensing

Indicators	A	B	C	D	E
Combination of Ratings i.e. TWR/APP Centre/APP, or one only possible	• One Rating for one Type of facility	• Combination of APP and TWR	• Combination of Centre and APP		
Minimum time in position to keep current	• Not defined	• Defined (Ops Staff) up to 360 hours/year	• Defined (Ops Staff) more than 360 hours/year	• Defined (Ops Staff) more than 600 hours/year	

Training & Performance Monitoring

Indicators	Level A	Level B	Level C	Level D	Level E
Relation of Position- and Simulator Training	• No simulator training in OJT • Simulators only in basic training	• Simulator only to train special situations	• Relation Position / Simulator 50/50	• Relation Position / Simulator 60 - 79/40 – 21%	• Relation Position / Simulator 80/20 or more than 80%
Procedures to maintain proficiency	• Not defined		• A defined programme		• C+ • Results are documented or • This training is performed in ATC schools
What monitoring tools and processes are in place, what indicators are used	• Planned	• Programmes (tools and processes) in place • No indicators defined	• Programmes (tools and processes) in place • Indicators defined • Monitoring Unit in place	• C + Readiness to compare with other providers and/or • Dedication to Performance expressed	

Business Planning

Indicators	A	B	C	D	E
Business Planning Process	• No business planning process	• Top-down, high level business planning	• Bottom up business planning	• Integrated top-down and bottom-up approach • No evidence for opportunity to iterate	• Fully integrated and multi-phase business planning process
Business Planning documentation	• Limited documentation, mainly for internal audience • No regular updating • No annual report	• Basic documentation, mainly for internal audience except annual report • Frequency of updating varies	• Specific documentation for various parts of the business mainly for internal audience • Annual frequency for most updatings	• Specific documentation for various parts of the business • Mixed internal and external audience • Frequent updating	
Relationship with other parties	• No strategic relationship with other parties	• Some cooperation with third parties but mainly indirect (via other organisations) • No direct, formal or structural cooperation	• Direct, formal relationships with other ANSPs on specific projects or under framework agreements	• Range of direct , strategic-level partnerships with other ANSPs	• Structural long-term strategic partnerships with other ANSP and/or suppliers and/or customers
Financial planning and budgeting	• Only high level planning and budgeting, done once a year • No formal review process	• Top down process with little input from business areas, review limited to top management/ Board of Directors	• Mainly bottom-up process with aggregation at the top	• Mix of top-down and bottom up process • Use of specific tools/indicators to monitor performance vs. budget (i.e. Balanced Scorecard, EVA,etc.)	• Planning used as a fully integrated decision -making tool • Updated in real time • Involvement of all business areas • Specific indicators to monitor performance
Sourcing strategy	• No sourcing strategy nor organisation	• No formal strategy • Mainly decentralised procurement • Authorization required for big items only	• Formalized sourcing strategy but only for core service-related spend	• Strategic sourcing approach (i.e. long-term relationship with strategic suppliers)	• Exhaustive sourcing strategy in place covering total spend • E-procurement used for non-critical item

Domain: Strategic Management

Human Resource Management

Indicators	A	B	C	D	E
HR tools and processes	• No dedicated HR unit • Limited number of HR tools and processes in place	• Dedicated HR unit • Limited number of HR tools and processes in place	• Comprehensive HR quality programme • Comprehensive set of tools and processes • But no formal HR management policies	• Comprehensive set of tools and processes • Formal HR management policies • No accredited HR quality programme	• Comprehensive set of tools and processes • Explicit HR management policies • Comprehensive accredited HR quality programme
Integration with other business areas	• No integration, back office role only	• Some integration but only as administrative support role	• HR manager is member of executive decision making process	• HR manager is member of executive decision making process • HR management system integrated with other business systems	• Function fully integrated with the rest of the business; close involvement of business units/areas
Labour Relationships	• Conflict avoidance mode; unions suspicious of changes but management can make proposals	• Consultation mode; ad-hoc working groups, collective bargaining	• Cooperation mode; consultation, working groups, mutually agreed working practices • No rep. on exec. board	• Staff representation at executive board level • No mutual agreement on working practices or working groups	• Staff representation at executive board level
Career Development	• No career development process • No formal training or feedback	• Formal feedback and training programmes • No individual goals • Performance-based reward • No leadership training	• Management and leadership training • Formal feedback and training programmes • No individual performance evaluation	• Management and leadership training • Formal feedback and training programmes • Individual goals but no performance-based reward	• Management and leadership training • Formal feedback and training programmes • Performance-based rewards and individual goals
Recruitment	• No internal recruitment process	• Manpower planning and skills requirement mainly defined centrally / at corporate level	• Manpower planning and skills requirements mainly defined by business units	• Manpower planning and skills requirements defined at corporate level based on inputs from business units	• Manpower planning and skills requirements defined both at corporate and business unit levels in close cooperation

Operations Planning

Indicators	A	B	C	D	E
Demand forecasting process (method and customer types included)	• Internal process through a dedicated forecasting department	• Adapting forecasts produced by external sources within the industry • Commercial air transport (CAT) customers included (schedule and charter)	• Adapting forecasts produced by external sources within the industry • More than CAT customers included	• Combination of methods used to forecast demand • CAT customers included (scheduled and charter)	• Combination of methods • More than CAT customer types included
Resolution	• National and airport level • 10 year horizon	• National, Centre, Sector, Airport , Individual Route • 10 year	• National, Centre, Sector, and/or Airport • 5 year	• Centre • 1-5 year horizon	• National and centre, and/or sector, and/or airport and/or individual route level • 1-5 year horizon
Effectiveness assessment	• None	• Basic actual vs. forecast comparison • Or yearly review	• Some retrospective statistical analysis	• More sophisticated analysis (statistical analysis) • Monthly monitoring	
Capacity measurement	• Rule of thumb or historical data	• Simulation at sector or centre level	• Simulation at centre level and historical at sector level	• Mix of simulation and historical at sector level	• Mix of simulation and historical at both centre and sector level
Capacity requirement management	• Other	• Simple link to traffic demand forecasts	• Laboratory simulation using traffic demand forecasts	• Operational simulation using traffic demand forecasts	• Combination of tools

Crisis Management

Indicators	A	B	C	D	E
Crisis management plan	• No plan	• No ANSP-specific plan • Plan at supra national level, or • Plan in place but no dedicated unit	• Plan in place within dedicated unit	• Plan in place and responsibility distributed throughout the organisation	• Plan in place and responsibility distributed throughout the organisation • Dedicated crisis management unit
Definition level	• None • Or airport specifications or service orders	• ANSP level and/or ATSU level	• System level	• Sub-system level	• Most levels including neighbouring areas
Interface management	• No interface with external parties	• Some coordination with selected parties	• Coordination with several parties (police, military, customers and airports) but not with other ANSPs or customers	• Coordination with other parties including other ANSPs	• Coordination with other parties including other ANSPs and customers

Environmental Planning

Indicators	A	B	C	D	E
Process for incorporating environmental impact	• No formal process for considering service impact on environment	• Environmental factors are considered on a case by case basis • Training given to relevant staff as part of induction process	• Formal policy on environmental protection in place but high level only (minimum legal requirements)	• Formal policy on environmental protection in place with relevant manuals and procedures, systematic basis and training	
Compliance monitoring	• Internal management only	• Internal management and compliance with environment regulator	• Compliance with aviation and /or environment regulator guidelines	• Internal management and compliance with aviation and environment regulators	

R & D Planning

Indicators	A	B	C	D	E
Organisation of R&D	• No R&D activity	• R&D mainly outsourced to outside supplier • Occasional in-house activity	• Some R&D activity performed in-house but no specific department	• R&D department/division in place • No mechanism to assess value	• R&D department/division in place • Mechanism to assess value in place
Drivers of R&D projects	• Fundamental research related • Long term focus • No direct focus on operations-related projects	• Applied Research • Medium term focus • Focus on projects relevant to operations	• Customer requirements in priority	• Development • Short term focus • Focus on project relevant to operational performance or efficiency	• Mix of applied research and development • Short-medium term focus • operational performance related projects
Success measurement	• Not defined	• Annual project review process on a portfolio basis	• Individual project reviews against milestones as part of the project management procedure	• Post project audit	• Combination of criteria
Resource Commitment	• No resource	• Limited resources (less than 2% of total)	• Some resources (2-5%)	• Significant resources (5-10% of total)	

Infrastructure Planning

Indicators	A	B	C	D	E
Organisation and management of infrastructure planning	• Infrastructure planning integrated in R&D planning	• No dedicated Infrastructure planning department • linked to operations planning and/or business planning	• Dedicated infra planning department • Infrastructure planning linked to operations and/or business planning • Replacing of legacy systems depends on operational requirements	• Dedicated infra planning department • Infrastructure planning linked to operations and/or business planning, based on ANA perception • Replacing of legacy systems depends on operational requirements	• Infrastructure planning linked to operations and business planning, based on ANA perception • Close communication with customer at an early stage • Replacing of legacy systems depends on operational requirements
Success measurement	• Customer reaction and meeting predicted timelines for operational availability	• Individual reviews	• Post project audit • Meeting financial forecast and predicted timelines for operational availability	• Individual reviews and/ or Post project audit • Customer reaction • Meeting financial forecast and/or predicted timelines for operational availability	• Most of D + TQM procedures in house
Scope of infrastructure planning	• Limited scope (mainly CNS, ATM systems and tools, training systems, buildings and grounds)	• Limited scope but covers at least operational concept, interface with customer or implication of airborne avionics on ground systems	• Wide scope except a few areas (QMP, Environment, Operational Concept or CDM, and/or Military Systems, etc.)	• Complete scope except one or two of the most difficult areas (interface with customers and partners, implication of airborne avionics, and/or operational concepts)	• Complete scope

Appendix 2 to the Final Report

Study on Benchmarking for Best Practices in Air Traffic Management

FACT SHEETS

31st January, 2003

Introduction

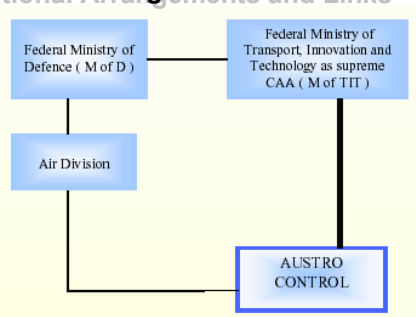
- This appendix offers a template for providers' fact sheets aimed at providing a snapshot of each provider, in terms of key organisational and financial data, as well as key institutional and operational environment data

- These fact sheets have been formed by combining existing data from Eurocontrol's PRR5 fact sheets (Annex 8) as well as new data collected from the providers' answers to the Study's Benchmarking Questionnaire

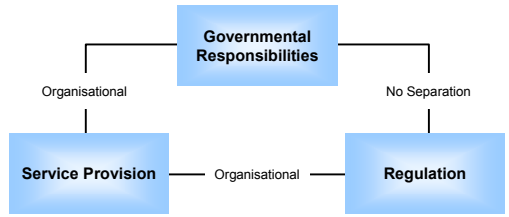
- The remaining gaps reflect areas where there is room for update of information

Institutional, organisational and legal factors

Institutional Arrangements and Links



Sharing of Responsibiliti and Type of Separation



Name:
AustroControl GmbH

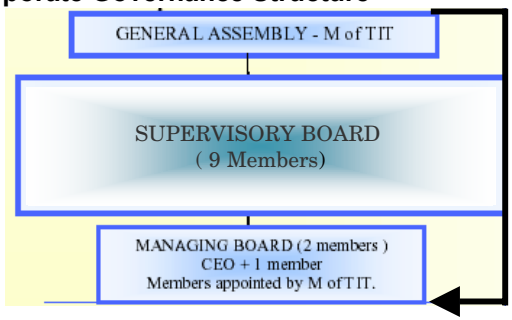
Legal Personality:
Limited liability joint-stock company
100% state owned (Law makes provision for Austrian Airports to own up to 49%)

Date of Establishment in Current Status: 1994

Civil – Military Relationship

Relationship	Actors involved/description of relationship
Formal cooperation between the relevant Ministries	Cooperation takes place between Austro Control GmbH and the responsible organisations of the Ministry of defence in most cases; examples of formal cooperation between the ministries: restricted areas, controlled airspace The use of civil ANS-equpiment by military ANS is regulated by contract between Austro Control and Military according to law

Corporate Governance Structure



Scope of Services

Area control
Approach control
Aerodrome control
Air traffic flow management
Aeronautical information
Flight information
Alerting service
Meteorological information
Airspace management
Search and rescue
Surveillance
Navigation
Aeronautical fixed & mobile comms
Training
Consultancy
Flight inspection
Ground handling / apron control
Met services
Maintenance
Standardisation
IT services
Governmental Services

Financials

€M	1998	1999	2000
Revenues	164	145	168
Enroute Revenues	118	100	121
% Total Revenues	72%	69%	72 %
Assets	205	208	222

Staff Breakdown

ATCO in Ops	238
ATCO in other duties	15
Ab-initio trainee	53
On the job trainee	22
ATC assistants & flight data personnel	19
Technical support staff	238
Administration	161
Ancillary	139
Other	128

General Country Data

GDP per capita: $25,000

Total population (2000): 8,106,000

Purchasing power parities for GDP: 0.910

Source: OECD Statistics

Reference Documents and Links

www.austrocontrol.at

Operational factors

Size of Airspace: 83.862km^2

Operational Units
1. AAC (Wien
6. APPs (Wien, Graz, Innsbruck, Klagenfurt, Linz, Salzburg)
6. TWRs
0. AFIs

Number of FIRs/UIRs – 1

Airspace Structure (map)

Note: Padua is missing in the above diagram

Complexity Level per FIR/UIR: High

Division Level Between Upper and Lower Airspace: FL245

Specific Features of Airspace
Number of boundaries with adjacent *airspace blocks (7 units)*. Wide variation in *traffic density* across *FIR (*in 2000, due to Kosovo crisis; main traffic in the north of FIR (east-west direction)

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	861,926
Visual Flight Rules (VFR)	310,578
Commercial air transport	n/a
General aviation	n/a
Aerial work	
Military flights operating as GAT	45,668
Military flights operating as OAT	
Flights operated using jet aircraft	
Flights operated using turboprops	
Others (UAV etc.)	

