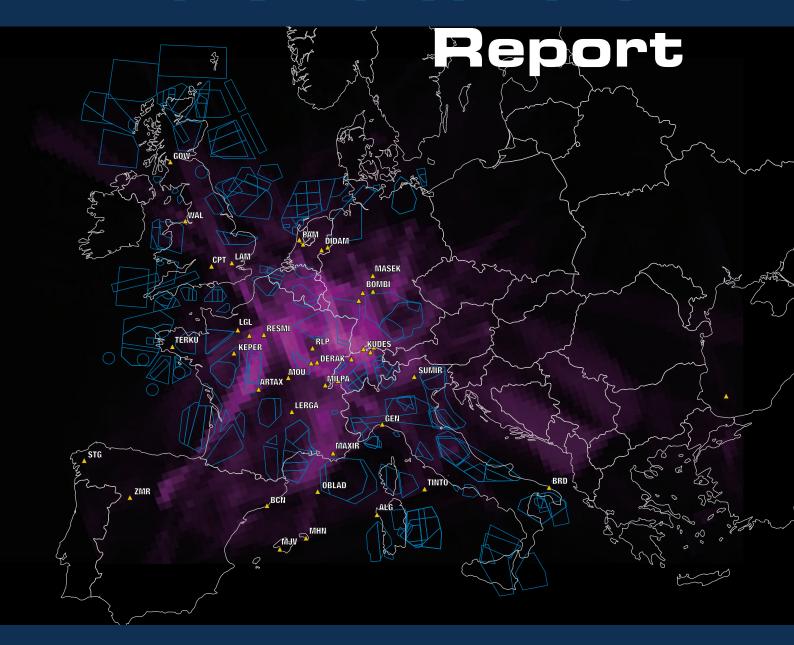
# **PRR 2008**

An Assessment of Air Traffic Management in Europe during the Calendar Year 2008

# Performance Review



May 2009
Performance Review
Commission



#### **Background**

This report has been produced by the Performance Review Commission (PRC). The PRC was established by the Permanent Commission of EUROCONTROL in accordance with the ECAC Institutional Strategy 1997. One objective of this strategy is "to introduce a strong, transparent and independent performance review and target setting system to facilitate more effective management of the European ATM system, encourage mutual accountability for system performance..."

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## **DOCUMENT IDENTIFICATION SHEET**

## **DOCUMENT DESCRIPTION Document Title** Performance Review Commission Performance Review Report covering the calendar year 2008 (PRR 2008) **EDITION:** PROGRAMME REFERENCE INDEX **EDITION DATE:** PRC Performance Review Report **FINAL** 07 May 2009 **SUMMARY** This report of the Performance Review Commission analyses the performance of the European Air Traffic Management System in 2008 under the Key Performance Areas of Safety, Delays, Flight Efficiency, Environmental impact, and Cost-Effectiveness. **Keywords** Performance Measurement Air Traffic Management **ATM ANS Performance Indicators** Performance Review Unit, EUROCONTROL, 96 Rue de la Fusée, CONTACT: B-1130 Brussels, Belgium. Tel: +32 2 729 3956, E-Mail: pru@eurocontrol.int http://www.eurocontrol.int/prc

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#### **EUROPEAN LEVEL - ANS PERSPECTIVE**

#### **SAFETY**



| KPIs             |        |                    |                     |                 |
|------------------|--------|--------------------|---------------------|-----------------|
|                  | TARGET | ACTUAL             | YEARLY<br>VARIATION | TARGET<br>MET   |
| <70%<br>MATURITY | 0      | Reg: 13<br>ANSP: 9 | ▼                   | Awaiting survey |

The Provisional Council target is "to raise the framework safety maturity level of ANSPs and National Regulators to a minimum of 70% in each State by end of 2008".

The number of ANSPs and Regulators below acceptable maturity decreased but was still far from 0 in the survey conducted in March 2008.

#### **ATFM DELAYS (EN-ROUTE)**



| KPIs               | TARGET | DATA<br>ACTUAL | YEARLY<br>VARIATION | TARGET<br>MET |
|--------------------|--------|----------------|---------------------|---------------|
| MINUTES/<br>FLIGHT | 1.0    | 1.9            | <b>A</b>            | No            |

The target was not met in 2008 in spite of low traffic growth.

En-route ATFM delays increased for the fourth consecutive year and exceeded the agreed target by 90%.

#### **FLIGHT - EFFICIENCY**





The Provisional Council target was not met in spite of the Flight Efficiency initiative.

The average route extension has increased since 2006, mainly due to increasing average flight distance (+3% in 2008).

#### **COST - EFFECTIVENESS**

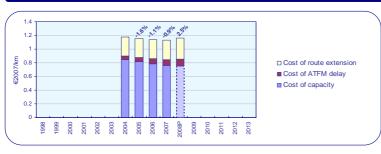


| KPIs                  | TARGET | DATA<br>ACTUAL | YEARLY<br>VARIATION | TARGET<br>MET |
|-----------------------|--------|----------------|---------------------|---------------|
| REAL UNIT<br>COST/ KM | -3.0%  | -1.0%          | <b>V</b>            |               |

On track to meet the PRC notional target over 2003-2008 period (-14%, i.e. 3% per year).

Based on forecast data of November 2008, the PC target for 2008-2010 (3% per year) will not be met.

#### **TOTAL ANS USER COSTS (EN-ROUTE)**



| KPIs                   | TARGET | DATA<br>ACTUAL             | YEARLY<br>VARIATION | TARGET<br>MET |
|------------------------|--------|----------------------------|---------------------|---------------|
| TOTAL UNIT<br>COST/ KM | None   | 1.16 <b>∉km</b><br>(€2007) | <b>A</b>            | N/A           |

The total en-route unit cost borne by airspace users for en-route (charges + delays + route extensions) decreased slowly from 2003 to 2007 and increased in 2008 (+2.5%)

#### **TRAFFIC** DATA MEASURE TRAFFIC ~ 10.1 M 2007 2008 million IFR flights 0.4% 10.1 M **FLIGHTS** 10.0 M Yearly variation ← IFR flights Traffic growth has slowed down in 2008 (0.4% in 5% 2008 vs. 5% in 2007) and is expected to be negative in 2009 (-5%). 2009 2012 2013 ESRA 2008 **AVIATION SAFETY** DATA **MEASURE** YEARLY 16 2007 2008 Total number of accidents 14 ATM-INDUCED 12 0 Direct ATM **ACCIDENTS** 10 -Accidents There was no ATM-induced accident in 2008. 6 2 ource: Flight Safety Foundati - Aviation Safety Net **PUNCTUALITY** DATA **MEASURE** 30% YEARLY VARIATION YEARLY % VARIATON 2007 2008 25% \_ DEPARTURES delayed by ARRIVALS > 20% - 3% 22.1% 21.5% ARRIVALS delayed by more 15% Air transport punctuality slightly improved in 2008, but 10% remains unsatisfactory. - ARRIVALS more than 15 min. ahead of schedule (%) 5% Source:AEA & CODA 2006 2007 2008 2009 2010 2011 2013 2007 2004 2005 \* preliminary estimate for December 2008 **PREDICTABILITY** DATA **MEASURE** Arrival time (compared to schedule YEARLY /ARIATION YEARLY % VARIATON 2007 2008 20 20th Percentile 15 STANDARD 19.8 min 19.1 min -3.5% DEVIATION in minutes 80th Percentile The variability (standard deviation) of the gate-to-gate flight time improved in 2008. Standard Deviation

**EUROPEAN LEVEL - AVIATION PERSPECTIVE** 

Figure 1: Key Performance Indicators in 2008

1998 2000 2000 2002 2003 2004 2006 2006 2006 2009 2010 2011 2013 2013

#### Introduction

PRR 2008 presents the performance of European Air Navigation Services (ANS) in 2008 in a more general aviation perspective and reviews it under the Key Performance Areas of Safety, Punctuality and Predictability, Capacity/delays, Flight-Efficiency, Cost-Effectiveness and Environmental impact.

Key Performance Indicators corresponding to both aviation and ANS perspectives are shown in Figure 1, together with approved targets for the latter.

#### **Traffic demand**

Traffic growth became negative from August 2008 onwards and was limited to 0.4% in 2008 (5% in 2007). Traffic forecasts for 2009 have been revised downwards, around -5%, as a consequence of the global financial crisis and economic downturn.

Traffic demand is becoming more volatile. Improved ANS flexibility, i.e. responsiveness to unforeseen changes, should be addressed in DMEAN, FABs, and SESAR.

#### Safety

There were no ATM-induced accidents in Europe in 2008.

In 2007, the number of reported high-risk separation minima infringements and runway incursions decreased against a general rise of traffic and total incident reports. Notwithstanding a significant amount of reports still under investigation and therefore not classified, this appears to be a positive trend reversal from the previous three years.

A majority of States have not yet fully implemented EUROCONTROL Safety Regulatory Requirements (ESARR). Compliance with regulations is an obligation of each State. A combination of enforcement measures (e.g. EU infringement procedures, where applicable) and/or support programmes must ensure that such regulations are fully transposed and implemented without delay.

The PRC supports confidentiality of individual incident reports as well as protection of individuals in a just culture environment. However, the PRC maintains that information about safety performance of ANS providers, whose prime duty is to ensure safety and who provide a public service, should be more transparent.

In the latest maturity survey (March 2008), thirteen States and nine ANSPs did not reach the minimum acceptable maturity level of 70%. The target that all regulators and ANSPs should reach this minimum level by end 2008 remains a challenge. More efforts are needed by those concerned to reach at least this minimum level.

The EU rule-making mechanism, safety oversight and the safety performance monitoring process are closely inter-linked. There is a continuous loop whereby the legislative process is followed by target-setting, compliance and performance monitoring, enforcement, incentives and feed-back.

The USOAP and ESIMS safety audit programmes will terminate in 2011 and no follow-up has yet been decided for the latter. The PRC considers that a structured ANS safety oversight scheme tailored to the European environment is needed, which could be based on a combination of surveys, peer reviews (as provided for in the SES legislation) and audits.

#### Air transport Punctuality/predictability

After a continuous deterioration between 2003 and 2007, air transport on time performance improved slightly in Europe in 2008, in a context of lower traffic growth.

Late arrivals are mainly driven by late departures at origin airports, with relatively small variations in the gate to gate phase. Departure delays originate principally from turn-around processes. ATFM-related departure

delays caused by en-route or airport constraints account for 27% (24% without weather-related ATFM delays), and show an increasing trend in 2008.

The predictability of operations several months in advance affects airline scheduling and the extent to which the use of available resources (aircraft, crew, etc.) can be maximised. After a continuous deterioration between 2003 and 2007, operational variability improved slightly in 2008.

Today's air transport system operates with wide time margins. Because of this high level of built-in variability, flexibility is needed in the way the current system is operated. Improvements in on-time performance and a reduction in variability require a simultaneous tightening of airline, airport and ATM processes, and imply a better coupling between them in the aviation network.

#### **En-route** performance

#### **EN-ROUTE ATFM DELAYS**

The en-route delay target was not achieved in 2008. Summer en-route ATFM delays increased for the fourth consecutive year and overshot the agreed target by 90% (1.9 min./flight, Target: 1 min./flight). 4.3% of flights were delayed more than 15 minutes due to en-route ATFM delays (3.3% in 2007).

While the majority of ACCs met or exceeded their capacity plans, the failure to deliver capacity as planned or inadequate plans in a few ACCs (notably Warsaw, Copenhagen, Nicosia, Zagreb, Vienna, Rhein and Zurich) negatively impacted the whole European network performance. The re-negotiation of some employment conditions with short notice effect was a significant contributor. Higher focus needs to be given to the respect of capacity plans and to adequate management of human resources.

There is typically a three-year time lag in raising ATM capacity through traditional methods (airspace design, recruitment, training, investment). There are at least two implications:

- 1) It is important that the development of future ANS capacity is not jeopardised during the current global financial crisis and economic downturn. The positive effect on costs would materialise relatively late, and the negative impact on capacity would appear when traffic growth resumes. Rather, lower traffic growth is an opportunity to catch up on the capacity shortfall that has built up over the last 3 years.
- 2) Capacity plans need to take account of collective agreements and those agreements need to be valid for the duration of the plans. Any revision should not jeopardise the capacity plans (e.g. compensating lower working hours by higher productivity).

#### **EN-ROUTE FLIGHT EFFICIENCY**

Flight-efficiency has significant economic and environmental impacts.

The flight efficiency target was not achieved in 2008. Improvements in relative route extension (-0.2%) were masked by increasing average flight distance (+3%).

Short term benefits can be achieved by raising user awareness of shortest available routes. Network management through the CFMU can play a role here.

Approximately 63% of route extension is due to domestic airspace design issues, but 26% is linked with cross-FAB airspace design, which illustrates the need for a network approach to airspace design.

#### ACCESS TO, AND USE OF, SHARED AIRSPACE

There was progress in 2008, with Military Key Performance Indicators becoming available. Implementation by States should be encouraged. Progress still needs to be made both in developing and offering routes through shared airspace and ensuring that these routes are effectively used by civil users, especially during weekends when military activity is minimal.

#### Performance at main airports

Airports are key nodes of the aviation network. Performance of the airport system depends on the actions of many key players, such as airport operators, airlines and ANS.

Managing performance at airports requires reliable performance indicators. Operational performance indicators related to the arrival and taxi phases are being developed in cooperation with airports, ANSPs and users.

The analysis of operational performance at airports reveals a contrasted picture across Europe. London Heathrow (LHR) shows by far the highest level of total additional times, followed by Rome (FCO) and Frankfurt (FRA) airports.

Operational performance is affected by a number of factors, including airport infrastructure, airport capacity and demand management (including scheduling), traffic variability, weather conditions, sustainability of airport capacity in adverse conditions and environmental/political restrictions, all of which need to be considered in a balanced assessment of performance.

Local performance can also have an impact on the overall performance of the European network. Delays resulting from local decisions may propagate throughout the European network, creating reactionary delays and introducing variability in daily operations at other airports.

While there may be a variety of causes for delay, the way the traffic is managed has an impact on the distribution of the delay between air and ground and thus on overall costs to airspace users.

Cancellations are also an important service quality indicator and need to be measured consistently throughout Europe.

Airport capacity being a main challenge to future air traffic growth, an increased focus needs to be put on the integration of airports in the ATM network and the optimisation of operations at and around airports.

#### Comparison of operational performance in the USA and Europe

The FAA/ATO and the PRC have cooperated to identify and measure comparable indicators of operational ANS performance on both sides of the Atlantic, using consistent data sources and methodologies.

One observes similar arrival punctuality levels in the US and Europe, albeit with higher delay variability in the US.

A breakdown by flight phases reveals strong and weak points on both sides:

- a schedule upwards-creep and lower average seating capacity are observed in the US;
- in the US, departure punctuality is better but taxi-out delays are longer;
- "Direct route extension" is approximately 1% lower in the US, with corresponding fuel burn benefits;
- while there is no superior performance in terms of arrival transit time in the TMA, London Heathrow is a clear outlier.

These differences possibly originate from different policies in allocation of airport slots and flow management, as well as different weather conditions. The impact on environment, predictability and flexibility in accommodating unforeseen changes may be different. A better understanding of trade-offs would be needed to identify best practices and policies.

Identification and application of today's best practices, with existing technology and operational concepts, could possibly help in raising the level of performance on both sides of the Atlantic in the relatively short term, and may have wider applicability.