Other Traffic Data

Ratio of descending-climbing to overflights: 40% (estimate)

Topography and Metero Related Complexity
Topography complications: Airports in the Alps
Fog: CAT III/ LOW VIS PROC.
Thunderstorms over the Alps:FDEN

Traffic Mix Related Restrictions/Constraints
LOWW VFR Traffic restricted to certain hours, Traffic density, runway capacity

Services Provided to Are Outside Airspace

Third party State	Area delegated	Services provided
All neighbouring units	Strengthening of L.s.Rs;	ATS
Slovenia	Mura Sector	ATS

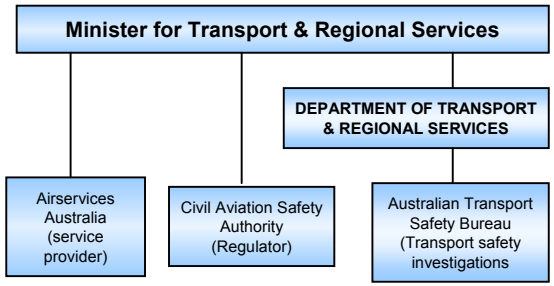
Areas Jointly Managed: None

Services Delegated to Others

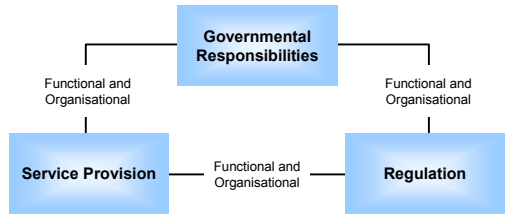
ANSP	Area delegated
All neighbouring providers	Strengthening of L.s.Rs; West Parts of Austria
Germany & Switzerland	West Parts of Austria

Institutional, organisational and legal factors

Institutional Arrangements and Links



Sharing of Responsibilities and Type of Separation



Name:
Airservices Australia

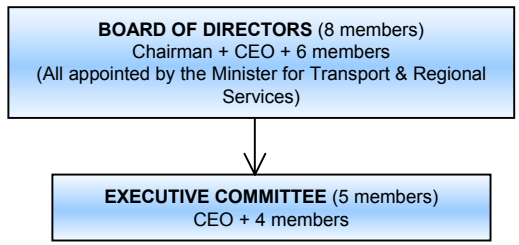
Legal Personality:
Commonwealth Authority

Date of Establishment in Current Status:
1995

Civil – Military Relationship

Strategically co-ordinated through the Air Co-Ordinating Committee hosted by Airservices Australia and the Department of Defence – also includes invitees from Civil Aviation Safety Authority (CASA), Department of Transport & Regional Services (DOTARS), Airlines and Regional Airspace Advisory Committee (RAPAC).
Procedures are tactically co-ordinated through supplements to the Manual of Air Traffic Services.
Further integration is being actively pursued through the development of an Integrated Operating Concept sponsored at government level.

Corporate Governance Structure



Scope of Air Navigation Services

- •Air Traffic Management (ATM)
- • Area control (ACC)
- • Approach control (APP)
- • Aerodrome control (TWR)
- •Oceanic Control
- • Flight information (FIS)
- • Alerting service
- • Air traffic flow management (ATFM)
- • Air Space Management (ASM)
- •CNS (en-route infrastructure)
- •Aeronautical information Service (AIS)
- •Aeronautical Radio Navigation Service
- •Aeronautical Telecommunications Service
- •Aviation Rescue & Fire Fighting

Consultancy
Flight Inspection

Financials

AU$ M	2001	2002
Revenues	583	511
Enroute Revenues	312	267
% Total Revenues	54%	52%
Assets	592	589

Staff Breakdown (as of 2001)

ATCO in Ops/ ATCO in other duties	1067
Flight data personnel	68
Technical support staff	356
Administration	1032
Other (fire fighters)	487

General Country Data

GDP per capita: $26,333

Total population (2000): 19,485,000

Purchasing power parities for GDP: 1.33

Source: OECD Statistics

Reference Documents and Links

www.airservices.gov.au/
Annual Report

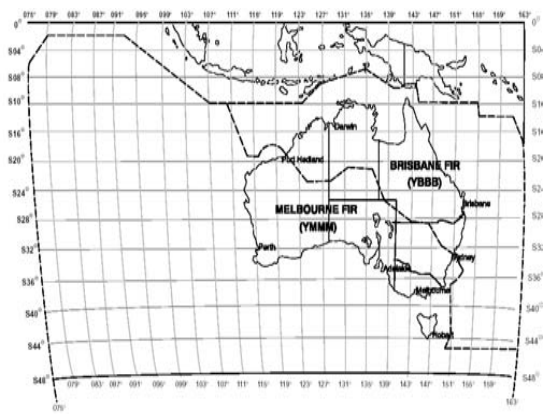
Operational factors

Size of Airspace – 56,000,000 km^2

Operational Units
2. ATCCs (Brisbane, Melbourne)
8. APPs
38. TWRs

Number of FIRs/UIRs – 2 FIRs

Airspace Structure (map)



Complexity Level per ATCC "Area of Responsibility" : Brisbane – Medium, Melbourne - Medium

Division Level Between Upper and Lower Airspace: None.

Specific Features of Airspace
Large areas of oceanic airspace are covered
Australian FIRs are adjacent to 11 other FIRs
Majority of traffic is concentrated in the East and South East
Large proportion of airspace also covers remote continental areas.

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	1,159,547
Visual Flight Rules (VFR)	990,285
Commercial air transport	
General aviation	
Aerial work	
Military flights operating as GAT	
Military flights operating as OAT	
Flights operated using jet aircraft	419,671
Flights operated using turboprops	
Others (UAV etc.)	

Other Traffic Data

Ratio of descending-climbing to overflights:

Very few overflights

Topography and Metero Related Complexity
Infrastructure concentrated in East Coast areas – all other continental coverage focused >FL200
Perth encounters windshear in summer. Fog is encountered at some aerodromes.

Traffic Mix Related Restrictions/Constraints
Service levels are adjusted to variations in sector volumes by introducing Class A, Class , Class E and Class G airspace.

Services Provided to Areas Outside National Airspace

Third party State	Areas where services are provided	Services provided
Solomon Islands	Upper Airspace	ATM

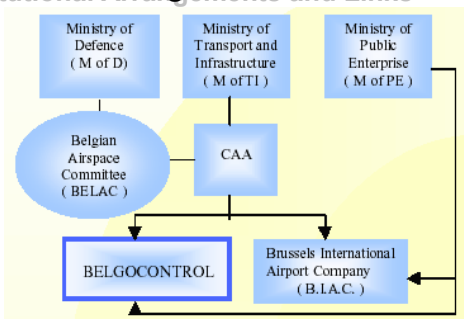
Services Delegated to Others

ANSP	Services delegated
RAAF	ATM in certain airspace associated with military activity

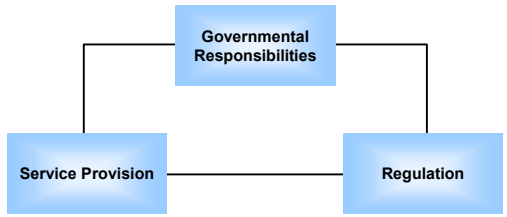
Areas Jointly Managed:

Institutional, organisational and legal factors

Institutional Arrangements and Links



Sharing of Responsibiliti and Type of Separation



Name:
BelgoControl

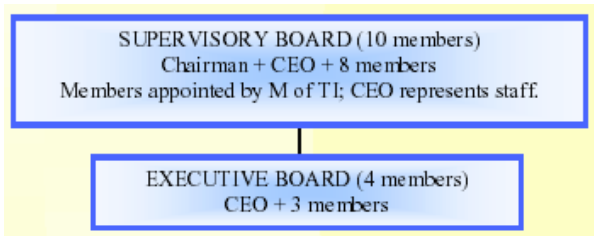
Legal Personality:
Public Autonomous Enterprise under a management contract. 100% state owned

Date of Establishment in Current Status: 1998

Civil – Military Relationship

Relationship	Actors involved/description of relationship
Formal cooperation between the relevant Ministries	BAF – CAA - Belgocontrol

Corporate Governance Structure



Scope of Services

Area control
Approach control
Aerodrome control
Air traffic flow management
Aeronautical information
Flight information
Alerting service
Meteorological information
Airspace management
Surveillance
Navigation
Aeronautical fixed comms
Aeronautical mobile comms

Financials

€M	1998	1999	2000
Revenues	132	156	154
Enroute Revenues	108	113	120
% Total Revenues	81%	72%	78%
Assets	275	297	318

Staff Breakdown

ATCO in Ops	411
ATCO in other duties	
Ab-initio trainee	
On the job trainee	
ATC assistants & flight data personnel	
Technical support staff	311
Administration	161
Ancillary	179
Other	135

General Country Data

GDP per capita: $25,300

Total population (2000): 10,251,000

Purchasing power parities for GDP: 0.924

Source: OECD Statistics,k

Reference Documents and Links

www.belgocontrol.be

Annual Report

Operational factors

Size of Airspace: 36,000 km^2

Operational Units
1. AAC (Brussels)
3. APPs (Brussels, Antwerp, Oostende)
5. TWRs (Brussels, Antwerp, Liege, Charleroi, Oostende)
0. AFIs

Number of FIRs/UIRs – 1/1

Airspace Structure (map)

Complexity Level per FIR/UIR: High

Division Level Between Upper and Lower Airspace: FL245

Specific Features of Airspace
Upper airspace served by Maastricht
8 neighbouring blocks in the Upper and Lower Airspace

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	570,255
Visual Flight Rules (VFR)	
Commercial air transport	
General aviation	
Aerial work	
Military flights operating as GAT	
Military flights operating as OAT	
Flights operated using jet aircraft	
Flights operated using turboprops	
Others (UAV etc.)	

Other Traffic Data

Ratio of descending-climbing to overflights:

IFR Flights domestic or international ratio:

Topography and Metero Related Complexity

Traffic Mix Related Restrictions/Constraints

Services Provided to Are Outside Airspace

Third party State	Area delegated	Services provided
Luxembourg	Luxembourg outside CTR	Enroute and parts of the Approach Service

Areas Jointly Managed: Nil

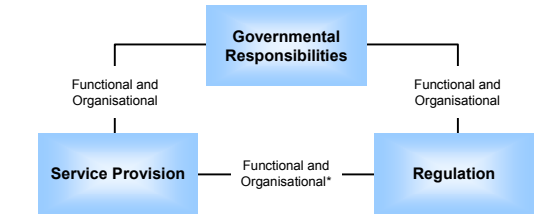
Services Delegated to Others

ANSP	Area delegated
Eurocontrol	Brussels UIR

Institutional, organisational and legal factors

Institutional Arrangements and Links

Sharing of Responsibiliti and Type of Separation



* Except for safety

Name:
NavCanada

Legal Personality:
Private Company

Date of Establishment in Current Status:

Civil – Military Relationship

Relationship	Actors involved/description of relationship
?	?