#### Cost-Effectiveness

At European system level, the real en-route unit cost decreased from 0.87 €km to 0.76 €km between 2003 and 2007, i.e. a reduction of -3.4% per annum:

- The combination of favourable traffic increase (+26%) and tighter cost management allowed a majority of States to improve their cost-effectiveness performance;
- This improvement is in line with the PRC's notional target (-3% per annum over 2003-2008). Had there not been significant cost increases in some States/ANSPs (e.g. Spain) during the period, the improvement at European system level would have been even better.

2008 marks the end of a positive business cycle which started in 2003. Traffic growth will be significantly lower in 2009 and possibly some time beyond. The economic downturn requires ANSPs to review their plans to ensure that they are consistent with more straitened economic circumstances. ANSPs cannot stand aside and it will be important that they continue, and enhance, the quest for efficiency.

In contrast, in a majority of ANSPs/States, projections indicate that the en-route cost-base is planned to significantly increase in 2009 despite a slowdown in traffic. This implies that the PC objective (-6% over 2008-2010) will not be met notwithstanding States/ANSPs commitment in Nov 2007. Latest Member States' projections indicate that en-route real unit costs are expected to decrease by -2.2% between 2008 and 2010, or even increase if traffic is lower than forecasted in 2009 and 2010.

It will also be important that the breathing space provided by weaker demand is used to build a stronger platform for the eventual resumption of traffic growth, so that there is a better match between capacity and demand and a better ongoing cost-effectiveness performance. There is still room for cost-effectiveness and productivity improvement based on benchmarking analysis. Initiatives like FABs and SESAR should contribute to rationalising investments and optimising the use of resources.

ANSPs management together with staff unions have a collective responsibility to address this challenge and to work together to implement measures that allow short and medium term flexibility in controlling costs.

En-route MET costs (5% of total en-route ANS costs) decreased by -9% in real terms between 2003 and 2007. This is a significant contribution to the en-route ANS cost-effectiveness improvement.

In 2007, the total cost-base for the EUROCONTROL Agency (8% of total en-route ANS costs) decreased by -1% in real terms. This is the first time on record that the EUROCONTROL cost-base has decreased. Further decreases are expected as part of the EUROCONTROL Agency cost-effectiveness objective until 2012. Given the increasingly straitened economic situation, it is important that the EUROCONTROL Agency commits to the planned cost-base decrease.

Setting of binding Community performance targets (SES II) would represent a significant step towards driving further performance improvements in ANS. These targets should be combined with the setting of unit rates in advance for a period of three to five years so as to provide an effective incentive to meet local objectives and improve cost predictability.

#### **Environmental impact**

Aviation's total contribution to  $CO_2$  emissions in the EU, including international aviation, is 3.4%. The ultimate improvement that could ideally be achieved in the absence of any ATM constraint (such as safety, capacity etc.) is a reduction of 0.2% of all  $CO_2$  emissions in the EU.

Directive 2008/101/EC regarding the EU emissions trading scheme has been adopted. It includes international aviation as of 2012. All flights arriving and/or departing from an EU/EEA airport will be covered for their entire length. The emissions covered by this Directive represent circa 240Mt CO<sub>2</sub> a year.

If the EUROCONTROL flight efficiency target were met, there would be clear environmental benefits related to en-route emissions. Thus far, this target has not been met.

Long-haul flights (>3 hours) account for 13% of flights, but 60% of fuel burn.

It would appear that at least half of the airports covered by the Noise Directive see their capacity affected by environmental (noise) restrictions. Furthermore, environmental restrictions may influence each other, i.e. affecting the flight path to minimise noise exposure on the ground would likely lead to reduced flight efficiency and thus increased emissions. Therefore, care must be taken and priorities clearly set before imposing such restrictions.

#### **Economic assessment**

Costs borne by users for en-route capacity (charges), ATFM delays and flight-inefficiencies in 2008 are estimated at €6.5 Billion, €0.9 Billion and €2.6 Billion respectively (2007 prices). There are trade-offs between them. It is the total economic cost borne by users (cost of capacity + delays + route extension) that should be minimised.

The significant improvements in en-route cost-effectiveness since 2004 have been almost cancelled-out by increases in delays and route extension. The real unit economic cost went down at a slow rate of approximately -1% per annum until 2007, but increased by nearly 2.5% in 2008.

An objective to progressively reduce the real unit economic cost was agreed by Ministers in 2000 and should be actively pursued, even more so in the current straitened economic circumstances. Reduction of the unit cost of capacity will be more challenging with lower traffic growth, which could be alleviated by more efforts on flight-efficiency and delays.

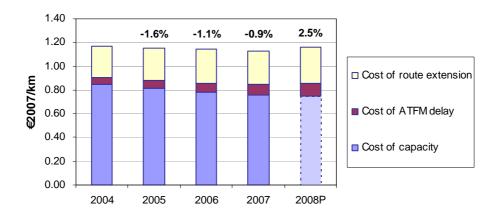


Figure 2: Real unit economic cost (en route)

#### **Further steps**

With slower traffic growth and more volatile traffic demand ahead, it is even more important to balance the different areas of performance, and to improve the terms of trade-offs, so as to contain costs and improve quality of service while improving safety.

This can be done in the short term through higher efficiency and flexibility in the use of scarce resources (human, financial, airspace, airport capacity, R/F spectrum), and in the longer term through appropriate regulation (in particular the proposed SES II performance scheme), governance and deployment of technology, as illustrated here.

The proposed SES II performance scheme is designed to be a powerful driver of ANS performance improvements. The PRC is prepared to contribute to these improvements.



The SES II package also includes a technological pillar, i.e. SESAR. It will be important to ensure the consistency of the SES II Performance Scheme and the SESAR performance framework.

Finally, a significant element appears to be missing to drive ANS performance, i.e. minimum requirements and common guidelines or rules for governance of ANSPs or FABs, wherever performance accountability lies.

#### Recommendations

The Provisional Council is invited:

a. **to note** the PRC's Performance Review Report (PRR 2008) and to submit it to the Permanent Commission:

#### **SAFETY**

- b. **to request** States to provide greater transparency of safety data, and particularly the public availability of States' ESIMS and USOAP audit reports concerning ANS safety, including Corrective Action Plans;
- c. **to request** the Director General to present a plan to ensure the continuity of safety oversight, taking due account of any future EASA responsibilities;
- d. **to require** the use by States/ANSPs of automated detection and reporting tools to complement manual reporting of incidents;

#### FLIGHT EFFICIENCY-ENVIRONMENT

- e. **to confirm** the already agreed target for flight efficiency of an annual reduction of the average route extension per flight of 2 Km, and related environmental impact (May 2007);
- f. **to request** that the CFMU and airspace users co-operate to increase the use of shorter alternative routes at the flight planning stage, including conditional routes;
- g. **to request** further development of route structures coordinated by EUROCONTROL, and that conditional routes are open as often as possible, particularly at week-ends;

#### **COST-EFFECTIVENESS**

h. **to agree** that there should be no mid-term upward revision by States of the 2009 unit rates and that States/ANSPs implement necessary measures to deal with any revenue shortfall in 2009;

#### **CAPACITY**

i. **to urge** States and Air Navigation Service Providers not to jeopardise future capacity provision during the current economic situation;

#### NETWORK MANAGEMENT

- j. **to request** the Director General to propose the role of, and propose performance indicators for, the network management function;
- k. **to request** the States to promote the use of airport collaborative decision-making.

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# PART I: BACKGROUND

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# **Chapter 1: Introduction**

#### 1.1 Origin and purpose of the report

- 1.1.1 Optimum performance of Air Navigation Services (ANS) is essential for the safety, efficiency and sustainability of civil and military aviation, and to meet wider economic, social and environmental policy objectives.
- 1.1.2 The purpose of this Performance Review Report (PRR 2008) is to provide policy makers and ANS stakeholders with objective information and independent advice concerning European ANS performance in 2008, based on research, consultation and information provided by relevant parties.
- 1.1.3 It has been produced by the independent Performance Review Commission (PRC) of the EUROCONTROL Organisation. Some background information on the PRC can be found on the inside-back cover page.
- 1.1.4 Communication and consultation are major priorities for the PRC. The draft final report, including draft recommendations, was made available to stakeholders for consultation and comment from 05 February to 05 March 2009. In addition, it was discussed with stakeholders at an open-forum consultation meeting held on 05 March 2009.
- 1.1.5 The PRC took due account of all stakeholder comments received when finalising PRR 2008, especially its recommendations which can be found in the Executive Summary.

#### 1.2 Contents of the report

1.2.1 This year, PRR 2008 has been structured as follows:

| EXECUTIV | VE SUMMARY   |  |  |  |
|----------|--|--|--|--|
| PART I   | BACKGROUND   |  |  |  |
|          | Introduction (Chapter 1)   |  |  |  |
|          | Traffic demand (Chapter 2)   |  |  |  |
| PART II  | ANS PERFORMANCE ASSESSMENT   |  |  |  |
|          | Safety (Chapter 3)   |  |  |  |
|          | Operational Performance  |  |  |  |
|          | Punctuality and predictability (Chapter 4)                           |  |  |  |
|          | • En-route (Chapter 5)   |  |  |  |
|          | At and around airports (Chapter 6)                                   |  |  |  |
|          | • Comparison of operational performance in US and Europe (Chapter 7) |  |  |  |
|          | Cost-effectiveness (Chapter 8)                                       |  |  |  |
| PART III | TRADE-OFFS AND OVERALL ASSESSMENT                                    |  |  |  |
|          | Environmental assessment (Chapter 9)                                 |  |  |  |
|          | Economic assessment (Chapter 10)                                     |  |  |  |
| PART IV  | GOING FORWARD (Chapter 11)   |  |  |  |
|          | Driving performance  |  |  |  |
|          | Conclusions and Recommendations                                      |  |  |  |

PRR 2008 Chapter 1: Introduction

- 1.2.2 In addition, new features of PRR 2008 include:
  - a high-level overview of ANS performance in the executive summary; 1
  - initial considerations about ANS Flexibility in handling variations in traffic demand;
  - a presentation of operational performance by flight phase (en-route, airport) rather than by KPA (delays, flight-efficiency), which is closer to where accountabilities lie, and makes it easier to assess trade-offs;
  - new performance indicators for flight-efficiency at and around airports;
  - a first assessment of the KPA Access, addressing civil-military aspects en-route;
  - comparison of operational performance in the US and in Europe, so as to identify best practices and potential areas of improvement;
  - environmental and economic assessments, together with discussion of trade-offs;
  - a final chapter "Going-forward", with recommendations.
- 1.2.3 Unless otherwise indicated, PRR 2008 refers to ANS performance in the airspace controlled by the 38 Member States of EUROCONTROL in 2008 (see Figure 3) hereinafter referred to as "Europe", and all data refer to the calendar year 2008.

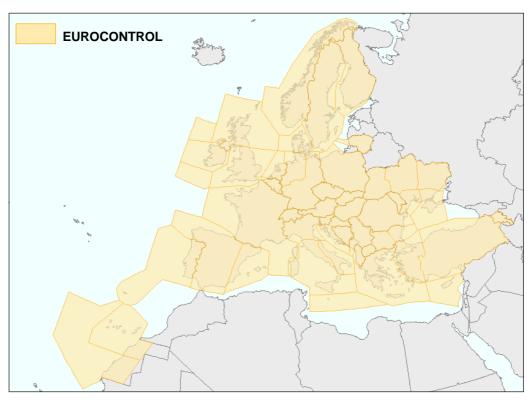


Figure 3: EUROCONTROL area

#### 1.3 New ANS performance scheme under SES II

1.3.1 Performance review of European ATM was established in 1998 in the EUROCONTROL Organisation "to introduce a strong, transparent and independent performance review and target setting system to facilitate more effective management of the European ATM system, encourage mutual accountability for system performance and provide a better

PRR 2008 2 Chapter 1: Introduction

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At PC 29 (May 2008), the Provisional Council "noted and supported the PCC opinion that en-route delay targets and results should in future be presented by the PRC to the Provisional Council ATM system wide, and in a more holistic, balanced scorecard-style, and using a range of specific indicators".

- basis for investment analyses..." through the creation of the independent PRC [Ref. 1].
- 1.3.2 In April 2004, four regulations establishing the Single European Sky (SES) entered into force [Ref. 2, 3, 4, 5]. These regulations (SES I) laid the basis, *inter alia*, for performance review of European ANS by the European Commission, assisted by EUROCONTROL.
- 1.3.3 In June 2008, the European Commission issued a second package of regulatory measures "SES II: towards more sustainable and better performing aviation" [Ref. 6]. The regulations include a "performance scheme", which will:
  - a. reinforce existing performance monitoring processes for periodic review, monitoring and benchmarking and secures access to data flow from various sources (collection, validation, evaluation and dissemination);
  - b. require a robust performance framework with Key Performance Areas in line with ICAO guidelines and Key Performance Indicators;
  - c. add Community target setting mechanisms at both European and local levels;
  - d. require establishment of national/FAB<sup>2</sup> performance targets under responsibility of National Supervisory Authorities (NSA);
  - e. define a common framework for corrective measures, including alert mechanisms, incentives and compliance, to be applied by States when targets are not met;
  - f. apply not only to ANS, as in SES I, but also to network functions;
  - g. establish an independent expert Performance Review Body (PRB) to assist the European Commission in implementing the performance scheme.
- 1.3.4 Items a) and b) are already in SES I regulations and reinforced in SES II. Items c) to g) are new features introduced by SES II. Annex I reproduces the text of Article 11 of the Framework Regulation concerning the performance scheme. It was adopted by the European Parliament and the Transport Ministers in March 2009.
- 1.3.5 This is expected to have a significant impact on European performance in general, and on performance review in particular. This is discussed further in chapter 11.

#### 1.4 PRC Evaluation of FABs

- 1.4.1 In October 2008, the PRC published its report "Evaluation of Functional Airspace Block (FAB) initiatives and their contribution to performance improvement" [Ref. 7]. This evaluation was conducted at the request of the European Commission.
- 1.4.2 The PRC's report developed a framework to define, *inter alia*, KPAs and Key Performance Indicators (KPI) to assess each of the FAB initiatives, and which could be used to monitor FABs. In particular the PRC's report:
  - describes the origins and development of the FAB concept;
  - describes and assesses the nine declared FAB initiatives as at 1 July 2008, and makes a comparative analysis of them;
  - reviews cost-benefit analyses developed by the FAB initiatives and their approaches to safety cases;
  - presents conclusions and recommendations.
- 1.4.3 This report can be the first in a series of such reports to assist the European Commission in monitoring the implementation of FABs and the SES.

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<sup>2</sup> FAB: Functional Airspace Block.

#### 1.5 Implementation status of PC decisions on PRC recommendations

- 1.5.1 Article 10.7 of the PRC's Terms of Reference states that, "the PRC shall track the follow-up of the implementation of its recommendations, and report the results systematically to the Provisional Council".
- 1.5.2 The Provisional Council (PC 29, May 2008) took the following decisions on PRC recommendations arising out of PRR 2007. Changes made by PC 29 are shown in **bold.**

The Provisional Council (PC 29, May 2008):

#### Safety

- (a) noted that the number of high-risk runway incursion reports is rising, and requested the Director General to report on achieved performance to the Provisional Council on a regular basis:
- (b) supported the standardisation of safety reporting at a high level of integrity and consistency across EUROCONTROL States, by every available means, and requested non-compliant States to implement ESARR 2 fully;
- (c) requested the Director General to ensure the implementation forthwith of the decision taken in May 2007 where PC 27 "invited the Director General to undertake a review of EUROCONTROL's publication and confidentiality policy, to ensure the appropriate balance between confidentiality and transparency of safety information", maintaining present just culture principles;

#### Delays

- (d) noted that ATFM delays have been rising for the third consecutive year and requested the full commitment of all stakeholders to the planning and implementation of ATC capacity in line with traffic growth;
- (e) noted and supported the PCC opinion that en-route delay targets and results should in future be presented by the PRC to the Provisional Council ATM system wide, and in a more holistic balanced score card-style and using a range of specific indicators;

#### Flight efficiency/Environment

(f) noted that its flight-efficiency performance target was not met in 2007 and requested the Director General to inform the Provisional Council as to the extent and timing of expected performance improvements arising from airspace programmes coordinated by the Agency in relation to achieving the flight efficiency target.

Figure 4: Provisional Council's decisions on PRR 2007 recommendations

1.5.3 In the past five years, the PRC has made 23 recommendations in its PRRs to the Provisional Council. The implementation status of the associated PC decision is shown in the table below:

| KPA/Decision           | Implemented | Partially implemented | Not<br>implemented | No action<br>needed, or<br>recent<br>decision | Total |
|------------------------|-------------|-----------------------|--------------------|---|-------|
| Safety                 | -           | 7                     | -                  | 3   | 10    |
| Delays & Capacity      | 3           | 2                     | -                  | -   | 5     |
| Flight-efficiency, ENV | 1           | -                     | -                  | 2   | 3     |
| Cost-effectiveness     | -           | 5                     | -                  | -   | 5     |
| Total                  |             |                       |                    |   | 23    |

Figure 5: Implementation Status of PC Decisions on PRC recommendations

1.5.4 To date, the PRC has made a total of ninety recommendations to the Provisional Council. Not all of these recommendations have required a corresponding action of the Provisional Council. All of the PRC's recommendations can be found on the PRC website [Ref. 8].

#### KEY MESSAGES OF THIS CHAPTER

- Traffic growth became negative from August 2008 onwards and was limited to 0.4% in 2008 (5% in 2007).
- Traffic forecasts for 2009 have been revised downwards, with negative growth forecast in 2009 (-5%). However, there remains significant uncertainty on traffic growth.
- Traffic demand is becoming more volatile. Improved ANS flexibility should be addressed in DMEAN, FABs and SESAR.

#### 2.1 Introduction

2.1.1 This chapter provides statistics and forecasts on IFR General Air Traffic (GAT) in Europe. It discusses traffic predictability and introduces ANS flexibility, i.e. responsiveness to unforeseen changes. It also presents traffic composition and an analytical framework.

#### 2.2 Air Traffic statistics

2.2.1 Traffic reached 10.1 million flights in 2008. Traffic growth slowed down to 0.4%<sup>3</sup> in 2008 vs. 5% in 2007 (ESRA 2008 area). Negative traffic growth was recorded as of August, for the first time since 2002, as shown in Figure 6.

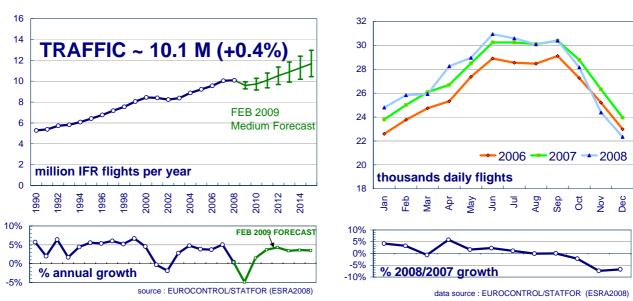


Figure 6: Traffic levels and variations

2.2.2 The daily traffic record was nevertheless broken three times in 2008 and reached 34 105 flights<sup>4</sup> on 27 June 2008 (33 321 in 2007), as shown in Figure 7 (left side). But both peak and average daily traffic decreased in the last quarter of 2008 (Figure 7, right side).

PRR 2008 5 Chapter 2: Traffic

<sup>3 +0.1%</sup> taking into account the leap year.

<sup>4</sup> ESRA 2008 area (see Glossary).



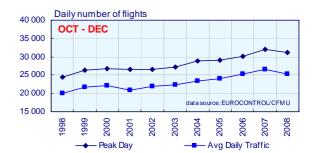


Figure 7: Peak day and average day of traffic

2.2.3 The framework for traffic analysis, showing the different indicators and their relationships, can be found in section 2.8. Key traffic data and indices are given in Figure 8, and represented graphically in Figure 24. More detailed traffic data can be found in Annex II.

| Year 2008                                 | Actual | Variation 2008/2007 | Index<br>100 in 2003 |
|---|--------|---------------------|----------------------|
| IFR flights in Europe <sup>5</sup>        | 10.1 M | +0.4%               | 120                  |
| IFR flight-hours in Europe <sup>5</sup>   | 14.3 M | +2.4%               | 126                  |
| Distance charged in RCS <sup>6</sup> (Km) | 8 851M | +1.5%               | 128                  |

Data source: EUROCONTROL/STATFOR/CRCO

Figure 8: Key traffic data and indices in Europe

#### 2.3 Traffic Growth

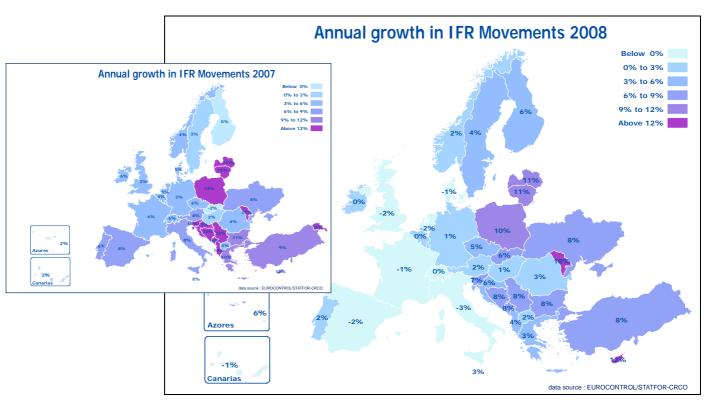


Figure 9: Yearly traffic variation per charging area

<sup>5</sup> ESRA 2008 area (see Glossary). This is a different area to the one used in PRR 2007.

<sup>6</sup> States in "EUROCONTROL Route Charges System" in 2008 excluding Santa Maria (see Glossary).

- 2.3.1 Traffic growth was again quite contrasted across States in 2008, ranging from -3% to 18%, as can be seen in Figure 9. As in 2007, growth was especially high in Poland, the Baltic States and South Eastern States. On the other hand, Italy, Spain, UK, the Netherlands, Denmark and France saw a negative growth.
- 2.3.2 Differences are also observed in volume and proportion of traffic growth in terms of overflights, international and domestic traffic, as can been seen in Figure 10.

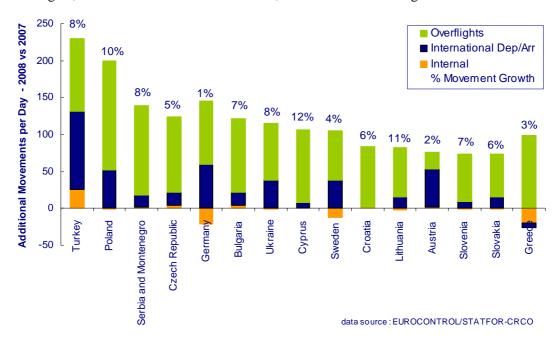


Figure 10: Largest traffic changes in movements per charging area

2.3.3 Figure 11 shows the top 20 airports in terms of movements. Increase of traffic was noticeable in Istanbul and Vienna. In contrast, nine airports out of twenty lost traffic, in particular Milan (traffic shift to Rome-Fiumicino) and Barcelona (influence of Madrid-Barcelona High Speed rail link<sup>7</sup>).

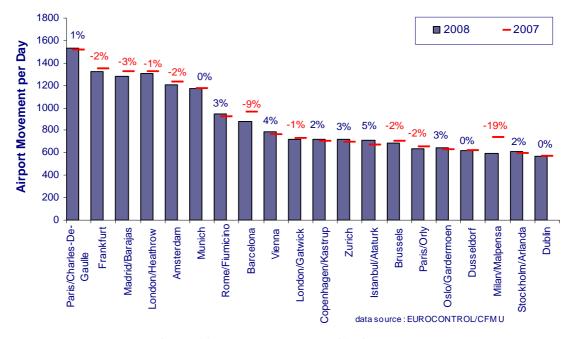


Figure 11: Movements at top 20 airports

The opening of the high-speed rail-link between Madrid and Barcelona contributed to a 40% drop in air passengers on this city pair in 2008. However, the impact on the number of flights in Spain remains small (0.5%).

2.3.4 Figure 12 shows airports with largest increases in movements<sup>8</sup>. As in previous years, some smaller airports (Leipzig, Bucarest Barneasa) contributed significantly to the increase of traffic.

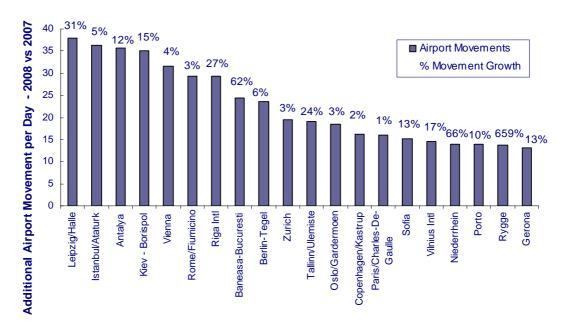


Figure 12: Airports with largest increase in average daily movements

#### 2.4 Traffic forecasts

- 2.4.1 Short term forecasts for 2009 have been revised downwards to around -5% (with wide uncertainty -1.5% to -8%) as a consequence of the global financial crisis and economic downturn.
- 2.4.2 The total service units in the EUROCONTROL 2002 region (ESRA 02) grew by +2.1% in 2008 (vs. 2007 actual). They are forecasted to decrease by -3.5% in 2009 (vs. 2008 actual).
- 2.4.3 In the medium term, forecast traffic growth is quite contrasted across Europe, as illustrated in Figure 13, with highest relative growth expected in Eastern Europe.

-

<sup>8</sup> RYGGE is a new airport, which explains the extremely high % increase.

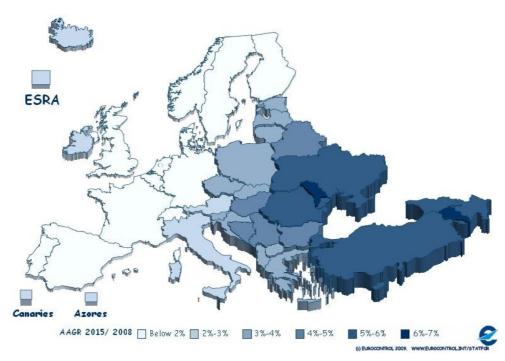
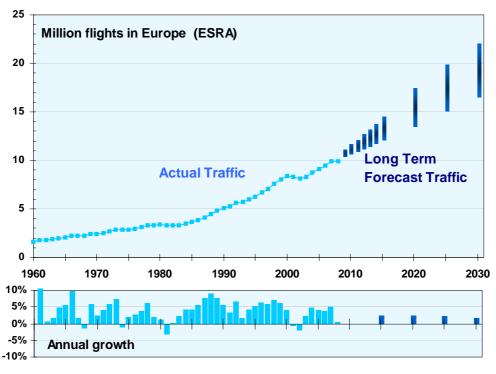


Figure 13: STATFOR Medium Term Forecast (dated Feb 2009)

2.4.4 EUROCONTROL's report "Challenges of growth 2008" [Ref. 9] anticipates continued traffic growth in the long term, as shown in Figure 14.



Source: EUROCONTROL

Figure 14: Long term traffic forecast

2.4.5 Interestingly, the report notes that airport capacity remains the main challenge, and that greenhouse gas emissions, local air quality and noise are becoming more challenging. Many airports will become congested. This will make network management essential to preserve some stability in its operation.

#### 2.5 Traffic predictability and ANS flexibility

#### TRAFFIC FORECAST ACCURACY

- 2.5.1 A degree of unpredictability of traffic demand in time and space is inevitable. This is not a failure of forecasting, rather a background against which ANS planning must operate, and respond through flexibility.
- 2.5.2 Figure 15 shows the successive medium term forecasts and actual traffic at European level. While forecasts are quite good in stable situations, they are necessarily relatively far off in case of unforeseen changes, such as the 2001 events and the economic crisis in 2008.

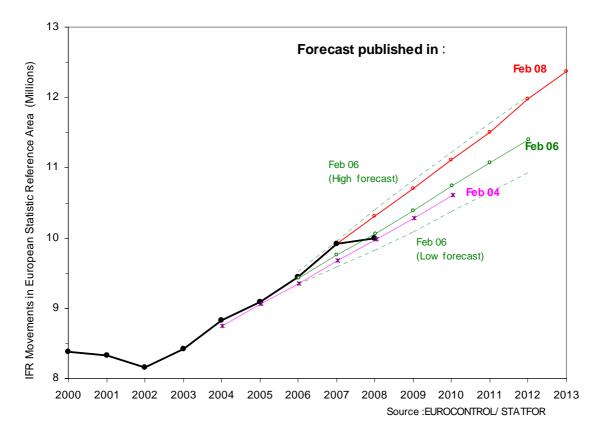


Figure 15: Medium-term forecasts with publication dates

#### FACTORS INFLUENCING TRAFFIC GROWTH

2.5.3 Gross Domestic Product (GDP) is understood to be a main driver of aviation growth. Figure 16 illustrates a correlation between air traffic and real GDP growth rates, with a long term average elasticity of 1.6 (+1% in GDP results in +1.6% in traffic) [Ref. 10]. The yellow bars correspond to crisis periods.

#### Global growth in passenger traffic and GDP

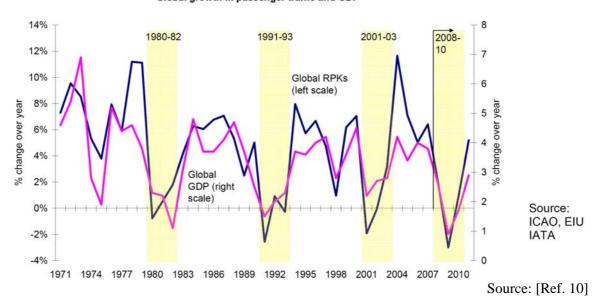


Figure 16: Real GDP and passenger traffic growth

2.5.4 Fuel price would appear to have had a minor impact on traffic demand: there was strong traffic growth in 2007, when fuel prices had more than doubled. Jet fuel prices reached 180\$ per barrel in July 2008, before subsiding to less than 60\$ in November. The average jet fuel price per barrel (Rotterdam spot price) was 90\$ (€55) in 2007 and 127\$ (€85) in 2008.

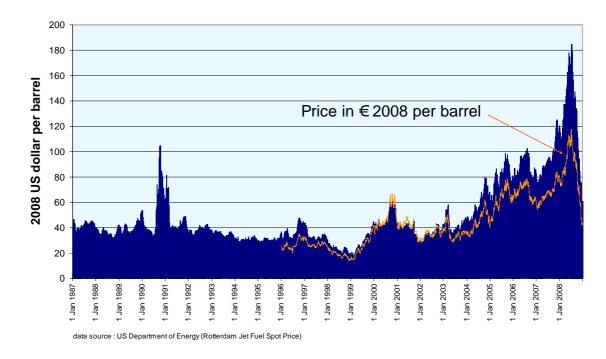


Figure 17: Average fuel cost (deflated)

- 2.5.5 However, fuel costs would appear to have an impact on airline behaviour, making traffic demand more volatile, as can be seen below.
- 2.5.6 In the past, airlines used to have mainly fixed costs. Many airlines have made their costs more variable, through leasing, outsourcing of non-core services, more flexible employment conditions, code sharing, etc. The variable part of many airlines' costs has

exceeded 50% for the first time in 2008, in part due to the rising share of fuel in their costs.