Corporate Governance Structure

Scope of Services

Area control
Approach control
Aerodrome control
Oceanic control
Air traffic flow management
Aeronautical information
Flight information
Alerting service
Meteorological information
Airspace management
Search and rescue
Surveillance
Navigation
Aeronautical information

Financials

CAN$k	2000	2001
Revenues	900 879	907 649
Assets	232 840	230 530

Staff Breakdown

	2001
ATCO in Ops	
ATCO in other duties	223
Ab-initio trainee	30
ATC assistants & flight data personnel	1253
Technical support staff	1108
Administration	450
Others	538

General Country Data

GDP per capita: $24,800

Total population (2000): 30,750,000

Purchasing power parities for GDP: 1.20

Source: OECD Statistics

Reference Documents and Links

www.navcanada.ca/

Annual Report
Business Plan 2000-2003
Safety Plan 2001-2002
RVSM Implementation Plan 2001

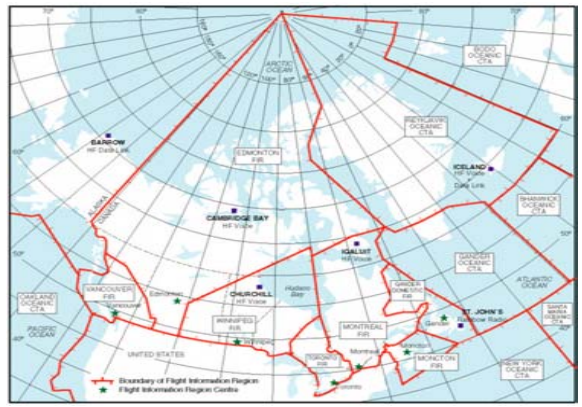
Operational factors

Size of Airspace: 21,352,689km^2

Operational Units

Number of FIRs/UIRs – 8

Airspace Structure (map)



Complexity Level per FIR/UIR: N/A

Division Level Between Upper and Lower Airspace: ?

Specific Features of Airspace
Upper airspace only: All FIRs, **Lower airspace only:** All FIRs
Oceanic airspace: Gander Oceanic FIR, **Interface to oceanic airspace:** Edmonton, Toronto, Montreal, Moncton, Gander

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	3,642,959
Visual Flight Rules (VFR)	864,102
Air Carriers	2,921,948
Gov. Civil	31,566
Military flights	12,880
Military flights	
Flights operated using jet aircraft	2,196,062
Flights operated using turboprops	1,249,303
Private	1,232,737
???	3,193
Others (UAV etc.)	
Total	**4,507,861**

Other Traffic Data

Ratio of descending-climbing to overflights:

Topography and Metero Related Complexity
Mountainous regions complicate arrival or departure procedures: Vancouver FIR, **Large areas (land or water) that create coverage problems for terrestrial systems (Remote Areas):** Edmonton FIR, Winnipeg FIR, Montreal and Gander, **Windshear/microbursts:** All FIRs, **Clear air turbulence /mountain waves:** All FIRs, **Fog:** All FIRs
Other features (please specify): Winter conditions

Traffic Mix Related Restrictions/Constraints
N/A

Services Provided to Are Outside Airspace

Third party State	Area delegated	Services provided
U.S.	See attachment 9	Enroute

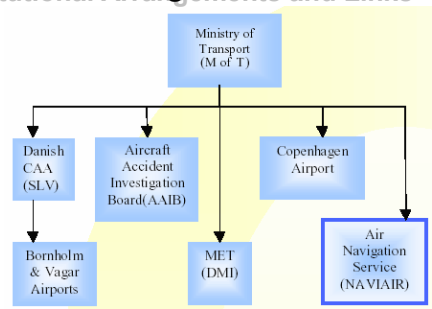
Areas Jointly Managed:
FAA – Various border regions – ATC
UK NATS – North Atlantic – ATC

Services Delegated to Others

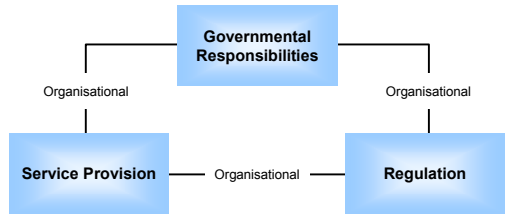
ANSP	Area delegated	Observed advantages or disadvantages
FAA	See attachment 9	Enroute

Institutional, organisational and legal factors

Institutional Arrangements and Links



Sharing of Responsibiliti and Type of Separation



Name:
Naviair

Legal Personality:
State Enterprise

Date of Establishment in Current Status: 2001

Civil – Military Relationship

Relationship	Actors involved/description of relationship
Agreement on Integration of civil and military flights in CPH ACC	Naviair responsible for the management of CPH ACC

Corporate Governance Structure

EXECUTIVE BOARD (6 members)
CEO + 5 members
The CEO is appointed by the M of T.

Scope of Services

TBD

Financials

€M	1998	1999	2000
Revenues	729	851	888
Enroute Revenues	429	455	473
% Total Revenues	59%	54%	53%
Assets	232	230	335

Staff Breakdown 2001

ATCO in Ops	194.5
ATCO in other duties	89.9
Ab-initio trainee	43.3
ATC assistants & flight data personnel	112.7
Technical support staff	138.6
Administration	157.7
Others, on the job training	24.2

General Country Data

GDP per capita: $25,500

Total population (2000): 5,337,000

Purchasing power parities for GDP: 8.34

Source: OECD Statistics

Reference Documents and Links

http://www.naviair.dk

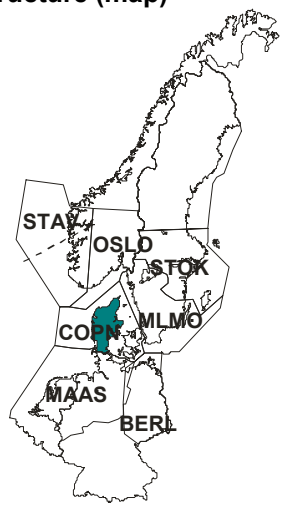
Operational factors

Size of Airspace – 134,048 km^2 (excluding Greenland)

Operational Units
1. AACs (Copenhagen)
4. APPs
8. TWRs
1. AFIs

Number of FIRs/UIRs – 1

Airspace Structure (map)



Complexity Level per FIR/UIR: Medium,

Division Level Between Upper and Lower Airspace: FL285

Specific Features of Airspace

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	581,088
Visual Flight Rules (VFR)	
Commercial air transport	
General aviation	
Aerial work	
Military flights operating as GAT	
Military flights operating as OAT	
Flights operated using jet aircraft	
Flights operated using turboprops	
Others (UAV etc.)	

Other Traffic Data

Ratio of descending-climbing to overflights: 58%

Topography and Metero Related Complexity

Fog: Lower capacity at airports.
Thunderstorms: CB-activities lower the capacity

Traffic Mix Related Restrictions/Constraints

Services Provided to Areas Outside Airspace

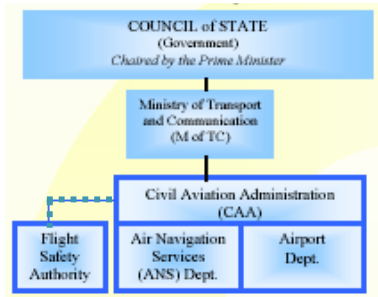
Third party State	Area delegated	Services provided
	24,213 skm	ATS

Services Delegated to Others
N/A

Areas Jointly Managed: Nil

Institutional, organisational and legal factors

Institutional Arrangements and Links



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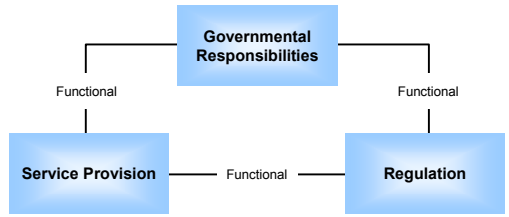


Name:
Civil Aviation Administration (CAA)

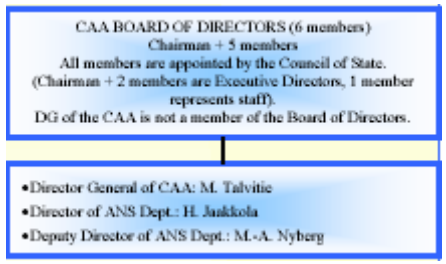
Legal Personality:
State Enterprise

Date of Establishment in Current Status: 1991

Civil – Military Relationship

Relationship	Actors involved/description of relationship
Formal cooperation between the relevant Ministries	CAA and FAF, ANS provided by CAA ANSP services for FAF are based on the commercial agreement between the CAA and the MIL Authorities

Corporate Governance Structure



Scope of Services

Area control
Approach control
Aerodrome control
Air traffic flow management
Aeronautical information
Flight information
Alerting service
Meteorological service
Airspace management
Surveillance
Navigation
Aeronautical fixed comms
Aeronautical mobile comms
Training
Consultancy
Flight inspection
Search & Rescue

Financials

€M	1998	1999	2000
Revenues	181	184	195
Enroute Revenues	15	17	20
% Total Revenues	9%	9%	10%
Assets	556	594	639

Note: Figures for total CAA

Staff Breakdown 2001 (ANS Only)

ATCO in Ops	233
ATCO in other duties	34
Ab-initio trainee	42
ATC assistants & flight data personnel	55
Technical support staff	133
Administration	13
Others	

General Country Data

GDP per capita: $22,900

Total population (2000): 5,181,000

Purchasing power parities for GDP: 0.992

Source: OECD Statistics

Reference Documents and Links

http://www.fcaa.fi

Operational factors

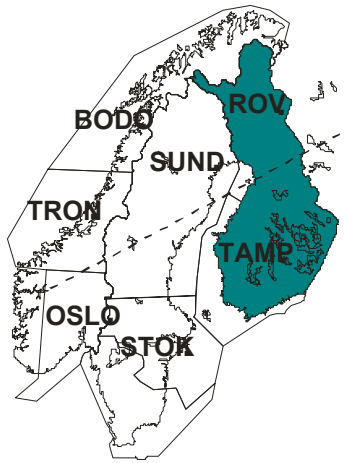
Size of Airspace – 439,790 km^2

Operational Units

2. AACs (Rovaniemi, Tampere)
5. APPs (Helsinki, Jyväskyä, Kuopio, Tampere-Pirkkala, Rovaniemi)
2. Mil-APPs (Halli, Kauhava)
19 TWR
6. AFIs

Number of FIRs/UIRs – 2 (EEPS, EFES)

Airspace Structure (map)



Complexity Level per FIR/UIR: EEPS: low, EFES: medium

Division Level Between Upper and Lower Airspace: FL245

Specific Features of Airspace

Finland has an Air Defence Identification Zone protecting its continental airspace and Territorial Sea
Finland has the Border towards non-ECAC airspace and is therefore i.a. RVSM transition zone

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	221,996
Visual Flight Rules (VFR)	
Commercial air transport	
General aviation	
Aerial work	
Military flights operating as GAT	
Military flights operating as OAT	
Flights operated using jet aircraft	
Flights operated using turboprops	
Others (UAV etc.)	