2.5.7 As illustrated in Figure 18, the "fuel" component of AEA members' operating costs has risen from 23% to 33% between 2006 and 2008.

#### **COST SHARE in % of TOTAL Operating Cost**

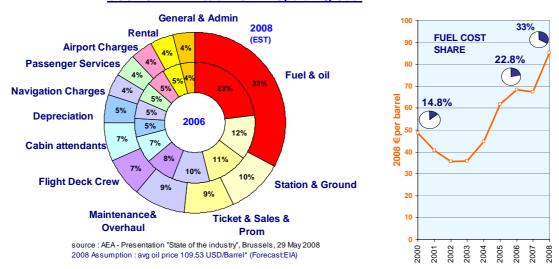


Figure 18: Breakdown of AEA airlines' operating costs

2.5.8 Changes in airlines' costs structure leads to changes in behaviour. When their costs were mostly fixed, airlines tended to attract more revenue through discounts. With mostly variable costs, airspace users are now more responsive in cutting, moving or adding flights. This behaviour is exacerbated by the growing share of the "low-cost" model (see Figure 19), which has significantly contributed to European traffic growth since 2002.

#### ANS FLEXIBILITY IN HANDLING UNFORESEEN CHANGES IN TRAFFIC

- 2.5.9 Demand for ATC is therefore likely to be subject to greater variability in time and space, and future traffic to become less predictable in the short-medium term, although the long-term traffic prospects remain positive. ANSPs should become more flexible so as to be able to handle a range of possible future scenarios efficiently.
- 2.5.10 Short term practices and programmes (e.g. DMEAN) would need to be adjusted to provide greater tactical flexibility, while keeping costs under control. Structural and organisational changes as foreseen in the context of the Functional Airspace Blocks (FAB) would allow for further flexibility (e.g. geographical traffic shifts managed over a larger area). Finally, more flexibility can be supported by advanced concepts and tools, which should be one of the key design objectives of SESAR.

#### 2.6 Traffic Composition

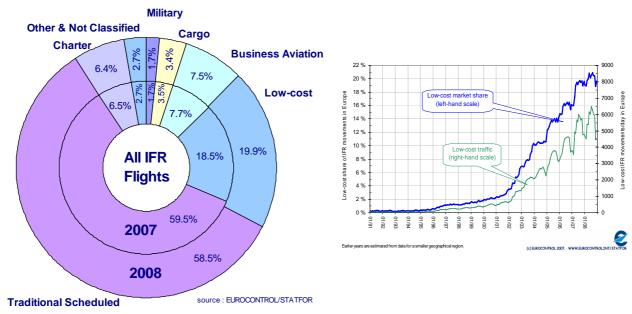


Figure 19: Distribution of IFR flights by type4

Figure 20: Evolution of "low-cost" flight movements

- 2.6.1 Figure 19<sup>9</sup> shows the user mix in controlled General Air Traffic (GAT) in 2007 and 2008<sup>10</sup>. The "low cost" category increased the most (+8% flights) and now accounts for 20% of the traffic. However, the "low cost" category saw its first monthly reduction in traffic in 15 years, with 4,600 flights a day in November 2008 compared to 4,900 in November 2007.
- 2.6.2 Business aviation market share decreased from 7.7% in 2007 to 7.5% in 2008. This corresponds to a 3% decrease in flights in 2008, compared to a 10% increase in 2007.

#### 2.7 Complexity and Traffic Variability

2.7.1 Traffic characteristics vary considerably across Europe. Traffic complexity and variability are two factors that can influence service provision costs and quality of service.

#### **COMPLEXITY**

- 2.7.2 Traffic complexity is generally regarded as a factor to be considered when analysing ATM performance. In 2006, the PRC produced a specific report on air traffic complexity indicators, prepared in close collaboration with ANSPs [Ref. 11].
- 2.7.3 An aggregated complexity has been defined, which is the product of adjusted density and structural complexity.
  - Adjusted Density measures the volume of traffic in a given volume of airspace taking into account the concentration of the traffic in space and in time.
  - Structural Complexity reflects the structure of traffic flows. It is defined as the sum of interactions between flights: horizontal interactions (different headings), vertical interactions (climb/descend) and interactions due to different speeds.

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<sup>9</sup> Cargo definition has been revised by STATFOR: the 2007 figures therefore differ from PRR 2007.

See classification of GAT in glossary. Note that the "Military IFR" segment does not include a substantial portion of military traffic under military control. Similarly, "Other" does not include General Aviation flying purely under Visual Flight Rules (VFR).

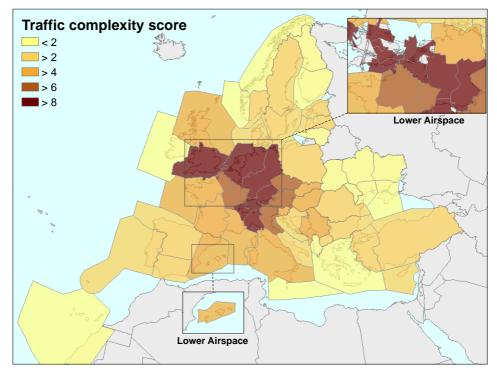


Figure 21: Aggregated complexity scores at ATC-Units level (2008)

- 2.7.4 Figure 21 shows the aggregated complexity scores for the different area control centres (ACCs). London TC (40) has the highest score, followed by Langen ACC (14), Brussels ACC (14) and Manchester ACC (14). In other words, for each hour flown in these airspaces, there are on average 14 minutes of potential interactions with other aircraft. The average European aggregated complexity score is close to 6 minutes of interaction per flight-hour.
- 2.7.5 Updated complexity indicators for ANSPs and some more information on complexity indicators can be found in Annex III.

#### TRAFFIC DEMAND VARIABILITY

2.7.6 Variability in traffic demand makes it more difficult to make best use of resources while providing the required capacity. A distinction is made between seasonal, within-week and hourly variability. Figure 22 presents the seasonal variability indicator, which is computed as the ratio between the peak weekly traffic demand and the average weekly traffic demand over the year.

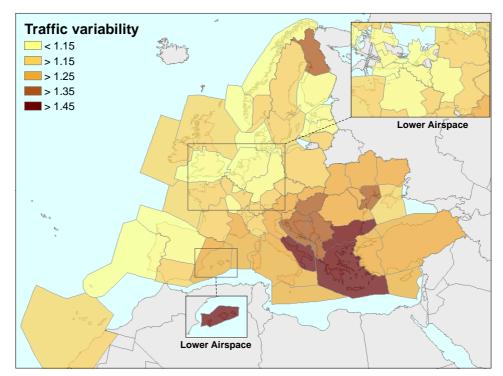


Figure 22: Seasonal traffic variations at ATC-Units level

2.7.7 Higher variability scores are observed in South-East Europe, especially in Greek airspace where the relatively low number of flights in winter contrasts sharply with high demand in summer.

#### 2.8 Framework for traffic analysis

#### FRAMEWORK FOR TRAFFIC ANALYSIS

2.8.1 Figure 23 shows the principal measures of traffic and their relationships, as well as corresponding indicators.

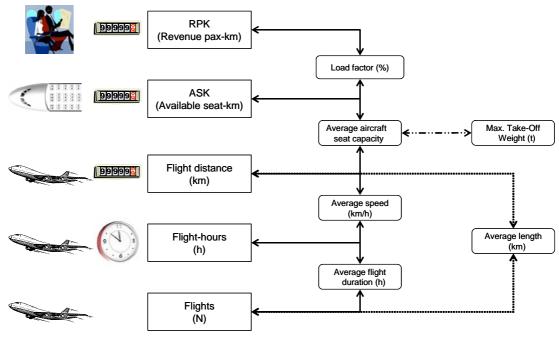


Figure 23: Framework for traffic analysis

- 2.8.2 The societal end result of air transport measured in Revenue Passenger Kilometres (RPK) results from a combination of factors:
  - the average flight length reflects the average distance between origins and destinations of flights in the network (not of passenger journeys). It is growing steadily (~1.5% per year). This reflects a growing cohesion among European States and with the rest of the world, which is to be expected after the accession of 12 new EU States, and with global trade and tourism;
  - average aircraft seating capacity, which is approximately 20% higher in Europe than in the US, as can be seen in Figure 83. It is related to Maximum Take-Off Weight (MTOW) which is growing slowly in Europe, as shown in Figure 24;
  - load factors which have been growing since 2001, as can be seen in Figure 25.

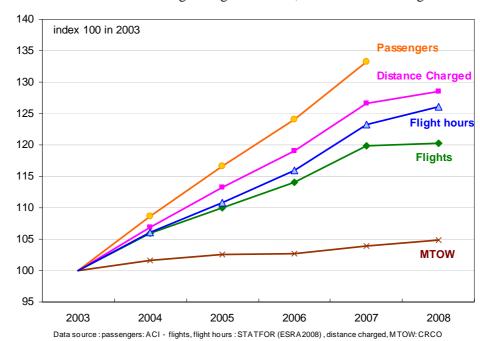


Figure 24: Key Traffic indicators and indices

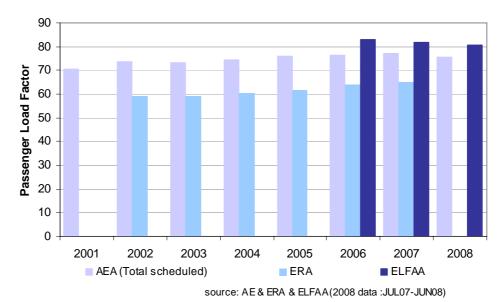


Figure 25: Passenger load factors

#### 2.9 Conclusions

- 2.9.1 Traffic growth became negative from August 2008 onwards and was limited to 0.4% in 2008 (5% in 2007). Traffic forecasts for 2009 have been revised downwards, around -5%, as a consequence of the global financial crisis and economic downturn.
- 2.9.2 Traffic demand is becoming more volatile. Improved ANS flexibility, i.e. responsiveness to unforeseen changes, should be addressed in DMEAN, FABs, and SESAR.

# PART II: ANS Performance Assessment

#### KEY MESSAGES OF THIS CHAPTER

- In 2007, the number of reported high-risk separation minima infringements and runway incursions decreased, even though traffic increased (5%). There was one accident with a direct-ATM contribution at the end of 2007. There was no accident with direct ATM contribution in 2008.
- The PRC supports confidentiality of individual incident reports as well as protection of individuals in a just culture environment. However, the PRC maintains that the safety performance of ANS providers, whose prime duty is to ensure safety in a public service, should be more transparent.
- Monitoring of safety performance should be harmonised in ECAC Member States. This should take account of all aspects of safety including, but not limited to, regulation, oversight, accident/incident investigation and safety management systems. This is essential in order to set and achieve targets.
- There is clear evidence showing that safety regulations are not implemented in full in some States. The PRC considers that a structured ANS safety oversight scheme tailored to the European environment is needed, which could be based on a combination of surveys, peer reviews and audits.

#### 3.1 Introduction

- 3.1.1 All data in this chapter refer to 2007, except for accidents, where data are for 2008.
- 3.1.2 According to the Chicago Convention [Ref. 12], the safety of international aviation is the prime obligation of the ICAO Contracting States. This is ever more important given ongoing pressures to increase capacity, flight-efficiency, and reduce costs and environmental impact.
- 3.1.3 Safety performance may be assessed at various levels, but this chapter essentially considers two levels:
  - State level, which uses the audit results of the USOAP and ESIMS programmes led respectively by ICAO and EUROCONTROL to assess each State's capability to conduct safety oversight of their air navigation system.
  - ANSP level, i.e. achieved safety performance (incidents and accidents), as well as maturity of safety processes (e.g. safety management). It is the PRC's view that the ultimate measure of achieved safety is the number of accidents and serious incidents.
- 3.1.4 Figure 26 illustrates the PRC's approach to safety performance review. It relies on established safety monitoring processes and includes various sources of safety data. This comprehensive approach is currently achieved only in part, the main impediment for its full implementation being unavailability of indicators and limited access to safety data.

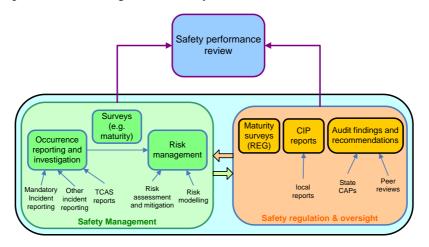


Figure 26: PRC's approach to reviewing ANS safety performance

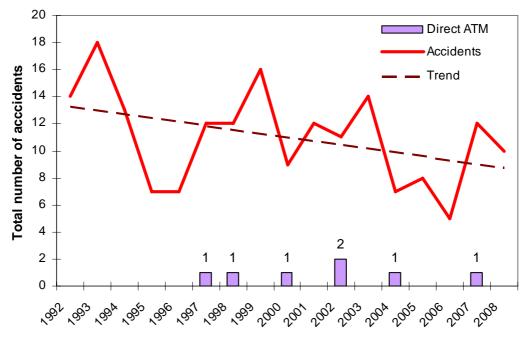
3.1.5 The Safety Reporting and Analysis Taskforce (SAFREP) is due to develop a safety performance measurement framework for end-2009, including validated leading<sup>11</sup> and lagging<sup>12</sup> indicators.

# 3.2 Key safety indicators

3.2.1 According to the ATM Strategy 2000+ [Ref 13], the number of accidents and serious or risk-bearing incidents must not increase, irrespective of traffic growth<sup>13</sup>. Hence, the PRC looks at achieved safety in terms of absolute numbers and not rates.

#### ATM-RELATED ACCIDENTS

3.2.2 There were no accidents with direct ATM contribution in 2008 in Europe.



Data source: Flight Safety Foundation - Aviation Safety Net

Figure 27: Commercial air transport accidents<sup>14</sup> in EUROCONTROL States

3.2.3 Annex 13 of the Chicago Convention requires that all accidents for investigation are reported to ICAO. Similarly, Regulation 1231/2007/EC referring to safety events reported under EU Directives 94/56/EC and 2003/42/EC requires the same reporting to be made to the European accident and incident database (ECCAIRS). However, getting precise numbers from these databases can be less than straightforward (i.e. restricted access, delay in reporting etc.). Therefore, the PRC uses data available from public sources, such as the Flight Safety Foundation database for accidents. The data for commercial flights are considered to be reasonably reliable to build a trend analysis, which is illustrated in Figure 27.

<sup>11</sup> Leading indicators give advance information relevant to safety in the future. They are developed through comprehensive analyses of safety oversight and management in States and ANSPs. They are designed to help identify whether the actions taken or processes in place are effective in lowering the risk.

<sup>12</sup> Lagging indicators measure: events that have happened (e.g. safety occurrences), effectiveness of safety improvement activities, outcome of service delivery. These focus on results and characterise historical performance.

This indicator must allow for an increasing reporting base (new States joining), where the additional number of incidents are part of an existing situation and not additional incidents due to degraded safety.

<sup>14 1997 -</sup> Amsterdam Schiphol airport, Netherlands, B757; 1998 - Yerevan airport, Armenia, Yak 40; 2000 - Paris CDG airport, France, Shorts 330/MD80; 2002 - Überlingen, Germany, B757/Tu154; 2002 - Stuttgart airport, Germany, B717/Cessna 172; 2004: Ronchi dei Legionari, Gorizia airport, Italy, MD82; 2007 - Bucharest Henri Coanda International Airport, Romania, B737.

#### ATM-RELATED INCIDENTS

- 3.2.4 ATM-related accidents being extremely rare (see Figure 27), accident numbers do not provide a statistically meaningful indication of ATM safety performance and trends.
- 3.2.5 Incidents, on the other hand, are more numerous, but depend on reporting, which may skew their statistical significance and trends. As incidents are often accident precursors, acting on incidents helps in preventing accidents. Incident numbers have lagging and leading indicator values.
- 3.2.6 The PRC monitors two incident types, considered to be the most critical: Separation Minima Infringement (SMI) and Runway Incursions. Details for other types of incidents and/or precursors can be found in the Annual Report of the Safety Regulation Commission (SRC) for 2008 [Ref. 14].
- 3.2.7 The number of high-risk SMI appears to have diminished (see Figure 28), even if the total number of reported SMI has slightly increased. This would be a trend reversal from the previous three years, notwithstanding the significant number of unclassified reports, (see Figure 31). Further monitoring is needed to see if this apparent improving trend is confirmed.

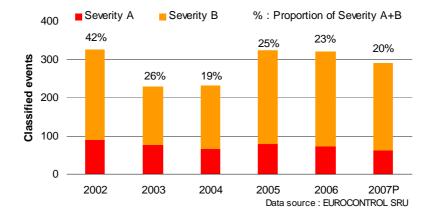


Figure 28: Reported high-risk Separation Minima Infringement

3.2.8 After an increase of reported high-risk Runway Incursions in 2005-2006, a decrease was observed in 2007. The number of reported high-risk incidents is still higher than those recorded in 2004, but with fewer Severity A events (see Figure 29). Given the relatively small numbers, this category may be subject to a trend reversal once all incidents are investigated and classified (see Figure 31). Further monitoring is needed to confirm this trend.

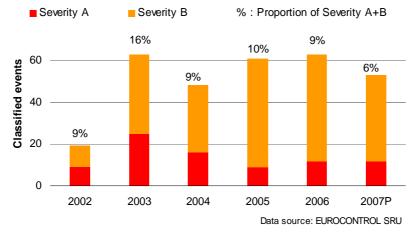


Figure 29: Reported high-risk Runway Incursions

3.2.9 It must be emphasised that increases in the number of reported incidents can indicate an enhanced willingness to report incidents and/or a worsening of the safety situation. Based on these three KPIs, there would appear to have been a moderate improvement in overall safety performance of the European system in 2007. Further monitoring is needed to confirm these trends.

# 3.3 Incident reporting

- 3.3.1 Incident reporting remains a vital activity for safety. The corresponding safety regulatory requirements (ESARR 2) [Ref. 15] have had the merit of establishing a clear reporting and analysis framework for ATM in Europe. However, although mandatory for all EUROCONTROL Member States since 2000, some States have still not implemented it fully and/or don't report at all. Figure 30 shows the number of States with constant and intermittent reporting (see also section 3.6).
- 3.3.2 There are two main issues with indicators based on incidents:
  - The quality and quantity of data is influenced by the reporting processes and culture, therefore the interpretation of variations needs to be done carefully;
  - The analysis of incidents, identification of causes and assessment of severity may vary from one organisation to another. It may also vary within the same organisation over time, due to changing practices or people. Thus, the consistent aggregation of data at European level may prove difficult.
- 3.3.3 The level and the quality of incident reports are strongly influenced by the existence of a "Just Culture", as suggested by ICAO Annex 13.
- 3.3.4 There is a time lag between the moment of occurrence and the moment when data become available for European performance review. The time needed to investigate and classify the events adds to the time needed to collect and aggregate the data at EUROCONTROL. This leads, in the case of ESARR2 data, to a lag of typically two years, which would need to be improved.
- 3.3.5 The number of States having failed to report<sup>15</sup> for the past three years increased in 2008. The SRC also recognises that "the number of States reporting has reached a plateau level beyond which EUROCONTROL may find it difficult to move". More pressure and enforcement (e.g. EU infringement procedures) may be needed for full implementation of safety regulations.

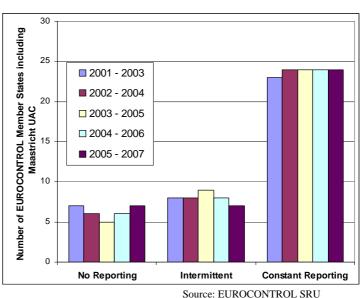


Figure 30: Incident reporting via ESARR 2

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<sup>15</sup> See the list of non-reporting States in 2008 in Figure 37.

- 3.3.6 A relevant indicator is the number of incidents that are still under investigation. All reports must be followed by a thorough analysis process to identify severity and causes, with possible recommendations for remedial actions.
- 3.3.7 There was a marked increase in the number of occurrences still under investigation at the end of 2007. The total number of incidents reported to EUROCONTROL grew by 8% against a traffic growth of 5%. However, 16% (nearly 1800 events) of these were either still under investigation or not yet investigated by the end of the year (compared with 6% at the end of 2006 and 2005). This may be an indication that effort devoted to investigation is insufficient.
- 3.3.8 Events still under investigation may artificially skew incident indicators, and care should be exercised in drawing conclusions from them.

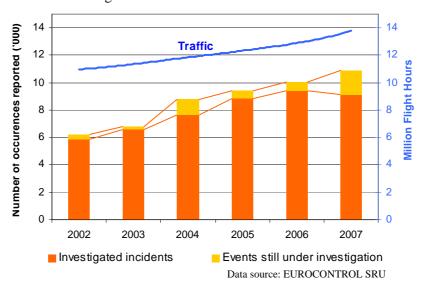


Figure 31: Number of ATM occurrences as reported to EUROCONTROL

- 3.3.9 Moreover, as demonstrated in PRR 2007 (Figure 38) and as shown in the SRC Annual Report for 2008 [Ref. 14, page 19], there is still significant under-reporting in Europe.
- 3.3.10 Significant variation exists in the various processes of incident reporting in Europe. There is a lack of consistency between States in ATM incident reporting as well as in the processes of severity assessment. These inconsistencies are likely to have resulted in the existence of unquantified safety risks in the European ATM system.
- 3.3.11 The current work undertaken through SAFREP to develop a European safety performance framework is expected to produce a harmonised scheme for severity assessment. Once adopted, all ECAC States and ANSPs should apply this new framework without delay.
- 3.3.12 Moreover, the introduction of automated tools would complement human reporting of losses of separation, reduce its inherent subjectivity, and ensure a wider and more stable coverage. Such tools are successfully implemented in some ANSPs, and even used to set national targets (e.g. French Parliament, see Ref. 16, p 77). The use of such tools would need to be in the context of "Just Culture".

# THE EUROCONTROL VOLUNTARY INCIDENT REPORTING SYSTEM

3.3.13 In 2007, EUROCONTROL started a Voluntary ATM Incident Reporting system (EVAIR) with a number of airlines that provide information on incidents to EUROCONTROL. While too early for reliable statistics, initial results identify a number of causal factors for incidents. The participating airlines cover about 30% of all ECAC traffic and provide an average of 100 reports a month. A main objective of EVAIR is to

- establish the feedback between airspace users and ANSPs to resolve identified problems rapidly.
- 3.3.14 Mistakes<sup>16</sup> appear to be the single largest category. The most common appear to be due to inadequate or incorrect planning and judgment. However, these early findings need to be put in the wider context, as human mistakes are often induced by a wider systemic issue.
- 3.3.15 Another major category highlighted by the EVAIR analysis is related to communications. Whether this is standard phraseology, plain language or traffic information, a large number of incidents reported fall in one or more of these categories.
- 3.3.16 For the time being, it is not possible to connect the ESARR2-AST and EVAIR data, but work is in progress within EUROCONTROL to this end. It should be possible in the future to identify the causal factors of the most serious incidents. This could help in better focusing the remedial actions and risk mitigation.

# 3.4 Safety Oversight

#### ICAO USOAP - HISTORICAL OVERVIEW

- 3.4.1 Safety oversight is defined as a function by means of which ICAO Contracting States ensure effective implementation of the safety-related Standards and Recommended Practices (SARPs) and associated procedures contained in the Annexes to the ICAO Convention and related documents. Safety oversight ensures that the national aviation industry provides a safety level at least equal to that defined by the SARPs. Thus, the State's responsibility for safety oversight is the foundation upon which safe global aircraft operations are built. Lack of appropriate safety oversight in one State may threaten the health of international aviation.
- 3.4.2 Based on Assembly Resolution A29-13: *Improvement of Safety Oversight*, ICAO established<sup>17</sup> in 1995, and expanded<sup>18</sup> in 2005 a Universal Safety Oversight Audit Programme (USOAP), comprising regular, mandatory, systematic and harmonised safety oversight audits conducted by ICAO for all 16 safety-related ICAO Annexes, divided in 8 auditing areas Legislation (LEG), Civil Aviation Organisation (ORG), Personnel Licensing (PEL), Aircraft Operations (OPS), Airworthiness (AIR), Air Navigation Services (ANS), Aerodromes Air Routes and Ground Aids (AGA) and Accident and Incident Investigation (AIG). Under this programme, all 170 ICAO Contracting States will have been audited by the end of 2010. By the end of 2008, twenty three EUROCONTROL Member States will have been audited.
- 3.4.3 Following an USOAP audit, a *Final Audit Report* is drawn up by the ICAO auditing team, consisting of an assessment of the safety oversight capability of the State based on the 8 Critical Elements (CEs) defined in ICAO Doc 9734 Part A. The report also contains an annex with Findings and Recommendations and a Corrective Action Plan (CAP) developed by the State in response to the audit recommendations. Subsequently, the State must comply and act on these recommendations through the completion of its CAP.

### **EUROCONTROL ESIMS AUDITS**

3.4.4 Since 2002, the SRU has put in place the ESARR Support, Implementation and Monitoring Programme (ESIMS), where States are audited with regards to ESARR implementation taking full account of the new context of SES. The ESIMS programme<sup>19</sup>

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<sup>16</sup> Actions, decisions or judgments that produce an unwanted or unintended result.

<sup>17</sup> Assembly Resolution A32-11 – Establishment of USOAP (Annexes 1, 6 and 8).

<sup>18</sup> Assembly Resolution 35-6 – Expansion of USOAP to cover all safety-related ICAO Annexes.

<sup>19</sup> Audits are carried out pursuant to Decision N° 92 of the EUROCONTROL Permanent Commission and conducted according to the principles established in SRC Document 21, Edition 3.0.

- provides a detailed analysis of the level of compliance with safety oversight mandatory provisions applicable in the Member States. It also enables the development of CAPs to address the deficiencies identified.
- 3.4.5 A Memorandum of Cooperation between ICAO and EUROCONTROL regarding safety oversight auditing ensures that coordination takes place at working and programme management levels. ESIMS and USOAP audit schedules are coordinated to avoid overlaps and take advantage of the synergies between the two programmes.
- 3.4.6 There is a correspondence between the areas reviewed in the ESIMS audits and the eight ICAO CEs. Similarly to USOAP, ESIMS audits use a series of protocol questions covering the safety oversight arrangements related to ATM Services personnel (part of PEL), ATM-related accidents and incidents (part of AIG) and the provision of ATS, ATFM and ASM. Although ESIMS audits do not cover the full scope of the USOAP audits, they are more focused customised to European environment.

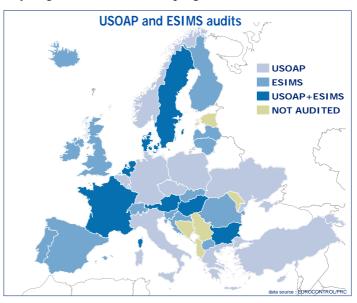


Figure 32: Member States audited by USOAP and ESIMS since 2005

# STATES' CAPABILITY FOR SAFETY OVERSIGHT

3.4.7 The capability of States to conduct safety oversight of their ATM system is summarised in Figure 33. The eight KPIs depicted on this figure represent the eight Critical Elements (CEs) used by the ESIMS audit programme as well as by the USOAP programme.

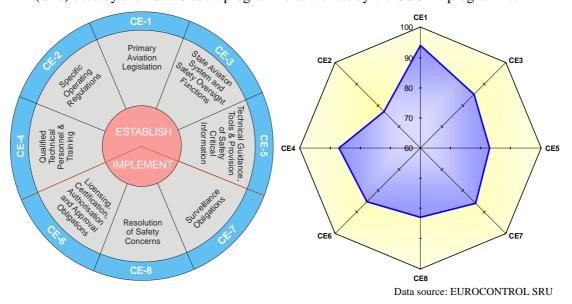


Figure 33: ICAO's 8 CEs and related results of ESIMS audits in 17 ECAC States

3.4.8 The figure shows the level of compliance for each CE. This is calculated as a straight average of the scores from 17 audited States since 2005. Within each State, the scores measure the percentage of audit protocol questions declared compliant.

- 3.4.9 This shows that CE-2 (specific operating regulations) has the lowest score of all CEs, due to a low rate of ESARR implementation in the 17 States audited. One reason for this delay appears to be due to the transposition of ESARRs in Community legislation and the associated "Double Regulation" issues. Although almost every EUROCONTROL Member State scores higher than the world average calculated by the USOAP programme<sup>20</sup>, the lack of effective implementation of ESARRs (see also Figure 37) demonstrates the urgent need of enforcing rules in the area of ANS.
- 3.4.10 Figure 34 shows the level of effective implementation of CE-2 per State<sup>21</sup>, as measured at the time of each audit. It must be noted that States have been audited at different periods of time and have submitted their CAPs in response to the audit findings. Subsequently, States reported back to the SRU their gradual progress in implementing their CAPs. The improvements in implementing CE-2 as reported by States are also shown.

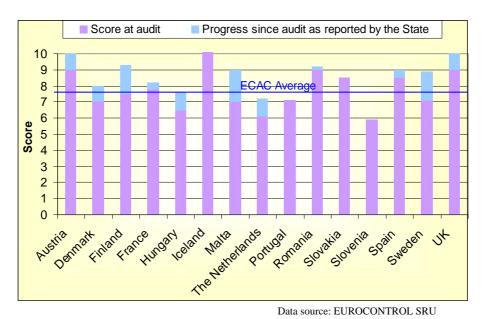


Figure 34: Effective implementation of ESARRs in 15 ECAC States audited by ESIMS

# 3.5 The future of ANS safety oversight in Europe

- 3.5.1 The safety oversight audit programmes of ICAO (USOAP) and EUROCONTROL (ESIMS) have reached the mid-point of their respective six-year audit cycles and will end in 2011.
- 3.5.2 Beyond 2011, ICAO is planning to enter into a performance monitoring scheme that is based on a well defined set of safety KPIs, augmented by ad-hoc safety oversight audits whenever serious safety-related deficiencies are identified.
- 3.5.3 European States have not yet organised a follow-up to the ESIMS programme beyond 2011. Similarly to ICAO, the European 2011+ safety oversight strategy should be based on a comprehensive and continuous performance monitoring and assessment process relying on elements that complement each other, such as safety oversight audits, peer reviews provided for by SES regulations, State's CAP monitoring, Safety Maturity Surveys, LCIP reports, etc., conducted in a standardised way throughout the ECAC area.

<sup>20</sup> See the safety oversight information on the ICAO public web site: http://www.icao.int/fsix/

<sup>21</sup> Although Lithuania and Bulgaria were also audited, the final and full results of the audit and corresponding CAP were not available at the time of the publication of this report, therefore these States are not included in the chart.