Other Traffic Data

Ratio of descending-climbing to overflights:
EFPS: 80%, EFES:70%

Topography and Metero Related Complexity

Fog: Low layer morning fog at sunrise time.
Snow

Traffic Mix Related Restrictions/Constraints

Services Provided to Areas Outside Airspace

Nil

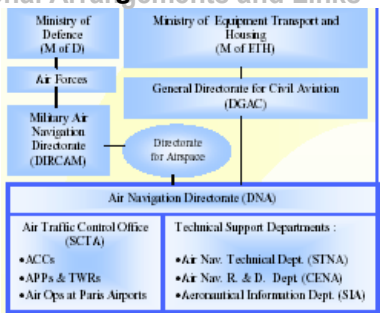
Areas Jointly Managed: Nil

Services Delegated to Others

ANSP	Area delegated
Sweden	Kvarken on Gulf of Bothnia
Norway	A small portion of the Northern part of Finland

Institutional, organisational and legal factors

Institutional Arrangements and Links



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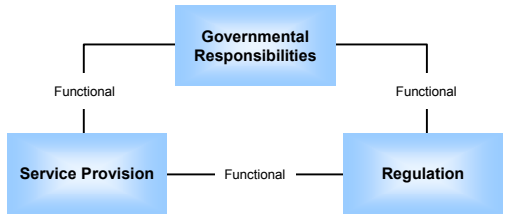


Name:
DNA

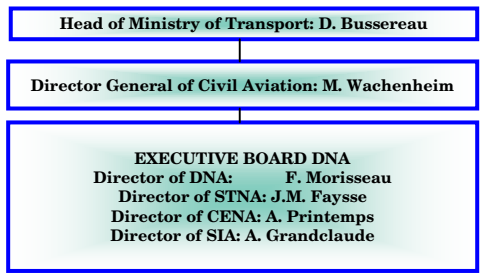
Legal Personality:
Government department

Date of Establishment in Current Status:

Civil – Military Relationship

Relationship	Actors involved/description of relationship

Corporate Governance Structure



Scope of Services

Area control
Approach control
Aerodrome control
Oceanic control
Air traffic flow management
Aeronautical information
Flight information
Alerting service
Airspace management
Surveillance
Navigation
Communications
Training
Consultancy
Search & Rescue

Financials

€M	1998	1999	2000
Revenues	948	1 017	997
Enroute Revenues	770	826	799
% Total Revenues	81%	81%	80%
Assets	606	660	585

Staff Breakdown (2001)

ATCO in Ops	2381
ATCO in other duties	186
Ab-initio trainee	449
Technical support staff	4082
Administration	1057
Others	449

General Country Data

GDP per capita: $24,400

Total population (2000): 58,892,000

Purchasing power parities for GDP: 0.941

Source: OECD Statistics

Reference Documents and Links

www.aviation-civile.gouv.fr/
Annual Report
Plan Strategique DGAC
French Civil Aviation National Budget 2003

Operational factors

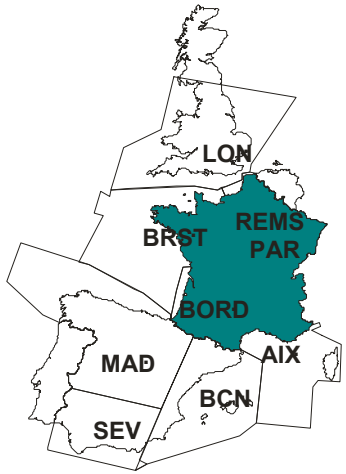
Size of Airspace – 1,159,347 km^2

Operational Units

5. AACs (Paris, Bordeaux, Marseille, Brest, Reims)
11. APPs
66. TWRs
0. AFIs

Number of FIRs/UIRs

Airspace Structure (map)



Complexity Level per FIR/UIR: Bordeaux: Medium, Paris:High

Division Level Between Upper and Lower Airspace: FL195

Specific Features of Airspace
Numerous military areas
Interface to oceanic airspace
Large number of boundaries with adjacent airspace blocks

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	2,501,025
Visual Flight Rules (VFR)	
Commercial air transport	
General aviation	
Aerial work	
Military flights operating as GAT	
Military flights operating as OAT	
Flights operated using jet aircraft	
Flights operated using turboprops	
Others (UAV etc.)	

Other Traffic Data

Ratio of descending-climbing to overflights:
62.5%

Topography and Metero Related Complexity
Fog: Regular phenomena
Thunderstorms mostly in Bordeaux ACC area

Traffic Mix Related Restrictions/Constraints

Services Provided to Areas Outside Airspace

Third party State	Area delegated	Services provided

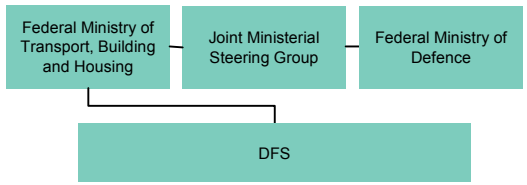
Areas Jointly Managed:

Services Delegated to Others

ANSP	Area delegated
Jersey	Channel Islands Control Zone
Skyguide	Geneva delegated area

Institutional and Organisational Factors

Institutional Arrangements and Links



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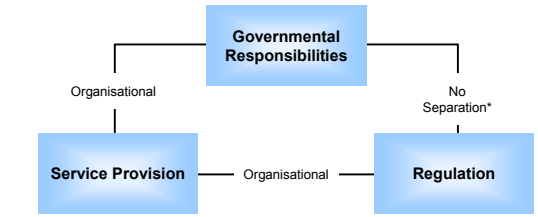


* Except functional in economics, organisational in accident investigations

Name:
DFS Deutsche Flugsicherung GmbH (DFS)

Legal Personality:
Limited liability company, governed by Private Company Law
100% state Owned
Integrated civil/military ANSP

Date of Establishment in Current Status:

Civil – Military Relationship

Relationship	Actors involved/description of relationship
Formal co-operation between Ministries	MoD and MOT by an Interdepartmental agreement
One ministry takes responsibility for all services	Agreement concerning ANS in crisis or war
Other mechanism	Follow – on Agreements on execution level

Corporate Governance Structure

Scope of Services

Area control
Approach control
Aerodrome control
Air traffic flow control
Aeronautical information
Flight information
Alerting
Airspace management
Surveillance
Navigation
Training
Consultancy
Flight inspection
Apron control

Financials €M

	1998	1999	2000
Revenues	884	898	894
Enroute Revenues	554	551	567
% Total Revenues	63%	61%	63%
Assets	1 181	1 157	1 244

Staff Breakdown

ATCO in Ops	1756
ATCO in other duties	182
Ab-initio Trainee	170
ATC Assistants & Flight Data Personnel	523
Technical support staff	1042
Administration	1044
Other	457

General Country Data

GDP per capita: $23,400

Total population (2000): 82,205,000

Purchasing power parities for GDP: 0.946

Source: OECD Statistics,

Reference Documents and Links

http://www.dfs.de/dfs/english/index.html

Annual Report

Operational factors

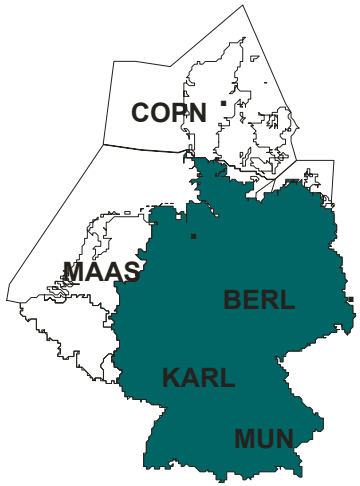
Size of Airspace: 386,421 km^2

Operational Units

1 UAC (Karlsruhe)
2 ACCs/UACs/APPs (Berlin, München)
3 ACCs/APPs (Bremen, Düsseldorf, Langen)
1 ACC for OAT in upper airspace in North-Western Germany (co-located with Maastricht UAC)
17 TWRs

Number of FIRs/UIRs – 5/3

Airspace Structure (map) Upper Airspace



Complexity Level per FIR/UIR: Bremen and Berlin low/medium
Duesseldorf, Rhein, Frankfurt, Muenchen high

Division Level Between Upper and Lower Airspace: FL 245

Specific Features of Airspace
Large number of neighbouring airspace blocks of different complexity

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	2,561,153
Visual Flight Rules (VFR)	
Commercial air transport	
General aviation	
Aerial work	
Military flights operating as GAT	40,037
Military flights operating as OAT	54,407
Flights operated using jet aircraft	80 %
Flights operated using turboprops	15 %
Others	5 %

Other Traffic Data

Ratio of descending-climbing to overflights:

Climb	18,7 %
Level	58,6 %
Descend	22.7 %

Topography and Meteo Related Complexity
Ratio of descending-climbing over flight: Topography complications: Alpine area in the south, no radar over parts of the North Sea
Clear air turbulence: Over Southern Germany
Fog: Regular phenomena

Traffic Mix Related Restrictions/Constraints
High amount of Temporary Segregated Areas, Glider areas, high number of VFR traffic

Services Provided to Areas Outside Airspace
N/A

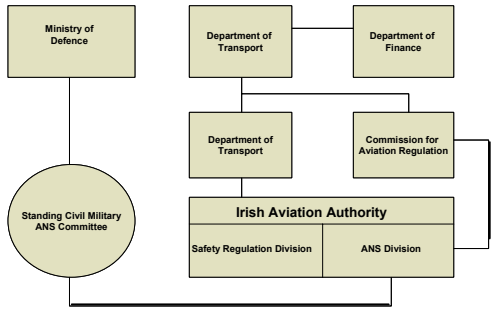
Areas Jointly Managed: Nil

Services Delegated to Others

ANSP	Area
Maastricht UAC	Hannover UIR
Sky Guide	Small parts of Rhein UIR, Frankfurt FIR, Muenchen FIR
Reims	Small part of lower airspace in the Frankfurt FIR

Institutional, organisational and legal factors

Institutional Arrangements and Links



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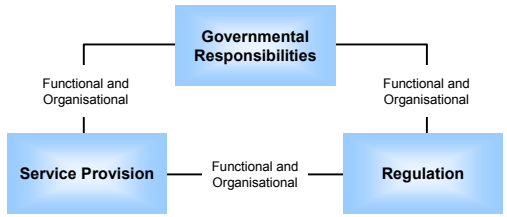


Name:
Irish Aviatin Authority

Legal personality:
Commercialised Public entity, wholly owned by the Irish State

Date of Establishment in Current Status: 1994

Civil – Military Relationship

Relationship	Actors involved / Description of Relationship
Formal co-operation between the relevant Ministries	Co-ordination between IAA and the Dept of Defence on ANS

Corporate Governance Structure

Board of the Authority (9 members)
Chairman + CEO + 7 Members
Chairman and other members are appointed by the Minister of Transport with the consent of the Minister of Finance
Board appoints CEO after consultation with Minister of Transport

Scope of Services

TBD

Financials

€M	1998	1999	2000
Revenues	74	76	75
Enroute Revenues	47	50	49
% Total Revenues	64%	66%	65%
Assets	71	67	76

Staff Breakdown: (year 2000)

ATCO in Ops	236
ATCO in other duties	40
Ab-initio trainee	14
ATC Assistants & Flight data personnel	27
Technical support staff	71
Administration	132
Others	104

General Country Data

GDP per capita: $21,600

Total population (2000): 3,787,000

Purchasing power parities for GDP: 0.989

Source: OECD Statistics

Reference Documents and Links

www.iaa.ie/

Annual Report

Operational factors

Size of Airspace – 358,411km^2

Operational Units

2. AACs (Dublin, Shannon)
3. APPs (Dublin, Shannon, Cork)
3. TWRs (Dublin, Shannon, Cork)
0. AFIs

Number of FIRs/UIRs – 1 Shannon FIR, 2 Shannon UIR, 3 SOTA

Airspace Structure (map)

Complexity Level per FIR/UIR:

1. Medium
2. Medium to high
3. Medium to high

Division Level Between Upper and Lower Airspace: FL245

Specific Features of Airspace **Fog: Upper airspace:** Variable traffice density depending on Oceanic track structure, **Lower airspace:** Various regional airports. Dublin airport close to FIR boundary, **Interface to oceanic airspace:** Large interface with oceanic airspace,
Wide variation in traffic density across FIR: Very large variation in traffic density across the FIR, **Other features:** Short term traffic levels are not easily forecast and actual traffic levels vary twice daily with only 12 hours notice of numbers and orientation

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	430,490
Visual Flight Rules (VFR)	23,062
Commercial air transport	
General aviation	
Aerial work	
Military flights operating as GAT	
Military flights operating as OAT	
Flights operated using jet aircraft	
Flights operated using turboprops	
Others (UAV etc.)	

Other Traffic Data

Ratio of descending-climbing to overflights: 48%-52%

Topography and Metero Related Complexity

Large areas (land or water) that create coverage problems for terrestrial systems (Remote areas)

Traffic Mix Related Restrictions/Constraints

Services Provided to Areas Outside Airspace

Third party State	Area delegated	Services provided
ICAO	SOTA	Full ATS
UK	Irish/UK/French boundary	Full ATS
France	Irish/UK/French boundary	Full ATS

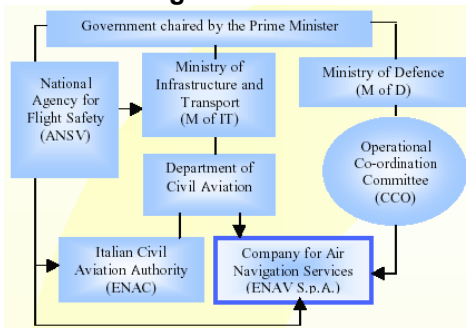
Services Delegated to Others

N/A

Areas Jointly Managed:

Institutional, organisational and legal factors

Institutional Arrangements and Links



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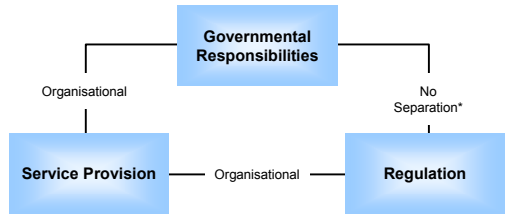


Name:
ENAV S.p.A. (Ente nazionale di Assitenza al Volo)

Legal Personality:
Joint stock company (shares are held by the government)

Date of Establishment in Current Status: 2001

Civil – Military Relationship

Relationship	Actors involved/description of relationship
Co-ordination between the Military authorities and the ANS provider	Italian Air Force and ENAC/ENAV

Corporate Governance Structure

ADMINISTRATION BOARD (8 members)
Chairman + MD + 6 members

Board appointed by the Ministry of Economy in consultation with the M. of IT, from a list of experts in civil aviation matters. The Board delegates its executive power to one of its members who is appointed as Managing Director. The MD then appoints the Director General in charge of all operational and co-ordination units who acts as a Chief Operating Officer (COO) or CEO.
In case the Director General is not appointed as CEO, the Managing Director operates both as M.D. and CEO.