3.5.4 Figure 35 illustrates the close correlation that should exist between the various elements of this safety oversight strategy. For example, if the agreed State's CAP sets a date to implement a particular safety performance indicator (e.g. a safety procedure to enhance coordination between sectors within a FAB or between FABs), the monitoring process should take into account all the information from the State's annual reports, the safety maturity surveys, the LCIP reports and the Peer reviews. If any of these reports indicates that the implementation of the required procedure is late, the competent authority should be consulted and a warning should be issued if warranted. This may lead to a revision of the business plan of the corresponding ANSP, entail the corresponding enforcement actions or trigger a partial ad-hoc safety oversight audit to assess the situation in the State.

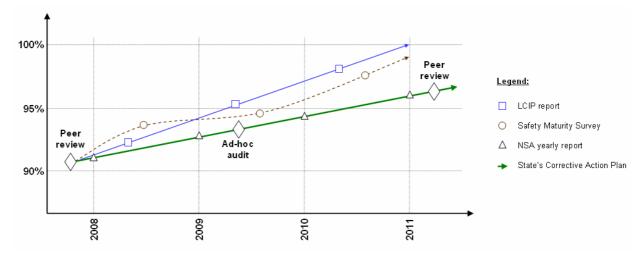


Figure 35: Structured approach to ANS safety oversight

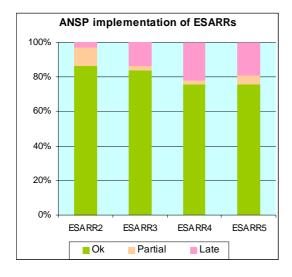
# 3.6 Safety regulation

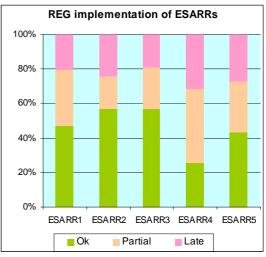
#### IMPORTANCE OF HARMONISED SAFETY REGULATIONS

- 3.6.1 Establishing safety regulations is the legal means of adopting or transposing ICAO Standards and Recommended Practices (SARPs) and other regional safety requirements (e.g. EC Regulations) into national regulatory systems, the purpose of which is to bind national service providers and aviation industry to minimum international safety standards for civil aviation. Establishing harmonised safety regulations is crucial for the creation of a Single European Sky. Although all EUROCONTROL Member States have already established their own safety regulations, through EU or national rules, based on provisions contained in the Annexes to the Chicago Convention and related documents, there still exist significant differences between these regulations and the ICAO SARPs, in particular in the area of ANS.
- 3.6.2 In order to reduce differences in national regulations and therefore between States, the EC is issuing new harmonised regulations, aiming at establishing common safety standards that are equal to, or higher than, the minimum requirements set by ICAO. The Safety Regulatory Commission (SRC) of EUROCONTROL has also issued common safety requirements (ESARRs) in the area of ATM, applicable to all EUROCONTROL Member States. Most of them have been incorporated into those EC rules. With the extension of EASA, new harmonised safety standards are expected in the next years in the areas of Aerodromes, Air routes and Ground Aids (AGA) and Air Navigation Services (ANS).

#### ESARR COMPLIANCE

- 3.6.3 The SRC has developed a number of EUROCONTROL Safety Regulatory Requirements (ESARR) since 1999. All ESARRs are mandatory for all EUROCONTROL Member States (for the State Regulator and the ANSP) and recommended to the rest of ECAC States. Furthermore, all ESARRs have now been transposed in a corresponding EU Law.
- 3.6.4 The current degree of implementation and compliance with ESARRs varies across States. Currently, of 38 EUROCONTROL Member States, only three have fully implemented all ESARR1 to ESARR5: Ireland, Lithuania and Sweden.





Data source: EUROCONTROL

Figure 36: Implementation rates of ESARRs in all 38 EUROCONTROL Member States

- 3.6.5 The average implementation rate of ESARRs in the EUROCONTROL Member States at the end of 2007 was 78% for ANSPs and a quite low 44% for Regulators. This striking difference is visible in Figure 36. Clearly, while by now all ESARRs should have been fully implemented by all ANSPs and Regulators, the situation among Regulators is particularly unsatisfactory.
- 3.6.6 The variable and less than optimal transposition of ESARRs is also visible from the results of the ESIMS audits. Indeed, the Critical Element 2 (Specific Operating Regulations) scores the lowest of all eight CEs (see Figure 33 and Figure 34). Furthermore, the SRC Annual Report highlights this situation, a reason quoted being the transposition of ESARRs into EC law.
- 3.6.7 Since all ESARRs have now an equivalent in EU legislation, their transposition should proceed swiftly, in particular for the States within the applicability area (EEA). The PRC will continue to monitor this situation.
- 3.6.8 Safety regulations must be transposed and implemented in full by each State. Enforcement should be used where possible (i.e. for non-implementation of EU-transposed ESARRs). For developing States and/or organisations, support programmes are likely to bring benefits.
- 3.6.9 USOAP will terminate in 2010 and ESIMS in 2011 and no follow-up is decided yet for the latter. The PRC considers that a structured ANS safety oversight scheme tailored to the European environment is needed, which could be based on a combination of surveys, peer reviews (as provided for in the SES legislation) and audits.
- 3.6.10 Figure 37 shows the detailed implementation of each ESARR1 to ESARR5. While ESARR6 has also been mandated since 2006, it was transposed into EU legislation only

in 2008 and therefore States might have had less time to dedicate the necessary resources. Its implementation will be traced in the future along with the other ESARRs.

3.6.11 Compliance is as reported by each State and recorded in the relevant Local Convergence and Implementation Plan (LCIP). ESARR2 requires sending the AST to the SRU annually. However, according to the SRC, a number of States have failed to do so in 2008, as shown in the table. The PRC considers that the State as fully compliant with ESARR2 only where all its requirements are met.

|                      | ESARR1    | ESARR2    |           |             | ESARR3    |           | ESARR4    |           | ESARR5    |           |
|----------------------|-----------|-----------|-----------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Due by:              | Nov 2007  | Jan 2002  |           | Mar<br>2008 | Jul 2003  |           | Apr 2004  |           | Apr 2005  |           |
| State                | Reg       | ANSP      | Reg       | AST sent    | ANSP      | Reg       | ANSP      | Reg       | ANSP      | Reg       |
| Albania              | Partial   | Ok        | Partial   | Ok          | Ok        | Partial   | Late      | Partial   | Ok        | Partial   |
| Armenia              | Ok        | Partial   | Partial   | No          | Ok        | Ok        | Ok        | Partial   | Ok        | Ok        |
| Austria              | Ok        | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Ok        | Ok        | Partial   |
| Belgium              | Partial   | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Late      | Ok        | Partial   |
| Bosnia & Herzegovina | Late      | Ok        | Late      | No          | Late      | Late      | Late      | Late      | Ok        | Ok        |
| Bulgaria             | Partial   | Ok        | Partial   | No          | Ok        | Late      | Ok        | under rev | Ok        | Partial   |
| Croatia              | Ok        | Ok        | Late      | No          | Ok        | Late      | Late      | Late      | Ok        | Partial   |
| Cyprus               | Ok        | Ok        | Ok        | No          | Ok        | Ok        | Late      | Late      | Ok        | Ok        |
| Czech Republic       | Partial   | Ok        | Ok        | Ok          | Ok        | Partial   | Ok        | Partial   | Ok        | Ok        |
| Denmark              | Late      | Ok        | Partial   | Ok          | Ok        | Partial   | Ok        | Partial   | Ok        | Ok        |
| Finland              | Ok        | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Partial   | Ok        | Ok        |
| France               | Ok        | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Ok        | Late      | Partial   |
| Germany              | Ok        | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Partial   | Ok        | Partial   |
| Greece               | Partial   | Partial   | Partial   | No          | Partial   | Partial   | Partial   | Partial   | Late      | Late      |
| Hungary              | Planned   | Ok        | Partial   | Ok          | Ok        | Partial   | Ok        | Partial   | Ok        | Ok        |
| Ireland              | Ok        | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Ok        | Ok        | Ok        |
| Italy                | Planned   | Ok        | Partial   | Ok          | Ok        | Partial   | Ok        | Ok        | Partial   | Partial   |
| Lithuania            | Ok        | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Ok        | Ok        | ok        |
| Luxembourg           | Partial   | Ok        | Ok        | No          | Ok        | Ok        | Ok        | Partial   | Ok        | Partial   |
| FYROM                | Late      | Partial   | Late      | Ok          | Late      | Late      | Late      | Late      | Late      | Late      |
| Malta                | Ok        | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Partial   | Ok        | Ok        |
| Moldova              | Late      | Ok        | Late      | Ok          | Late      | Late      | Late      | Late      | Late      | Late      |
| Monaco               | Ok        | Ok        | Ok        | No          | Ok        | Ok        | Ok        | Ok        | Ok        | Ok        |
| Montenegro           | under rev | under rev | under rev | Ok          | under rev |
| Netherlands          | Partial   | Ok        | Late      | Ok          | Ok        | Partial   | Ok        | Partial   | Ok        | Partial   |
| Norway               | Ok        | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Ok        | Ok        | Partial   |
| Poland               | Partial   | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Partial   | Ok        | Ok        |
| Portugal             | Ok        | Ok        | Ok        | Ok          | Ok        | Partial   | Ok        | Partial   | Ok        | Late      |
| Romania              | Planned   | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Partial   | Ok        | Ok        |
| Serbia               | Late      | Late      | Late      | Ok          | Late      | Late      | Late      | Late      | Late      | Late      |
| Slovakia             | Late      | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Late      | Ok        | Ok        |
| Slovenia             | Ok        | Ok        | Late      | No          | Ok        | Ok        | Ok        | Late      | Ok        | Late      |
| Spain                | Ok        | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Ok        | Late      | Late      |
| Sweden               | Ok        | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Ok        | Ok        | Ok        |
| Switzerland          | Partial   | Ok        | Ok        | Ok          | Ok        | Ok        | Ok        | Partial   | Ok        | Late      |
| Turkey               | Late      | Partial   | Late      | No          | Late      | Late      | Late      | Late      | Partial   | Late      |
| Ukraine              | Partial   | Ok        | Late      | No          | Ok        | Ok        | Ok        | Late      | Late      | Late      |
| UK                   | Partial   | Ok        | Ok        | Ok          | Ok        | Partial   | Ok        | under rev | Ok        | Ok        |

Data source: LCIP 2008-2012 and SRC (for AST data)

Figure 37: ESARR implementation status

# 3.7 ATM Safety Maturity

- 3.7.1 EUROCONTROL launched the safety maturity survey programme in 2002, as part of the European Safety Programme, in order to assess the level of safety management systems and the general level of safety maturity within the ANSPs and State Regulators.
- 3.7.2 The survey is based on a number of questions divided in several areas. It is largely a self-assessment exercise, whereby the surveyed organisations fill in questionnaires. Information is then checked against other sources of data, such as the audit results from ESIMS and the LCIP and it is followed by a number of interviews.
- 3.7.3 The areas covered by the survey can be found in Annex IV of PRR2007 (pp. 100-101) [Ref 17]. These areas have enabled those areas most in need of improvement to be targeted, such as the area of incident reporting.
- 3.7.4 As minimum maturity level of 70% was considered acceptable by expert judgement, the Provisional Council of EUROCONTROL set this target to be achieved by end-2008. Having this target in place and having established a measurement process has clearly had the merit of focusing efforts and achieving real improvements in terms of safety management and safety culture.
- 3.7.5 A new and more comprehensive framework is currently under development in partnership with CANSO and ICAO. It will be tested for the first time in 2009, in parallel with the last run of the current framework. Then, subject to adoption by the Provisional Council, it will become standard from 2010.
- 3.7.6 This framework is expected to allow better focusing of attention on critical areas and raising the bar to an even better performance level.

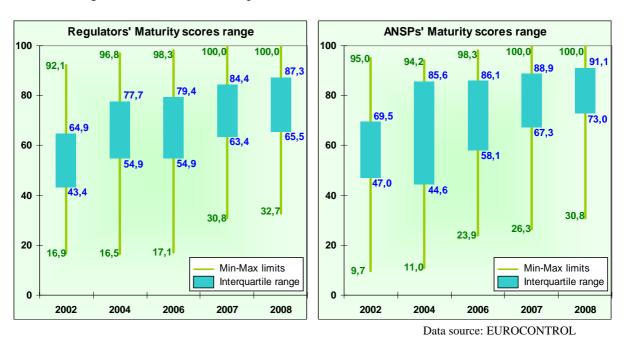


Figure 38: Maturity scores (EUROCONTROL 2008 area)

3.7.7 As already stated, the Provisional Council has established a minimum target level of 70% maturity score for Regulators as well as for ANSPs, to be reached by the end of 2008. Due to confidentiality restrictions, the PRC cannot show individual maturity scores for each organisation. Figure 38 shows that while there is still a significant spread of maturity scores, the gap is narrowing and the trend is clearly positive.

- 3.7.8 Figure 39 shows that for the 2008 assessment (i.e. level at end-2007) thirteen Regulators and nine ANSPs scored under the target level of maturity (see also Annex V). While there is a clearly improving trend, there is still some ground to be covered before reaching the PC-endorsed target for all organisations.
- 3.7.9 The PRC will monitor the end-2008 results from the 2009 assessment.

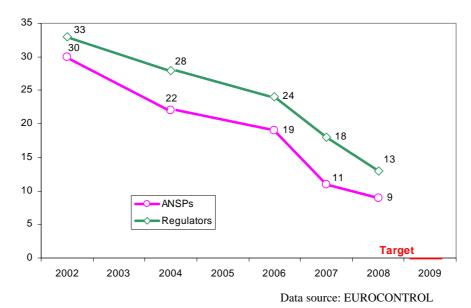


Figure 39: Number of ANSPs and Regulators with maturity below target level

# 3.8 Transparency

## SAFETY PERFORMANCE TRANSPARENCY AND SAFETY IMPROVEMENT

- 3.8.1 Upon PRC recommendation, the Provisional Council (PC 27, May 2007) "requested the Director General to undertake a review of EUROCONTROL's publication and confidentiality policy, to ensure the appropriate balance between confidentiality and transparency of safety information". This decision was reiterated in May 2008.
- 3.8.2 The PRC has constantly advocated for a better level of transparency that would provide adequate information about the safety levels in each State and ANSP. The PRC's objective is to have open and transparent reporting of safety performance information without comprising "Just Culture" principles and confidentiality of information pertaining to individuals. This is related to the safety responsibility these organisations have towards the flying public.
- 3.8.3 At the very least, the level of implementation of safety regulations, as well as the State's oversight capability are basic information that are required to indicate that public service obligations are fulfilled as far as ATM safety is concerned.
- 3.8.4 It is worth noting that a number of European States that have been audited by ICAO have agreed to a full public disclosure of their final audit report. These are Andorra, Belgium, Bulgaria, the Czech Republic, Germany, Italy, Monaco, Norway and San Marino. The general scores for each Critical Element are made public for all audited States. In a welcome move, the SRC also now discloses the same information from the ESIMS audits.
- 3.8.5 Publishing safety information is however not uncommon in Europe. Figure 40 shows that safety information is published many States, whether by the ANSP, the State or both. A sample of that data can be found in the ANSP fact sheets in Annex IX of this report.