Managing Director

Scope of Services

Area control
Approach control
Aerodrome control
Air traffic flow management
Aeronautical information
Flight information
Alerting service
Meteorological information
Airspace management
Search and rescue
Surveillance
Navigation
Aeronautical fixed comms
Aeronautical mobile comms
Training
Flight inspection
Fire and rescue

Financials

€M	1998	1999	2000
Revenues	464	523	422
Enroute Revenues	348	387	401
% Total Revenues	75%	74%	77%
Assets	1 389	1 560	1 707

Staff Breakdown

ATCO in Ops	1366
ATCO in other duties	187
Ab-initio trainee	110
ATC assistants & flight data personnel	942
Technical support staff	210
Administration	406
Other Informatics	92
Meteorologist	31
Pilots + inspection operators	23
Supports	62

General Country Data

GDP per capita: $22,100

Total population (2000): 57,189,000

Purchasing power parities for GDP: 0.790

Source: OECD Statistics

Reference Documents and Links

www.enav.it/

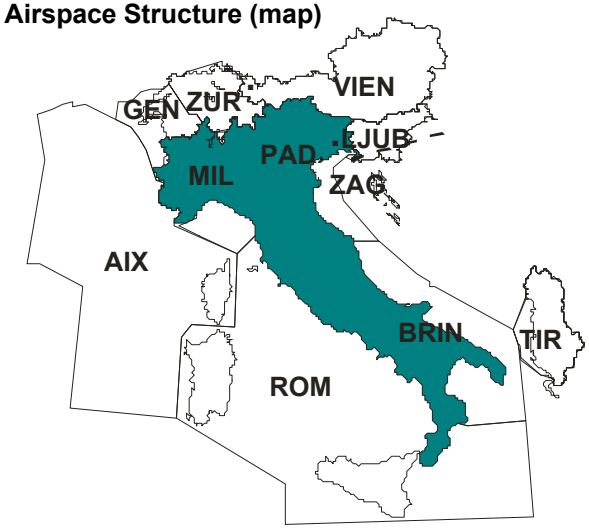
Operational factors

Size of Airspace: 726,500 km^2

Operational Units
4. AACs (Milan, Paudua, Rome, Brindisi)
19. APPs TWRs
25. TWRs
14. AFIs

Number of FIRs/UIRs – 3 FIR/1 UIR (4 ACCs)

Airspace Structure (map)



Complexity Level per FIR/UIR: ML – H – H + ML

Division Level Between Upper and Lower Airspace: FL195

Specific Features of Airspace
Milano ACC only works Lower Airspace

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	1,355,251
Visual Flight Rules (VFR)	96,581
Commercial air transport	
General aviation	
Aerial work	
Military flights operating as GAT	
Military flights operating as OAT	
Flights operated using jet aircraft	
Flights operated using turboprops	
Others (UAV etc.)	

Other Traffic Data

Ratio of descending-climbing to overflights:

Topography and Metero Related Complexity
Mountainous regions (Limitations for IFR - procedures and coverage problems)

Large Areas over water east of Sardinia and south of Italy

Traffic Mix Related Restrictions/Constraints
Mix of OAT and GAT

Services Provided to Are Outside Airspace

Third party State	Area delegated	Services provided
Switzerland, France, Tunisia, Malta, FYROM, Slovenia, Austria	Parts of TMA and along airways	ATS including AFTM

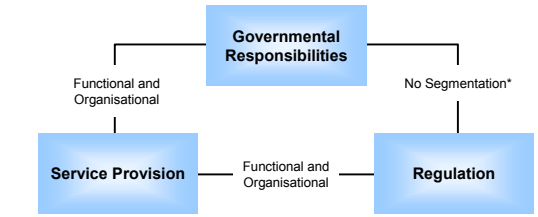
Areas Jointly Managed: No

Services Delegated to Others
N/A

Institutional, organisational and legal factors

Institutional Arrangements and Links

Sharing of Responsibilities and Type of Separation



* Except for accident and appeals/dispute resolution(functional and organisational)

Name:
Luxembourg Airport Administration

Legal Personality:
Government Agency

Date of Establishment in Current Status:

Civil – Military Relationship

No military air navigation service

Corporate Governance Structure

Scope of Services

Area control
Approach control
Aerodrome control
Air traffic flow management
Aeronautical information
Flight information
Alerting service
Meteorological service
Search and rescue
Surveillance
Navigation
Aeronautical fixed comms
Aeronautical mobile comms
Fire and rescue

Financials

Staff Breakdown

ATCO in Ops	40
ATCO in other duties	
Ab-initio trainee	5
ATC assistants & flight data personnel	0
Technical support staff	43
Administration	7
Other	59

General Country Data

GDP per capita: $36,400

Total population (2000): 439,000

Purchasing power parities for GDP: 0.956

Source: OECD Statistics

Reference Documents and Links

Operational factors

Size of Airspace – 300,000 km^2

Operational Units
?
?

Number of FIRs/UIRs – 1

Airspace Structure (map)

Complexity Level per FIR/UIR: Medium

Division Level Between Upper and Lower Airspace: 195

Specific Features of Airspace
Lower Airspace only up to FL 135, Neighbours are France, Germany, and Belgium, 80% of the traffic is transiting the airspace

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	56,317
Visual Flight Rules (VFR)	4,809
Commercial air transport	55,110
General aviation	5,195
Aerial work	150
Military flights operating as GAT	n/a
Military flights operating as OAT	n/a
Flights operated using jet aircraft	37,869
Flights operated using turboprops	23,257
Others (UAV etc.)	

Other Traffic Data

Ratio of descending-climbing to overflights:

Topography and Metero Related Complexity

Narrow and small airspace

Fog – Requiring CAT 2 and 3 operations

Traffic Mix Related Restrictions/Constraints

None

Services Provided to Areas Outside Airspace

Third party State	Area delegated	Services provided
Germany	At the boundary from 2 500 feet to FL 135	ATC, Flight Information, Alerting Service
France	At the boundary from 2 500 feet to FL 135	ATC, Flight Information, Alerting Service
Belgium	At the boundary from 2 500 feet to FL 135 + 2 Airways	ATC, Flight Information, Alerting Service

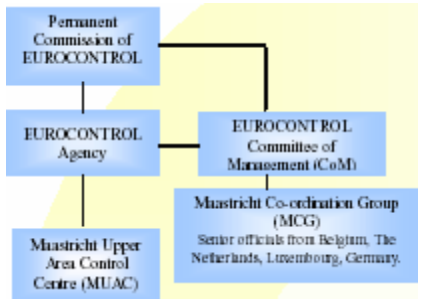
Areas Jointly Managed: None

Services Delegated to Others

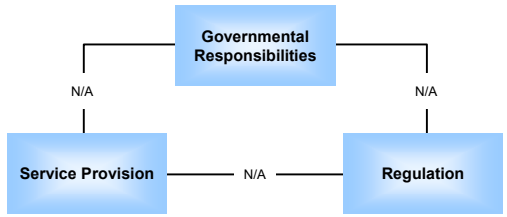
ANSP	Area delegated
Belgocontrol	Luxembourg territory from FL 135 to FL 245
Eurocontrol Maastricht	Luxembourg territory above FL 245
Eifel Control (USAFE)	Area for Tacan Approache ETAD Rwy 05

Institutional, organisational and legal factors

Institutional Arrangements and Links



Sharing of Responsibiliti and Type of Separation

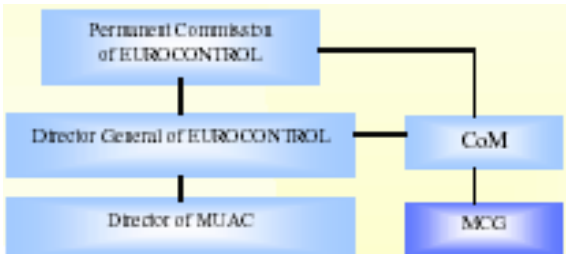


Name:
Maastricht UAC , EUROCONTROL
Legal Personality:
EUROCONTROL: International Organisation established under the EUROCONTROL Convention of 13.12.19 and amended on 12.2.1981.
Date of Establishment in Current Status:
At the request of the Benelux States and Germany, MUAC is operated as a EUROCONTROL Agency's Service according to the Maastricht Agreements of 25.11.1986

Civil – Military Relationship

Relationship	Actors involved/description of relationship
Military objectives dealt with at national levels	Four Member States Concerned

Corporate Governance Structure



Scope of Services

Area control
Air traffic flow management
Aeronautical information
Flight information
Alerting service
Airspace management
Surveillance
Navigation
Aeronautical fixed comms
Aeronautical mobile comms

Financials

€M	1998	1999	2000
Revenues	76	83	89
Enroute Revenues	72	78	85
% Total Revenues	95%	95%	95%
Assets	69	71	74

Staff Breakdown - 2001

ATCO in Ops	175
ATCO in other duties	26
Ab-initio trainee	47
ATC assistants & flight data personnel	135
Technical support staff	131
Administration	37
Other	10

General Country Data

GDP per capita: NA

Total population (2000): NA

Purchasing power parities for GDP: NA

Source: OECD Statisticsk

Reference Documents and Links

Operational factors

Size of Airspace:

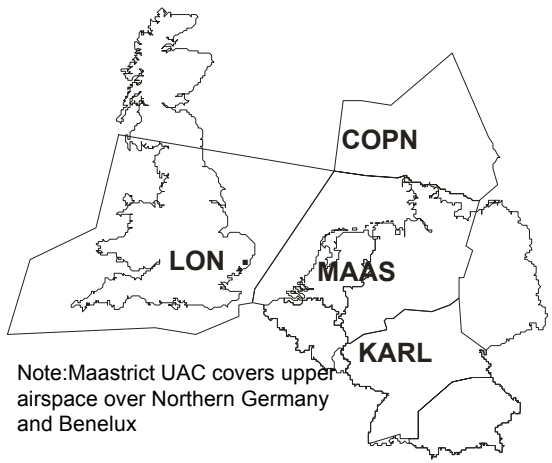
261.392 km^2

Operational Units

1. ACC (Maastricht-UAC)

Number of FIRs/UIRs – 1/2

Airspace Structure (map)



Note:Maastrict UAC covers upper airspace over Northern Germany and Benelux

Complexity Level per FIR/UIR:

High Complexity

Division Level Between Upper and Lower Airspace: FL245 (with upper limit FL 660 and unlimited in the case of German airspace)

Specific Features of Airspace

Upper Airspace only.
Airspace delegated by Four Member States.