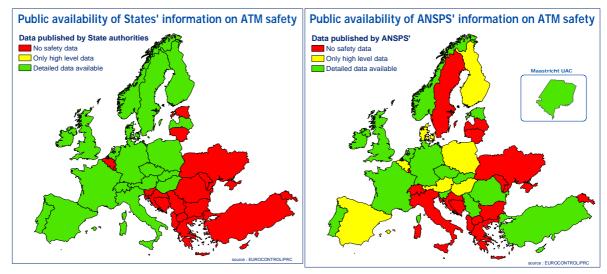


Figure 40: Public availability of information on ATM safety

## 3.9 Conclusions

- 3.9.1 There were no ATM-induced accidents in Europe in 2008.
- 3.9.2 In 2007, the number of reported high-risk separation minima infringements and runway incursions decreased, against a general rise of traffic and total incident reports. Notwithstanding a significant amount of reports still under investigation and therefore not classified, this appears to be a positive trend reversal from the previous three years.
- 3.9.3 A majority of States have not yet fully implemented EUROCONTROL Safety Regulatory Requirements (ESARR). Compliance with regulations is an obligation of each State. A combination of enforcement measures (e.g. EU infringement procedures, where applicable) and/or support programmes must ensure that such regulations are fully transposed and implemented without delay.
- 3.9.4 The PRC supports confidentiality of individual incident reports as well as protection of individuals in a just culture environment. However, the PRC maintains that information about safety performance of ANS providers, whose prime duty is to ensure safety and who provide a public service, should be more transparent.
- 3.9.5 In the latest maturity survey (March 2008), thirteen States and nine ANSPs did not reach the minimum acceptable maturity level of 70%. The target that all regulators and ANSPs should reach this minimum level by end 2008 remains a challenge. More efforts are needed by those concerned to reach at least this minimum level.
- 3.9.6 The EU rule-making mechanism, safety oversight and the safety performance monitoring process are closely inter-linked. There is a continuous loop whereby the legislative process is followed by target-setting, compliance and performance monitoring, enforcement, incentives and feed-back.
- 3.9.7 The USOAP and ESIMS safety audit programmes will terminate in 2011 and no follow-up has yet been decided for the latter. The PRC considers that a structured ANS safety oversight scheme tailored to the European environment is needed, which could be based on a combination of surveys, peer reviews (as provided for in the SES legislation) and audits.

# **Chapter 4: Punctuality/Predictability**

#### KEY MESSAGES OF THIS CHAPTER

- In 2008, 21.6% of flights arrived more than 15 minutes late compared to schedule. Although slightly improving (22.1% in 2007), air transport punctuality remains unsatisfactory in Europe.
- Late arrivals originate mainly from late departures, 72% of which originate from airline and airport processes.
- Predictability slightly improved in 2008. The spread of arrival delays for a given flight is important for scheduling purposes.
- There is a clear interrelation between airport capacity utilisation, variability of operations and quality of service. In order to improve air transport performance, three initiatives should be followed in parallel:
  - (1) Improve departure punctuality, which requires coordinated efforts from all stakeholders;
  - (2) Improve resilience to adverse weather;
  - (3) Improve flexibility in adjusting ATM capacity to variations in demand.

#### 4.1 Introduction

- 4.1.1 Chapters 4 to 7 are dedicated to operational service quality. The aim is to determine how well the ATM system allows airspace users to optimise their operations, according to their needs and requirements. The goal is to minimise overall direct (fuel, etc.) and strategic (schedule buffer, etc.) costs to airspace users whilst maximising the utilisation of available airport and en-route capacity.
- 4.1.2 This chapter seeks to provide a high level view of the operational quality of service provided in the European Air Transport Network in order to analyse the contribution of ANS towards overall performance in more detail in Chapter 5 and 6 (see Figure 41).

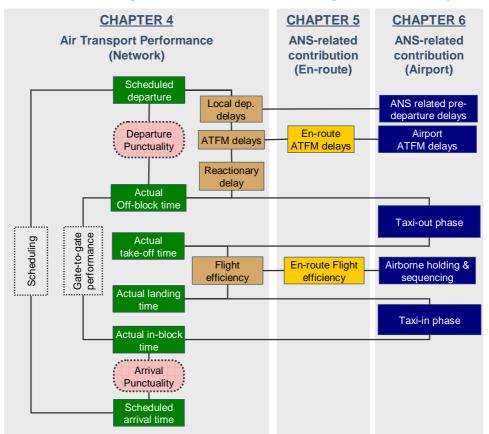


Figure 41: Conceptual framework for the analysis of operational air transport performance

- 4.1.3 The chapter furthermore aims at illustrating the link between the planning phase (i.e. scheduling of operations) and the actual performance on the day of operations which shapes the passenger perception of air transport performance, expressed in "On-time performance".
- 4.1.4 There are many factors contributing to the on time performance of a flight. In reality, it is the "end-product" of a complex interrelated system, involving many different stakeholders of the aviation community from the scheduling phase up to the day of operation.

# 4.2 Air Transport Punctuality (On-time Performance)

- 4.2.1 The proportion of flights delayed by more than 15 minutes compared to schedule is generally used as the Key Performance Indicator (KPI) for on-time performance. Figure 42 shows on-time performance in Europe between 2002 and 2008.
- 4.2.2 In addition, the proportion of flights arriving more than 15 minutes ahead of schedule is shown at the bottom of Figure 42, as it is an important parameter from an operational point of view.

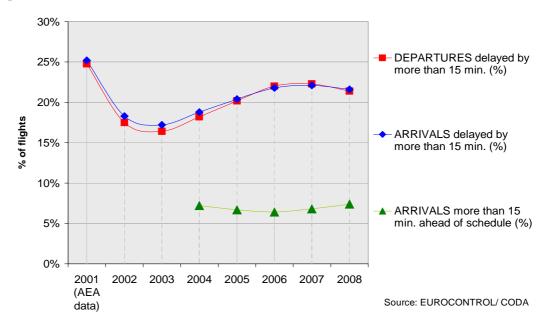


Figure 42: On-time performance

4.2.3 After a continuous deterioration between 2003 and 2007, on time performance in Europe improved slightly in 2008. However, the improvement in on-time performance in 2008 needs to be seen in context with the slowdown in traffic growth (see Chapter 2) as a result of the global financial crisis and economic downturn.

# 4.3 Linking air transport scheduling with operational performance

4.3.1 From a scheduling point of view, the predictability of operations months before the day of operations has a major impact on the extent to which the use of available resources (aircraft, crew, etc.) can be maximised. The lower the predictability of operations during the scheduling phase, the more time buffer is required to maintain punctuality and schedule integrity<sup>22</sup>, and the higher the 'strategic' costs to airspace users.

<sup>22</sup> The level of "schedule padding" is subject to airline policy and depends on the targeted level of on-time performance.

- 4.3.2 "Predictability" measures the variation in air transport operations as experienced by the airspace users. It consequently focuses on the variance (distribution width) associated with the individual phases of flight (see (1) in Figure 43).
- 4.3.3 In addition to "predictability", the efficiency of operations is of major importance airspace "Efficiency" generally relates to fuel efficiency or reductions in flight times of a given flight and can be expressed in terms of fuel and time. It consequently focuses on the distance of the mean from travel times a pre-defined (schedule) or unimpeded optimum time (see (2) in Figure 43).

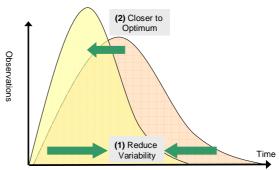


Figure 43: Variability and efficiency

- 4.3.4 The goal is to minimise overall direct (fuel, etc.) and strategic (schedule buffer, etc.) costs to airspace users whilst maximising the utilisation of available capacity.
- 4.3.5 It should be noted that this approach measures performance from a single airspace user perspective. At system level, ANS performance is inevitably affected by operational trade-offs and environmental or political restrictions which may negatively impact on individual airspace users but which may be necessary or well justified as they benefit the air transport system as a whole in terms of capacity, safety or environmental sustainability.

# 4.4 Predictability of air transport operations

- 4.4.1 Predictability measures the variation in air transport operations as experienced by the users. Figure 44 shows the level of variability in the European air transport system (Intra-European flights) from the airline perspective.
- 4.4.2 Departure and Arrival time variability is measured by comparing actual to scheduled times. The variance in the flight segment times (gate to gate) relates to the actual observed travel times.

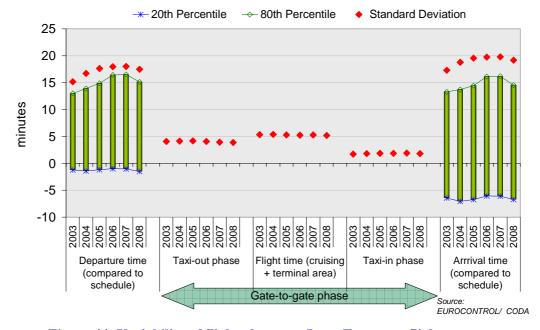


Figure 44: Variability of flight phases on Intra European flights

- 4.4.3 The band between the 80<sup>th</sup> and 20<sup>th</sup> percentile (green bar in Figure 44) shows that very few flights depart before their scheduled departure time but a considerable number of flights arrive before their scheduled arrival time. This is consistent with the observation in Figure 42 which shows the percentage of arrivals more than 15 minutes ahead of schedule.
- 4.4.4 Whereas, from an airline viewpoint "early" flights most likely result in an underutilisation of resources, from an airport and ATC point of view, flights ahead of schedule can represent as much of a problem as delayed flights (gate availability, variability of traffic flows, etc.).
- 4.4.5 The variance in the gate-to-gate phase (i.e. from off block to in-block) contributes to a lesser extent to the level of variability in the European air transport system. However, the variability in the taxi-out and the terminal airborne phase can vary significantly between airports and is addressed in more detail in Chapter 6.
- 4.4.6 Departure-time variability, and hence arrival-time variability increased between 2003 and 2006 and decreased in 2008.
- 4.4.7 The main driver of arrival time variability remains the variance induced by delays at the gate. This is also confirmed by Figure 42, where almost no gap between departure and arrival punctuality is visible. The underlying drivers of departure delays in Europe are analysed in more detail in the next section of this chapter.

# 4.5 Drivers of departure time variability

- 4.5.1 Figure 45 provides a breakdown of <sup>23</sup> the drivers of departure time variability between 2002 and 2008. The analysis refers to delays which are experienced before the aircraft goes off-block and which were identified as the main source of variability in the European Air Transport Network. The underlying drivers are broken down into three main categories:
  - Local turnaround delays are primary delays caused by airlines (technical, boarding, etc.), airports (equipment, etc.) or other parties such as ground handlers involved in the turn around process. As the focus of this report is on ANS performance, a detailed analysis of local turnaround delays is beyond its scope.
  - ATFM delays are primary delays which are the result of an imbalance between demand and available capacity en-route or at airports. Aircraft are held at their origin through "ATFM slots" which may cause delays to the concerned flights. The ATFM delay of a given flight is attributed to the most constraining ATC unit, either en-route (en-route ATFM delay) or departure/arrival airport (airport ATFM delay). En-route and airport ATFM delays are reviewed in more detail in Chapters 5 and 6 respectively.
  - Reactionary delays are secondary delays caused by primary delays on earlier legs of
    the aircraft, which cannot be absorbed during the turn-around phase at the airport.
    Due to the interconnected nature of the air transport system, long primary delays can
    propagate throughout the network until the end of the day.

<sup>23</sup> As reported by the main airlines operating in Europe (>65% coverage).

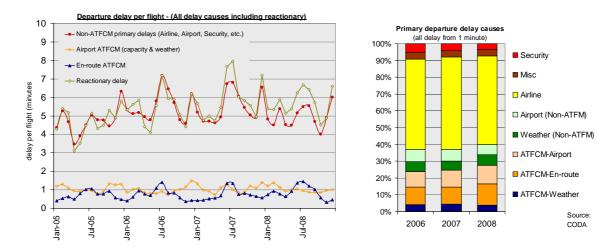


Figure 45: Drivers of overall departure punctuality (system)

4.5.2 As can be seen in Figure 45, underlying delays principally originate from non-ATFM-related causes. ATFM related causes accounted for 27% of departure delays<sup>24</sup> in 2008, and showed an increasing trend in 2008 notwithstanding the overall improvement of departure punctuality. Reactionary delays (Delays caused by the late arrival of the preceding aircraft) follow very closely the evolution of primary delay.

# 4.6 Improving on-time performance and reducing variability

- 4.6.1 Today's air transport system operates with wide time and flow margins. For airlines, even short haul flights of less than 60 minutes are considered as being on-time if they are less than 15 minutes late. At airports, it is not unusual to have up to ten flights scheduled to depart or arrive at the same time. In ATM, the departure window is 15 minutes wide (-5/+10 min.) if ATFM regulations are in place, and 30 minutes otherwise [Ref. 18].
- 4.6.2 Because of the high level of built-in variability, flexibility is needed in the way the current system is operated. Improvements in on-time performance and a reduction in variability requires a simultaneous tightening of airline, airport and ATM processes, and imply a better coupling between them.
- 4.6.3 This requires a coordinated approach from all stakeholders:
  - on-time performance is predominantly driven by departure delays. Hence all stakeholders need to focus on the reduction of departure delays attributable to them;
  - the direct ATM related contribution in the departure phase is approximately 27.5% (23.8% without weather related ATFM delays). The share of ATFM delays is increasing and there is a need to counteract this trend. En-route and airport related ATFM delays are analysed in more detail in Chapter 5 and 6 respectively;
  - in view of a considerable level of "built in" variability in today's air transport system (+/- 15 min.) ATM requires a flexible approach to balancing capacity with demand;
  - the responsible bodies should focus on accurate and realistic airport scheduling, including the ability to sustain a throughput close to declared capacity under most weather conditions.
- 4.6.4 Due to the interconnected nature of the air transport system, there are also "network effects" which are the result of the interactions between all the stakeholders and which cannot be attributed to individual stakeholders. Network effects such as 'reactionary

<sup>24</sup> Including weather-related ATFM delays (23.8% without weather-related ATFM delays).

delay" and European Air Traffic Flow and Capacity Management (ATFCM) performance are addressed in the remainder of this chapter.

# 4.7 Network management

## REACTIONARY DELAYS (NETWORK SENSITIVITY)

4.7.1 Long delays on earlier flight legs can propagate throughout the network until the end of the operational day. Depending on a multitude of factors such as time of the day, length of the delay, aircraft utilisation, airline strategy etc., the primary delay may not only affect the initially delayed airframe on successive legs but may also affect other aircraft waiting for passengers or crew.

#### 0.85 ratio reactionary to primary delay 0.80 0.75 0.70 0.65 0.60 0.55 0.50 0.45 0.40 2001 2002 2003 1999 2000 2004 2005 2006 2007 2008 AEA data eCODA data

Sensitivity of the European air transport network to primary delays

Primary delay includes local turnaround delays and en-route and airport ATFM delays

Figure 46: Sensitivity of the Air Transport Network to primary delays

4.7.2 The sensitivity of the air transport network to primary delays can be measured using the reactionary to primary delay ratio (see Figure 46). The higher the ratio, the more sensitive is the system to primary delays. Reasons for an increased sensitivity to primary delays can be manifold (utilisation level of resources, schedule padding, airline strategies, etc.).

# ATFCM PERFORMANCE

- 4.7.3 Due to the complexity of interactions between airlines, airports and ANS, it is difficult to assess overall Air Traffic Flow and Capacity Management (ATFCM) performance. Three indicators are presently used to monitor overall ATFCM performance levels:
  - 1. Over-deliveries (excess demand<sup>25</sup>>10%);
  - 2. Delays due to inefficient regulations (filed demand below capacity); and,
  - 3. Slot adherence (% of take-offs outside the ATFM slot window).

Excess demand: difference between the actual flow entering a resource (e.g. sector, airport) and the maximum specified by the ATFM regulation.