Traffic Data (2001)

Traffic Breakdown

Instrument Flight Rules (IFR)	1,229,413

Other Traffic Data

Ratio of descending-climbing to over flights: 75 %

Topography and Meteo Related Complexity

High Complexity

Traffic Mix Related Restrictions/Constraints

Services Provided to Areas Outside Airspace

Third party State	Area delegated	Services provided
Belgium	Above Brussels FIR	ANS
Germany	Hannover UIR and parts of the airspace above Berlin FIR	ANS
Netherlands	Upper part of Amsterdam FIR	ANS

Services Delegated to Others

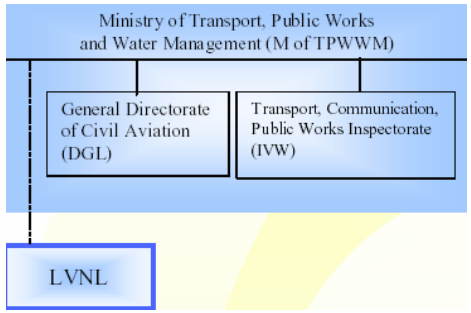
N/A

Areas Jointly Managed:

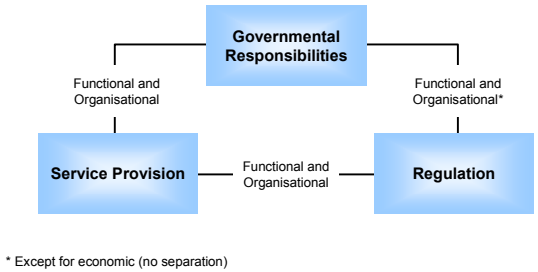
Northern Germany with DFS for Control of German OAT

Institutional, organisational and legal factors

Institutional Arrangements and Links



Sharing of Responsibilities and Type of Separation



* Except for economic (no separation)

Name: LVNL

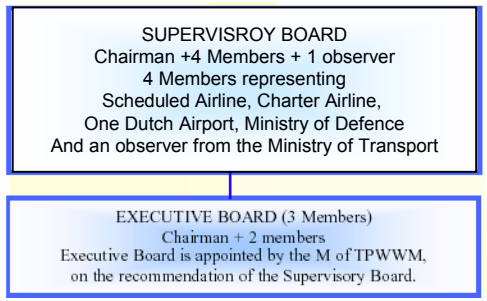
Legal Personality: Corporatised, 100% state owned

Date of Establishment in Current Status: 1993

Civil – Military Relationship

Formal cooperation between the relevant Ministries: CAA
LVNL Military NRAF HQ and MIL/ATC

Corporate Governance Structure



Scope of Services

Area control
Approach control
Aerodrome control
Air traffic flow management
Aeronautical information
Flight information
Alerting service
Airspace management
Surveillance
Navigation
Aeronautical fixed comms
Aeronautical mobile comms

Financials

NLG M	1998	1999	2000
Revenues	309	338	362
Enroute Revenues	224	183	257
% Total Revenues	72%	53%	70%
Assets	565	539	554

Staff Breakdown

ATCO in Ops	159
ATCO in other duties	28
Ab-initio trainee	20
ATC assistants & flight data personnel	70
Technical support staff	356
Administration	256
Others	50

General Country Data

GDP per capita: $24,400

Total population (2000): 15,926,000

Purchasing power parities for GDP: 0.933

Source: OECD Statistics

Reference Documents and Links

www.lvnl.nl/

Operational factors

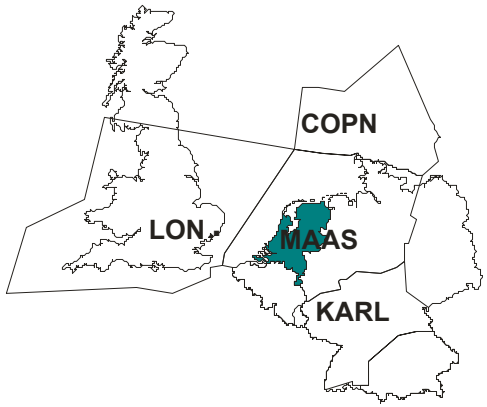
Size of Airspace – 90,324 km^2

Operational Units
1. AACs (Amsterdam)
4. APPs (Schiphol, Rotterdam, Eelde, Beek)
4. TWRs (Schiphol, Rotterdam, Eelde, Beek)

1. AFIs

Number of FIRs/UIRs – 1 (EHACC)

Airspace Structure (map)



Complexity Level per FIR/UIR: High

Division Level Between Upper and Lower Airspace: FL245

Specific Features of Airspace
Upper airspace only: UAC MAS
Lower airspace only: LVNL

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	542,929
Visual Flight Rules (VFR)	
Commercial air transport	
General aviation	
Aerial work	
Military flights operating as GAT	
Military flights operating as OAT	
Flights operated using jet aircraft	
Flights operated using turboprops	
Others (UAV etc.)	

Other Traffic Data

Ratio of descending-climbing to overflights:

Topography and Metero Related Complexity
Windshear/microbursts: Use of runways
Fog: Use of runways

Traffic Mix Related Restrictions/Constraints

Services Provided to Areas Outside Airspace
None

Services Delegated to Others

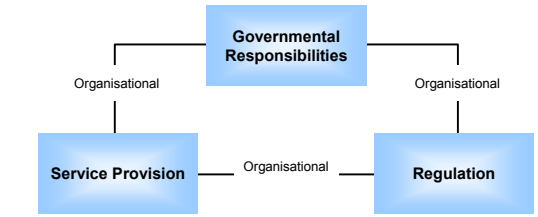
ANSP	Area delegated
UAC MAS	Upper Airspace

Areas Jointly Managed:
UAC MAS – MAS agreement – Upper Airspace
MIL/ATC – None – Civil aviation in military airspace

Institutional, organisational and legal factors

Institutional Arrangements and Links

Sharing of Responsibilities and Type of Separation



* Except …

Name:
Airways New Zealand

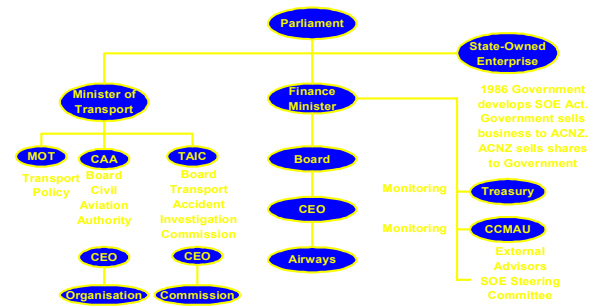
Legal Personality:
State enterprise

Date of Establishment in Current Status: 1987

Civil – Military Relationship

There are no military air navigation services – Airways provides all services

Corporate Governance Structure



Scope of Services

Area control
Approach control
Aerodrome control
Oceanic control
Aeronautical information
Flight information
Alerting service
Surveillance
Navigation
Aeronautical fixed comms
Aeronautical mobile comms
ADS (CNS)
Training
Consultancy
Flight inspection

Financials

€ M	2000	2001
Revenues	49,	50
Assets	40	42

Staff Breakdown (as at 2001)

ATCO in Ops	292
ATCO in other duties	21
Ab-initio trainee	n/a
ATC assistants & flight data personnel	73
Technical Staff	97
Administration	136
Other	1

General Country Data

GDP per capita: NZD 28,700

Total population (2002): 3.95 million

Purchasing power parities for GDP: ?

Source: OECD Statistics

Reference Documents and Links

www.airways.co.nz/
Annual Report
CAA Act 1990

Operational factors

Size of Airspace – 27,922,900 km^2

Operational Units

Area Control Centres	3
Flight Service Stations	1
Control Towers	17

Number of FIRs/UIRs – 2

Airspace Structure (map)

Complexity Level per FIR/UIR: Low to medium

Division Level Between Upper and Lower Airspace: FL290

Specific Features of Airspace

Oceanic has an interface to domestic and other oceanic FIRs. Oceanic traffic mainly traverses the Tasman Sea and is subject to peaks. Domestic traffic is dominated by a few trunk routes There is seasonal variation in Antarctic traffic

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	304,004
Visual Flight Rules (VFR)	181,523
Military flights	15,980

Other Traffic Data

Ratio of descending-climbing to overflights:

Topography and Metero Related Complexity

Clear air turbulence/mountain waves – Level changes are sometimes needed to avoid turbulence

Others – Controllers are taught of the extreme conditions that might apply. Special procedures apply at Wellington to monitor separations on finals

Traffic Mix Related Restrictions/Constraints

Traffic mix containing large proportions of both IFR and VFR traffic has impact on capacity at airports. A training booking system in place to limit the total number of training flights that can take place

Services Provided to Are Outside Airspace

Third party State	Area delegated	Services provided
ICAO	Oceanic FIR	Oceanic services

Areas Jointly Managed: None

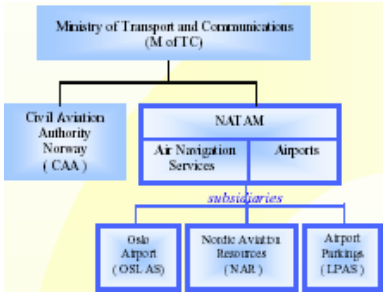
Services Delegated to Others

ANSP	Area delegated
US Air Force	Antatctic McMurdo Sector below 60S

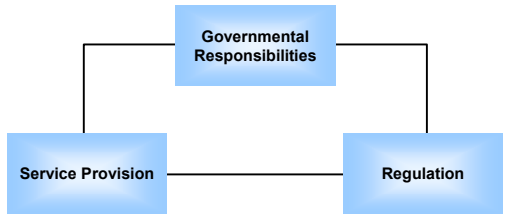
NOTE: Data provided for the fact sheets reflect total NATAM, excl. OSL. In the ACE 2001 report Bodø Oceanic and AFIS are excluded (in the 2000 report the were, however, included). All information is based on facts from year 2001. Note that from 01/01/03 NATAM has become a limited state owned company renamed AVINOR

Institutional, organisational and legal factors

Institutional Arrangements and Links



Sharing of Responsibilities and Type of Separation



Name:
NATAM

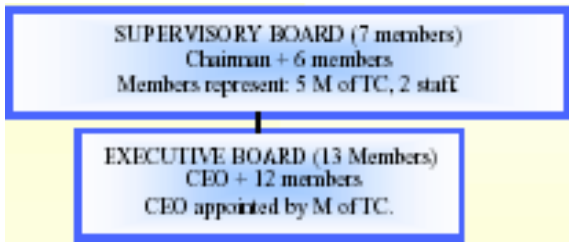
Legal Personality:
Government Agency under Ministry of Transport and Communication

Date of Establishment in Current Status: 2001 (separation of NATAR from CAP)

Civil – Military Relationship

Cooperation between ministry and service provider –
NATAM provides military air nav. services

Corporate Governance Structure



Scope of Services

Area control
Approach control
Aerodrome control
Oceanic control
Air traffic flow management
Flight information
Alerting service

Financials

NOK M	1998	1999	2000
Revenues	3 049	2 486	2 350
Enroute Revenues	436	484	487
% Total Revenues	14%	19%	21%
Assets	11 512	11 923	12 358

Staff Breakdown (ANSP Only)

ATCO in Ops	431
ATCO in other duties	38
Ab-initio trainee	85
ATC assistants & flight data personnel	216
Technical support staff	184
Administration	204
AFIS	119
Other	31

General Country Data

GDP per capita: $27,700

Total population (2000): 4,491,000

Purchasing power parities for GDP: 9.05

Source: OECD Statistics

Reference Documents and Links

Operational factors

Size of Airspace – 2,079,007 km^2

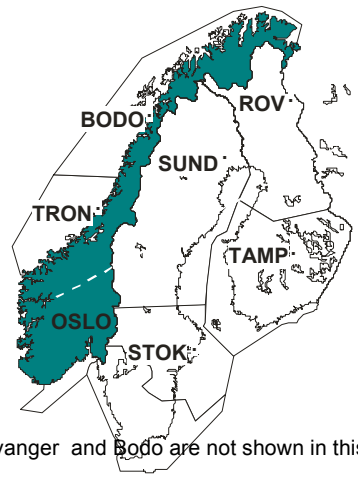
4: Operational units:45 airports owned and operated by NATAM:

- 27 Regional airports with AFIS (incl. one heliport).
- 2 main airports with AFIS.
- 1 regional airport with ATCO's.
- 15 main airports with ATCO's.

Units providing ATC and FIS:

- 29 AFIS.
- 12 TWR/APP.(incl one airport owned by a private limited company)
- 8 TWR (incl. 3 TWR at military airports.
- 4 APP.(incl. One APP at a military airport)
- 4 ATCC (incl. 5 APP and Bodø Oceanic).

Airspace Structure (map)



Note: Stavanger and Bodo are not shown in this map

Complexity Level per FIR/UIR:
?

Division Level Between Upper and Lower Airspace: Division between upper and lower information region: FL 245
Operational sectors stretch from sea level and unlimited upwards (FL 460)

Specific Features of Airspace: NATAM is responsible for ATS at 45 airports. 29 of these have AFIS only. The traffic at the AFIS airports range from 8000 to 285.000 IFR movements annually. NATAM is also responsible for providing all ATS for military aircraft

Traffic Data

Traffic Breakdown

Total IFR flights controlled	425 880
IFR helicopter continental shelf*	33 531
Total	**459 411**
IFR airport movements controlled by the ANSP	669 772
IFR helicopter continental shelf*	33 531
Total	**492 942**
Total flight hours controlled (by ATCC and APP)	244 684

* This traffic is not accounted for by Eurocontrol (IFR movements at Sola, Flesland and Kverberget)

Other Traffic Data

Ratio of descending-climbing to overhflight:

Topography and Meteo Related Complexity: Very rugged terrain and severe weather conditions in many areas. Dark during daytime in the winter in the north

Traffic Mix Related Restrictions/Constraints: High level of domestic traffic, especially at the smaller airports, thus Norwegian airspace has a disproportionately high share of climbs and descents.

Services Provided to Areas Outside Airspace See services delegated to others.

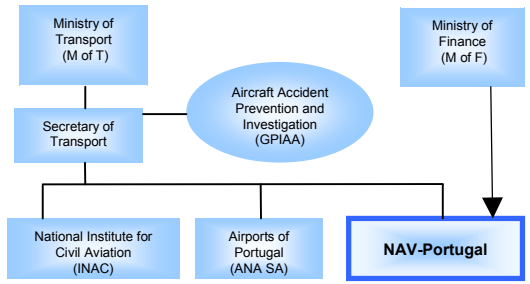
Areas Jointly Managed:

Services Delegated to Others:

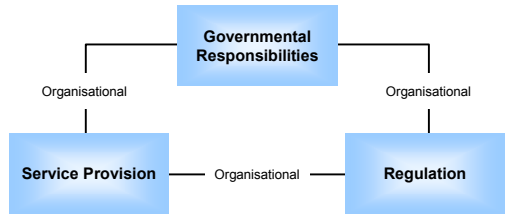
When travelling between Oslo and the northern part of our country the border between Norway and Sweden is crossed many times. Thus some adjustments along the border where Sweden provide ATC over Norwegian territory in some areas are made, and vice versa. Similar adjustments with the Scottish sector in the North Sea for off-shore helicopter operations are also made.

Institutional, organisational and legal factors

Institutional Arrangements and Links



Sharing of Responsibilities and Type of Separation



Name: Navegação Aérea de Portugal, EP
NAV-Portugal

Legal Personality:
Public entity corporation 100% state-owned

Date of Establishment in Current Status: 18th December 1998.

Civil – Military Relationship

Relationship	Actors involved/description of relationship
Formal cooperation between the relevant Ministries	NAV-EP, Ministry of Transports, Ministry of Defence
Other mechanism (please specify)	Formal and day-to-day peacetime co-operation between civil and military ANS providers, based on bilateral agreements at their own level

Corporate Governance Structure

BOARD OF ADMINISTRATION (5 members)
Chairman + 4 members

- All members are appointed by M of T for a 3 year term. Each member has executive functions within NAV-Portugal. Each member is responsible to supervise one or several NAV-Portugal Directorates and Advisory Bodies to the Board. There are 7 Directorates and 6 Advisory Bodies.
- There is neither CEO nor COO within NAV-Portugal

Note: NAV-Portugal has also a Board of Auditors composed by 3 members which are appointed by M of T for a 3 year term.

Scope of Services

Area control
Area control Oceanic
Approach control
Aerodrome control
Air traffic flow management
Aeronautical information
Flight information
Alerting service
Meteorological information
Airspace management
Aeronautical fixed communications
Aeronautical mobile communications
Surveillance
Navigation

Financials

€M	1998 *	1999	2000
Revenues	274	122	163
Enroute Revenues	86	101	137
% Total Revenues	31%	82%	84%
Assets	739	140	182

* Includes airports and air navigation (former ANA,EP)

Staff Breakdown (31/12/2001)

ATCO in Ops	240
ATCO in other duties	87
Ab-initio trainee *	20
ATC assistants & flight data personnel	219
Technical support staff	183
Administration	311
Other	44

* Ab-initio trainee are not considered as effective staff, although they are reflected in the staff costs

General Country Data

GDP per capita: $15,800

Total population (2000): 10,008,000

Purchasing power parities for GDP: 0.656

Source: OECD Statistics

Reference Documents and Links

http://www.nav.pt/

Operational factors

Size of Airspace:

Lisbon FIR	683 683 km^2
Santa Maria FIR	5 126 635 Km^2

Operational Units

2. ACCs (Lisboa, Santa Maria)
5. TMAs (Lisboa, Porto, Faro, Madeira, Santa Maria)
10. TWRs (Lisboa, Cascais, Porto, Faro, Madeira, Porto Santo, Ponta Delgada,Santa Maria, Horta, Flores)

Number of FIRs/UIRs – 2 (Lisbon FIR and Santa Maria FIR)

Airspace Structure (map), excluding Santa Maria

Complexity Level per FIR/UIR: Lisbon FIR : Medium –high, Santa Maria OCA FIR : Medium

Division Level Between Upper and Lower Airspace: Lisbon FIR/UIR - FL245, Santa Maria OCA FIR - not applicable

Specific Features of Airspace

Oceanic airspace: Yes – Santa Maria OCA FIR
Interface to oceanic airspace: Yes – Between Lisbon FIR and Santa Maria OCA FIR.
Wide variation in traffic density across FIR: Yes – More density in continental sectors.

Traffic Data

Traffic Breakdown	Lisbon FIR	Santa Maria FIR
Instrument Flight Rules (IFR)	326 924	88 305
Visual Flight Rules (VFR)	44 576	1 801
Commercial air transport		N/A
General aviation		N/A
Aerial work		N/A
Military flights operating as GAT	11 093	9 164
Military flights operating as OAT		N/A
Flights operated using jet aircraft		N/A
Flights operated using turboprops		N/A
Others (UAV etc.)		N/A

Other Traffic Data

Ratio of descending-climbing to overflights:
Lisbon FIR 151.3%, Santa Maria FIR: 39.1%

Topography and Meteo Related Complexity

Mountainous regions complicate arrival or departure procedures: Yes –LPMA, LPHR and LPFL. **Mountainous regions require additional ground-based infrastructure for coverage:** Yes. **Large areas (land or water) that create coverage problems for terrestrial systems (Remote Areas):** Yes. Due to large water area there are some problems of radar coverage in the Western limit of Lisbon FIR/UIR expected to be solved with future ADS, namely in Santa Maria OCA FIR. **Clear air turbulence /mountain waves:** At LPMA. Requires the imposition of minimum training requirements and wind limitations as described in Portuguese AIP AGA 2-5-4A and next. **Fog**: At LPPR and LPPT. Low visibility operations procedures and capacity reduction.

Traffic Mix Related Restrictions/Constraints

OAT flights, moreover Air Defence flights introduce some operational complexity since they have priority and are conducted by military units. Thus, sometimes there is the need to impose restrictions to the GAT traffic. Military flights operating as OAT.

Services Provided to Areas Outside Airspace

Third party State	Area delegated	Services provided
Spain	Area limited by: 3910N 00708W-Portuguese/Spanish border to 3953N 00652W-3947N 00638W-3927N00625W-south limit of UN975-to origin	ATC

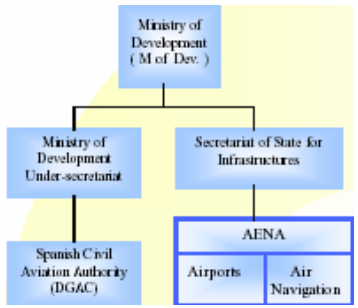
Services Delegated to Others

ANSP	Area delegated
AENA	ATS route UW106

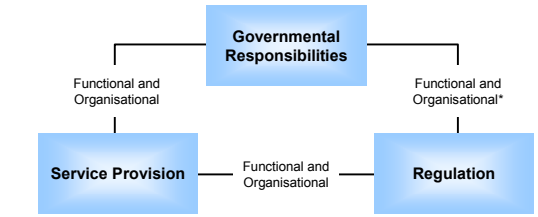
Areas Jointly Managed:
N/A

Institutional, organisational and legal factors

Institutional Arrangements and Links



Sharing of Responsibilities and Type of Separation



* Except …

Name: AENA

Legal Personality: Corporatised, 100% state owned

Date of Establishment in Current Status: 1991

Civil – Military Relationship

Formal cooperation between the relevant Ministries: Some agreements in specific areas (share airports…)
Other mechanism (please specify): RD 12/1978 about the delimitation of faculties between Ministry of Defence and Ministry of Development. Aena makes the control and proposes the sanctions.
There are specific agreements about working of fulfilment of state, community and international rules.

Corporate Governance Structure

Scope of Services

TBD

Financials

€M	1998	1999	2000
Revenues	341	406	518
Enroute Revenues	309	3	404
% Total Revenues	91%	83%	78%
Assets	477	479	525

Staff Breakdown

ATCO in Ops	1,501
ATCO in other duties	197
Ab-initio trainee	92
ATC assistants & flight data personnel	
Technical support staff	
Administration	
Others, on the job training	

General Country Data

GDP per capita: $18,000

Total population (2000): 39,466,000

Purchasing power parities for GDP: 0.773

Source: OECD Statistics

Reference Documents and Links

www.aena.es
Annual Report

Operational factors

Size of Airspace – 2,287,023 km^2

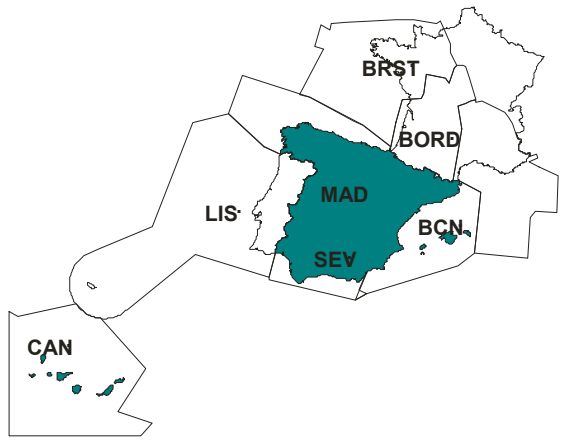
Operational Units

4. AAC (Barcelona, Madrid, Canarias, Sevilla)
9. APPs
34. TWRs
0. AFIs

Number of FIRs/UIRs –

1. Madrid
2. Barcelona
3. Canarias

Airspace Structure (map)



Complexity Level per FIR/UIR:

1. High
2. Medium-high
3. Medium

Division Level Between Upper and Lower Airspace: FL245

Specific Features of Airspace

Upper airspace only no: Both upper and lower
Interface to oceanic airspace: YES (Santa Maria & Shanwick)
Large number of boundaries with adjacent airspace blocks: YES
Wide variation in traffic density across FIR: There are major and secondary traffic flows
Other features (please specify): See AIP

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	1, 387,854
Visual Flight Rules (VFR)	153,700
Commercial air transport	1,323,364
General aviation	184,537
Aerial work	
Military flights operating as GAT	33,653
Military flights operating as OAT	
Flights operated using jet aircraft	
Flights operated using turboprops	
Others (UAV etc.)	

Other Traffic Data

Ratio of descending-climbing to overflights:

Topography and Metero Related Complexity

Mountainous regions complicate arrival or departure procedures: Specific airports (ex. Granada, La Palma), **Mountainous regions require additional ground-based infrastructure for coverage:** Specific areas (ex. Vitoria, Pamplona, Santiago, Vigo, Malaga, Granada), **Large areas (land or water) that create coverage problems for terrestrial systems (Remote Areas):** Canarias (over sea) **Windshear/microbursts:** Yes, occasionally , **Clear air turbulence/mountain waves:** Yes, occasionally, **Fog:** Yes, occasionally (LVPs)

Traffic Mix Related Restrictions/Constraints

Services Provided to Areas Outside Airspace

Third party State	Area delegated	Services provided

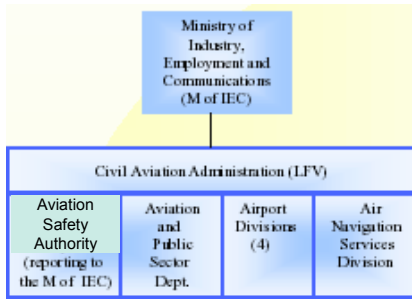
Areas Jointly Managed:

Services Delegated to Others

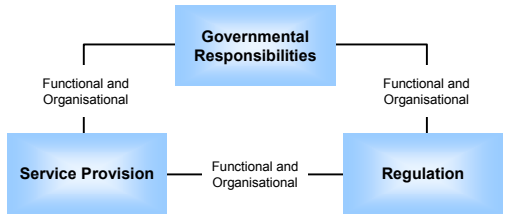
ANSP	Area delegated

Institutional, organisational and legal factors

Institutional Arrangements and Links



Sharing of Responsibilities and Type of Separation



Name:
LUFTFARTSVERKET (LFV)
SWEDISH CAA

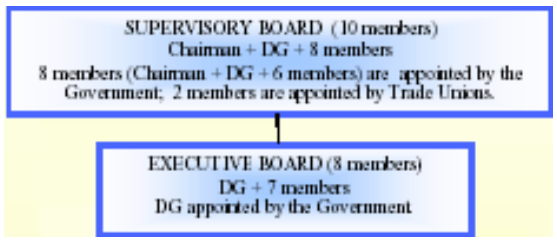
Legal Personality:
Government Agency

Date of Establishment in Current Status:
1967

Civil – Military Relationship

One Administration (LFV) under one ministry takes responsibility for all Air Navigation Services (ANS) – LFV is responsible for all ANS matter for all users (civil and military) during peacetime. Formal consultation with the Swedish Armed Forces (SAF) is required when they are affected by a LFV decision in the ANS field. Consequently there are formal agreements between LFV and SAF with regard to ANS, both from regulatory and service provision point of view

Corporate Governance Structure



Scope of Air Navigation Services

Air Traffic Management (ATM)
- Area control (ACC)
- Approach control (APP)
- Aerodrome control (TWR)
- Flight information (FIS)
- Alerting service
- Air traffic flow management (ATFM)
- Air Space Management (ASM)

CNS (en-route infrastructure)
Aeronautical information (AIS)
MET Authority (Services are provided by the Swedish Meteorological and Hydrological Institute)
Search and Rescue (SAR)

Financials (ANS Division)

€M	1998	1999	2000
Revenues	141	160	172
Enroute Revenues	99	107	119
% Total Revenues	70%	67%	69%
Assets	123	158	179

Staff Breakdown

ATCO in Ops	457
ATCO in other duties	198
Ab-initio trainee	82
ATC assistants & flight data personnel	108
Technical support staff	73
Administration	160
Other	72

General Country Data

GDP per capita: $22,200

Total population (2000): 8,872,000

Purchasing power parities for GDP: 9.53

Source: OECD Statistics,

Reference Documents and Links

www.lfv.se/

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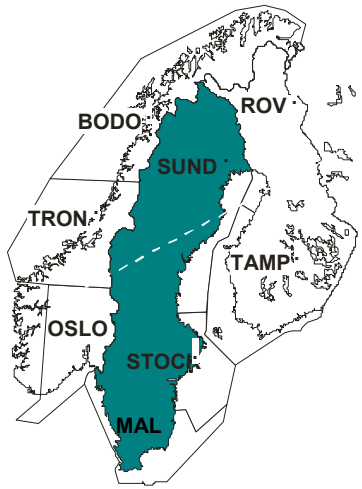
Operational factors

Size of Airspace – 610,000 km^2

Operational Units
3. ATCCs (Stockholm,Sundsvall, Malmö)
10. APPs
36. TWRs
1. AFIS

Number of FIRs/UIRs – 1/1

Airspace Structure (map)



Complexity Level per ATCC "Area of Responsibility" : Sundsvall: Low; Stockholm and Malmö: Medium-High

Division Level Between Upper and Lower Airspace: FL285

Specific Features of Airspace
Wide variation in traffic density across FIR
Very low traffic density in the northern part of Sweden FIR/UIR

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	657,200
Visual Flight Rules (VFR)	
Commercial air transport	502,000
General aviation	141,000
Aerial work	14,000
Military flights operating as GAT	
Military flights operating as OAT	
Flights operated using jet aircraft	
Flights operated using turboprops	
Others (UAV etc.)	

Other Traffic Data

Ratio of descending-climbing to overflights:
Malmo AOR: 37%, Stockholm AOR: 90%,
Sundovall AOR: 83%

Topography and Metero Related Complexity
Mountainous regions require additional ground-based infrastructure for coverage; However it's decided, due to the very low density of traffic and the high cost, not to invest in such infrastructure

Traffic Mix Related Restrictions/Constraints
Different civil and military measurement systems e.g speed in knots and km/h, heights in feet and meters

Services Provided to Areas Outside National Airspace

Third party State	Areas where services are provided	Services provided
SF, DK, NO, PL	Different areas along common FIR/UIR boundaries	ATC

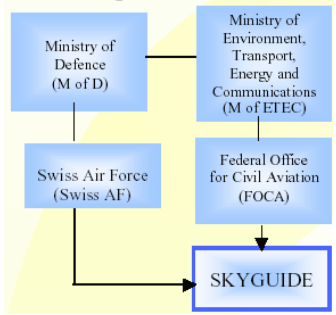
Areas Jointly Managed:

Services Delegated to Others

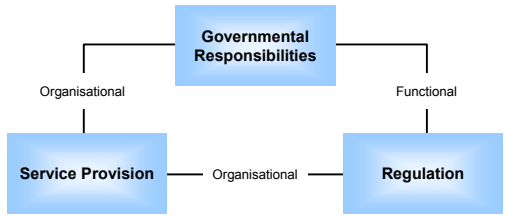
ANSP	Services delegated
DK, NO	ATC in different areas along common FIR/UIR boundaries

Institutional, organisational and legal factors

Institutional Arrangements and Links



Sharing of Responsibiliti and Type of Separation



Name:
Skyguide

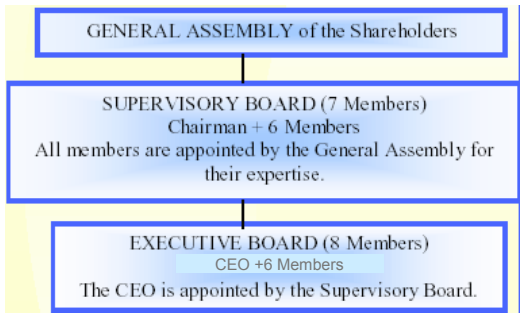
Legal Personality:
State owned private law company

Date of Establishment in Current Status: 2001

Civil – Military Relationship

Relationship	Actors involved/description of relationship
Full integration	Civil and military ATS are fully integrated

Corporate Governance Structure



Scope of Services

Area control
Approach control
Air traffic flow management
Aeronautical information
Flight information
Airspace management
Training
Consultancy

Financials

€M	1998	1999	2000
Revenues	258	265	276
Enroute Revenues	348	387	401
% Total Revenues	75%	74%	77%
Assets	232	244	242

Staff Breakdown (2001)

ATCO in Ops	365
ATCO in other duties	36
Ab-initio trainee	62
ATC assistants & flight data personnel	52
Technical support staff	249
Administration	81
Other	215

General Country Data

GDP per capita: $28,600

Total population (2000): 7,185,000

Purchasing power parities for GDP: 1.90

Source: OECD Statistics

Reference Documents and Links

www.skyguide.ch/

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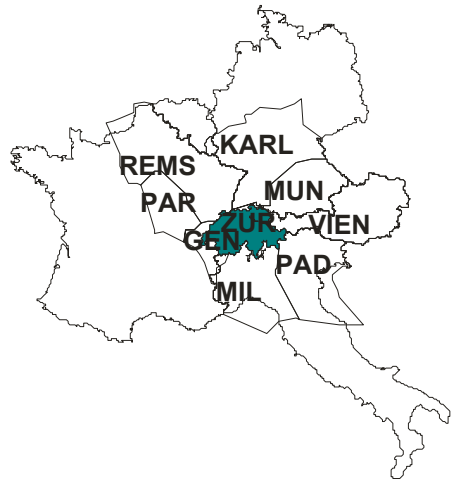
Operational factors

Size of Airspace: 63,726 km^2

Operational Units
2. AACs (Geneva, Zurich)
2. APPs (Geneva, Zurich)
4. TWRs (Geneva, Zurich, Bern)
4. AFIs (Geneva, Zurich, Bern)

Number of FIRs/UIRs – 1FIR, 1 UIR

Airspace Structure (map)



Complexity Level per FIR/UIR: High

Division Level Between Upper and Lower Airspace: FL265

Specific Features of Airspace
5 adjacent centres

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	1,877,621
Visual Flight Rules (VFR)	130,754
Commercial air transport	
General aviation	
Aerial work	
Military flights operating as GAT	
Military flights operating as OAT	
Flights operated using jet aircraft	
Flights operated using turboprops	
Others (UAV etc.)	

Other Traffic Data

Ratio of descending-climbing to overflights: 66%

Topography and Metero Related Complexity
Mountains: Alps, MRT, First IFR level available regarding QNH

Traffic Mix Related Restrictions/Constraints

Services Provided to Are Outside Airspace

Third party State	Area delegated	Services provided
France	East	Full ATC
Germany	South	Full ATC
Italy	North	Full ATC

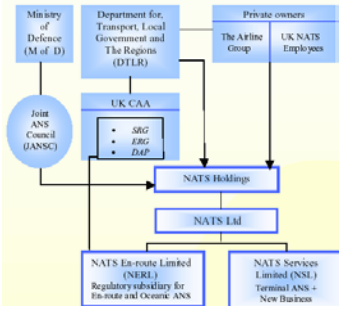
Areas Jointly Managed: Nil

Services Delegated to Others

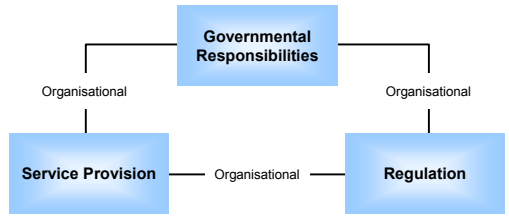
ANSP	Area delegated
Italy	South of Lugano

Institutional, organisational and legal factors

Institutional Arrangements and Links



Sharing of Responsibiliti and Type of Separation



Name:
NATS

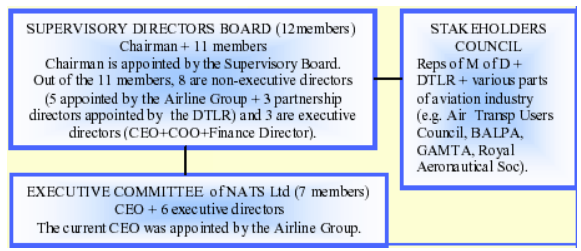
Legal Personality:
Part privatised (Government retains 49% including Golden Share)

Date of Establishment in Current Status: 2001

Civil – Military Relationship

Relationship	Actors involved/description of relationship
Contractual	NATS supplies services to the military under a commercial contract with the Ministry of Defence

Corporate Governance Structure



Note: DTLR has now been replaced by Department for Transport (DfT)

Scope of Services

Area control
Approach control
Aerodrome control
Oceanic control
Air traffic flow management
Aeronautical information
Flight information
Alerting service
Airspace management
Surveillance
Navigation
Aeronautical fixed comms
Training
Consultancy

Financials

£M	1999/2000	2000/01	2000/02
Revenues	568	595	553
Enroute Revenues	479	511	466
% Total Revenues	84.4%	85.9%	84.4%
Assets	574	618	936

Staff Breakdown (2001)

ATCO in Ops	1,356
ATCO in other duties	219
Ab-initio trainee	165
ATC assistants & flight data personnel	1,231
Technical support staff	1,376
Administration	1,170
Other	199

General Country Data

GDP per capita: $22,800

Total population (2000): 59,766,000

Purchasing power parities for GDP: 0.651

Source: OECD Statistics

Reference Documents and Links

www.nats.co.uk
Annual Report

Operational factors

Size of Airspace: continental 878,430 km^2, oceanic 2,192,000 km^2

Operational Units

4 AACs (London, Manchester, Scottish)
1. OAC (Shanwick)
11. APPs
14. TWRs
2. AFIs (Geneva, Zurich, Bern)

Number of FIRs/UIRs – 2/2+1

Airspace Structure (continental airspace map)

Complexity Level per FIR/UIR: London High, Scottish Medium, Oceanic Medium

Division Level Between Upper and Lower Airspace: London FL245, Scottish FL245, Oceanic FL0

Specific Features of Airspace

Upper airspace: Total controlled environment **Lower airspace:** Segmented controlled environment **Oceanic airspace:** Bordering Norwegian, Icelandic, Canadian, Portuguese and French controlled airspace
Interface to oceanic airspace: Both FIRs Large number of boundaries with adjacent airspace blocks Wide variation in traffic density across FIR Joint civil/military service with dedicated military airspace

Traffic Data

Traffic Breakdown

Instrument Flight Rules (IFR)	2,022,538
Visual Flight Rules (VFR)	n/a
Commercial air transport	1,894,094
General aviation	106,068
Aerial work	n/a
Military flights operating as GAT	22,379
Military flights operating as OAT	n/a
Flights operated using jet aircraft	Approx. 83%
Flights operated using turboprops	Approx. 17%
Others (UAV etc.)	n/a

Other Traffic Data

Ratio of descending-climbing to overflights: London FIR 89%, Scottish FIR 82%

Topography and Metero Related Complexity

Mountainous regions require additional ground-based infrastructure for coverage
Large areas of water that create coverage problems for terrestrial systems (Remote Areas)

Traffic Mix Related Restrictions/Constraints

Interaction of civil and military - mix of OAT and GAT traffic - Numerous military agencies, communications between all agencies and subsequent co-ordination

Services Provided to Areas Outside Airspace

1. North Sea from Iceland, Norway
2. Within the Shannon UIR from Irish Republic
3. Areas of Dutch airspace around REFSO from Netherlands
4. Reims airspace north of RATUK from France

Areas Jointly Managed:

Ireland/France – Southern Oceanic transition area – Radar **Control Service**
Ireland – Shanwick OCA – Communications
MoD – London and Scottish FIRs – Joints ATC services

Services Delegated to Others

1. Irish Sea delegation of ATS to Dublin on L975 and B39
2. North east corner of North Sea lower airspace to Norway, Denmark, and Amsterdam
3. North East corner of North Sea Upper Airspace to Denmark
4. Southwest corner of London UIR to France and Irish Republic
5. Airspace at 61N to Iceland