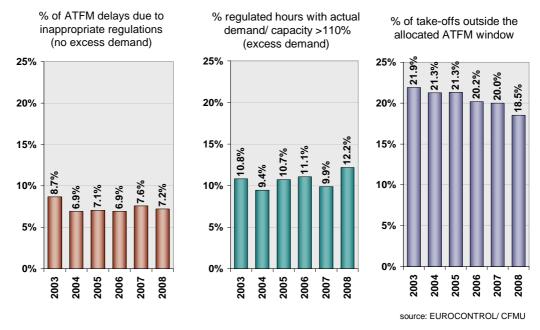


Figure 47: ATFCM indicators

4.7.4 The level of non-adherence to ATFM slots remains high, although some improvement is noted.

#### 4.8 Conclusions

- 4.8.1 After a continuous deterioration between 2003 and 2007, air transport on time performance improved slightly in Europe in 2008, in a context of lower traffic growth.
- 4.8.2 Late arrivals are mainly driven by late departures at origin airports, with relatively small variations in the gate to gate phase. Departure delays originate principally from turnaround processes. ATFM-related departure delays caused by en-route or airport constraints account for 27% of departure delays (24% without weather-related ATFM delays), and show an increasing trend in 2008.
- 4.8.3 The predictability of operations several months in advance affects airline scheduling and the extent to which the use of available resources (aircraft, crew, etc.) can be maximised. After a continuous deterioration between 2003 and 2007, operational variability improved slightly in 2008.
- 4.8.4 Today's air transport system operates with wide time margins. Because of this high level of built-in variability, flexibility is needed in the way the current system is operated. Improvements in on-time performance and a reduction in variability require a simultaneous tightening of airline, airport and ATM processes, and imply a better coupling between them in the aviation network.

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# **Chapter 5: En route Operational Performance**

#### KEY MESSAGES OF THIS CHAPTER

- En-route ATFM delays increased for the fourth consecutive year and exceeded the agreed target by 90% (1.9 min./flight, Target: 1 min/flight). 4.3% of flights were delayed more than 15 minutes due to en-route ATFM delays (3.3% in 2007).
- Insufficient capacity delivery or plans in a dozen of ACCs penalised the whole system, often due to staffing issues. Capacity plans need to take account of collective agreements and those agreements need to be valid for the duration of the plans.
- It is important that the development of ANS capacity is not adversely affected during the current global financial crisis and economic downturn.
- The flight efficiency target was not achieved in 2008. Improvements in relative route extension (-0.2%) were masked by increasing average flight distance (+3%).
- Two thirds of route extension is due to domestic airspace design issues, but one quarter is linked with cross-FAB airspace design, which illustrates the need for a network approach to airspace design.
- MIL KPIs are becoming available and implementation by States should be encouraged. Progress still
  needs to be made in development of routes through shared airspace and the civil use of shared airspace,
  especially during weekends when military activity is minimal.

### 5.1 Introduction

- 5.1.1 Building on the framework outlined in Figure 41 in Chapter 4, this chapter analyses the operational performance of <u>en-route</u> ANS (ATFM delays, flight efficiency, access to and use of airspace), and the next chapter analyses operational performance in the <u>TMA and at airports</u>.
- 5.1.2 This new approach by area (en-route, TMA & airport) rather than by KPA (delays, flight-efficiency) enables accountabilities and trade-offs to be seen more clearly. The KPA Access is introduced for the first time (en-route only) to address civil-military issues.
- 5.1.3 The environmental impact of flight efficiency, and trade offs between the different flight phases, are addressed in Chapter 9. The economic impact of, and trade offs between, en route capacity (route charges), ATFM delays and flight efficiency are addressed in Chapter 10.

# 5.2 En-route ATFM delays - European View

- 5.2.1 This section reviews *Air Traffic Flow Management* (ATFM) delays originating from enroute capacity restrictions. Aircraft expected to arrive during a period of congestion are held upstream on the ground at their departure airport until the downstream en-route capacity constraint is cleared. The ATFM delay is the difference between the *Calculated Take Off Time* (CTOT) and the take-off time estimated in the aircraft's flight plan.
- 5.2.2 ATFM delays can have ATM-related (staffing, etc.) and non-ATM related (weather, etc.) reasons. When an ATFM regulation is issued, the reason for the regulation is indicated by the *Flow Management Position* (FMP). The corresponding delay codes are used to group ATFM delays according to their cause. As in PRR 2007, the categories "ATC Capacity" and "Staffing" have been combined.

# EUROPEAN ATFM EN-ROUTE DELAY TARGET

5.2.3 The European target for en-route ATFM delay is one minute per flight target until 2010 (PC, 2007). This target refers to en-route ATFM delay in the summer period (May to October), all causes included (capacity, weather, etc.).

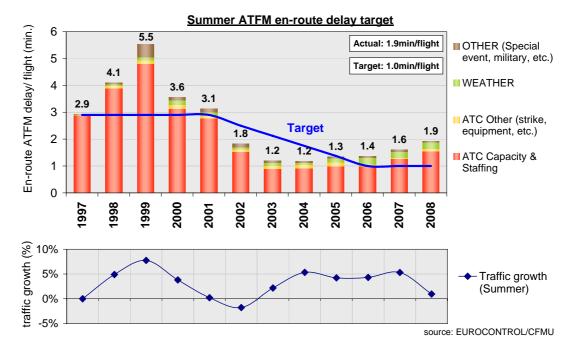


Figure 48: Summer ATFM en-route delay target

- 5.2.4 As shown in Figure 48, summer en-route ATFM delays<sup>26</sup> increased for the fourth consecutive year to 1.9 minutes per flight, the highest value since 2001, despite a notable slowdown in traffic growth. The ATFM delay target was not achieved, and exceeded by 90% in 2008.
- 5.2.5 As shown in Figure 49, effective capacity<sup>27</sup> decreased for the first time in the past 10 years. This is because some ACCs were unable to open their maximum configuration at peak hours, often due to staffing issues (see section on "Most penalising ACCs" below). The gap between effective capacity and air traffic demand therefore continued to widen.

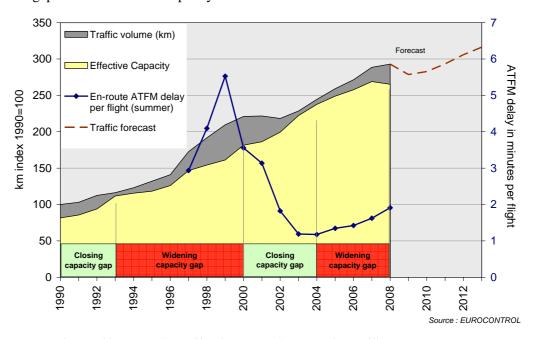


Figure 49: Matching effective capacity and air traffic demand

<sup>26</sup> Regulations on traffic volumes EGLL60, EHFIRAM, LEBLFIN, LECMARR1 have been reclassified as airport regulations.

<sup>27</sup> Traffic level that can be handled with optimum delay (cf. PRR 5 (2001), Annex 6).

5.2.6 Past experience shows cyclic behaviour in traffic growth. Despite uncertainties attached to traffic forecasts, care should be taken not to jeopardize future capacity increases as it takes several years for capacity-expanding initiatives to be implemented.

#### EUROPEAN ATFM EN-ROUTE PERFORMANCE

5.2.7 Figure 50 shows the evolution of en-route ATFM delays<sup>28</sup> in Europe between 2006 and 2008. ATC Capacity and Staffing related issues (76%) are the main cause for en-route ATFM delays, followed by "weather" (9.7 %). "Other" reasons account for 14.3%, of which 6.2% are ATM-related (strike, equipment, etc.).

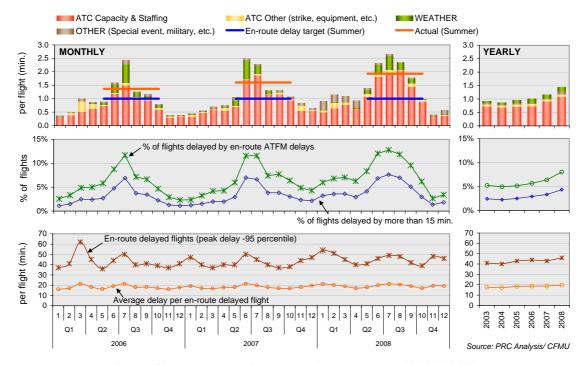


Figure 50: Evolution of en-route ATFM delays (2006-2008)

- 5.2.8 En-route ATFM delays show seasonal variations, peaking during summer when traffic demand is generally highest. This is exacerbated by some ACCs being unable to open their optimum configuration during peak periods mainly due to various staffing issues.
- 5.2.9 8% of flights were subject to en-route ATFM delays in 2008. 4% of flights were delayed by more than 15 minutes and 1% delayed by more than 30 minutes. There is a clear increase in the number of flights affected by en-route ATFM delays between 2004 and 2008.
- 5.2.10 The average en-route ATFM delay per delayed flight remains relatively constant. Although of interest for passengers and aircraft operators, it does not appear to be a relevant indicator for ANS performance management purposes.

#### MOST PENALISING ACCS

- 5.2.11 This section analyses delay performance at local level (ACC).
- 5.2.12 On average, one flight crosses approximately three ACCs. The one-minute per flight delay target at European level cannot therefore be applied to individual ACCs (otherwise flights are counted three times).

Figure 50 shows en route ATFM delays for the full year, while Figure 48 shows en route ATFM delays for the summer period only.

- 5.2.13 Consequently, the performance at ACC level is assessed in line with the capacity objective set out in the ATM 2000+ Strategy [Ref.13] "to provide sufficient capacity to accommodate demand in typical busy hour periods without imposing significant operational, economic or environmental penalties under normal conditions."
- 5.2.14 While it is normal that capacity issues and significant delays occur on some days, ACCs should not generate high delays on a regular basis. This is why delay performance at ACC level is assessed in terms of the <u>number of days</u> with large en-route ATFM delay (>1 minute per flight<sup>29</sup>). Based on experience, thresholds are set at 30 days (congested) and 100 days (highly congested).
- 5.2.15 As shown in Figure 51 (see also Annex III), most ACCs provided sufficient capacity (<30 days with large delay). However, the number of highly congested ACCs increased to 7, while the total number of congested ACCs decreased to 14. Those 14 ACCs (out of 68) accounted for 78% of en-route ATFM delays in 2008.

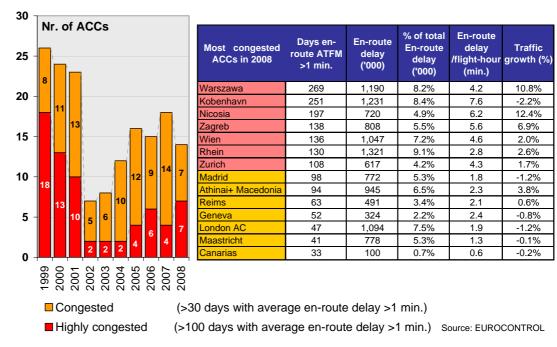


Figure 51: Most penalising ACCs

5.2.16 Figure 52 shows maps of the most penalising ACCs in 2007 and 2008. Five out of the seven "highly congested" ACCs are outside the dense European Core Area, which confirms that ATFM delays are mostly related to capacity planning and deployment issues (including staffing and system problems), rather than structural limits. It is also important to note that, despite an overall traffic stagnation, traffic growth remained high in the Eastern part of Europe. Moreover, in the first half of the year, traffic on peak days increased compared to 2007 (see also Chapter 2).

As one flight goes through 3 ACCs on average, every ACC must generate less than 0.3 minute per flight in average for the European target of 1 minute per flight to be met. One minute per flight on average is therefore a large delay for an ACC.

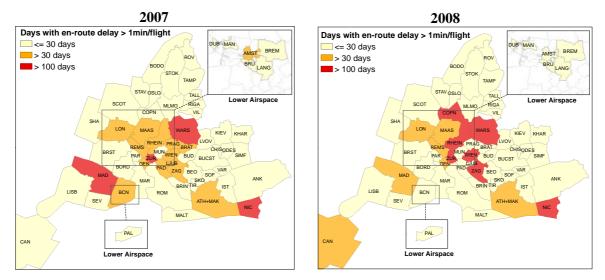


Figure 52: Most delay-generating ACCs

#### UNDERLYING DRIVERS

- 5.2.17 Figure 53 provides an indication of the underlying ATFM delay causes for the most penalising ACCs in 2008. To account for scale effects, the indicator is en-route ATFM delay per controlled flight hour.
- 5.2.18 Apart from Copenhagen ACC, capacity & staffing related issues are by far the main cause of ATFM restrictions. For Copenhagen ACC, more than half of delays are due to the implementation of the new ATM system in winter 07/08.

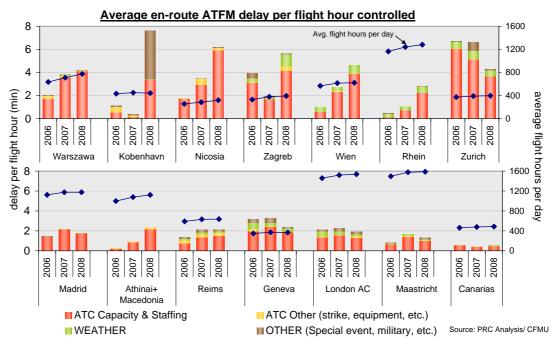


Figure 53: Underlying ATFM en-route delay drivers (most penalising ACCs)

# ACC CAPACITY PLANNING

- 5.2.19 This section compares actual and planned performance for the most constraining ACCs.
- 5.2.20 The responsibility to plan and to deliver the right level of capacity lies with ANSPs. EUROCONTROL supports the European medium term capacity planning with a number of tools, data sets and traffic scenarios. The resulting capacity plans are then published in the Network Operations Plan (NOP).

5.2.21 Figure 54 compares actual traffic demand and ATFM delays to the forecast levels in the Medium Term Capacity Plan<sup>30</sup> for the most penalising ACCs.

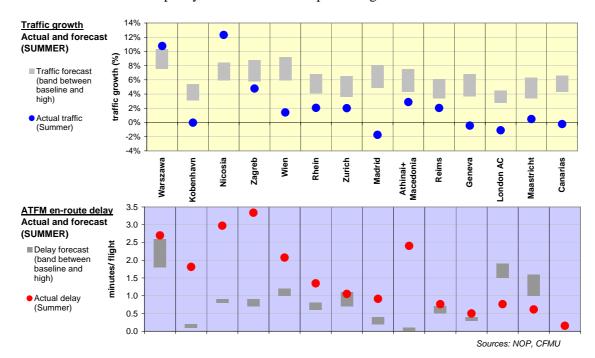


Figure 54: Accuracy of capacity planning (Summer)

- 5.2.22 Some interesting points can be noted in Figure 54:
  - with the exception of Warsaw and Nicosia, actual traffic growth was well below the baseline forecast;
  - for almost all of the most penalising ACCs (Copenhagen, Nicosia, Zagreb, Vienna, Rhein, Madrid and Greece), the high level of ATFM delay was not predicted;
  - higher than expected traffic growth in Warsaw and Nicosia contributed to higher than expected level of en-route ATFM delay there.
- 5.2.23 It is worth pointing out that the high level of delay was unpredicted for almost all ACCs which consequently created instability in the system and hence negatively impacted the whole European network performance. The failure to meet, or keep below, forecast delay levels is even more surprising in view of the significantly lower than expected traffic growth for most ACCs (with the exception of Warsaw and Nicosia). The main reason for this was the unexpected staffing issues that were not taken into account by these ACCs during the planning period.
- 5.2.24 Staffing issues appear to be a growing issue at many European ACCs and seem to have had a significant impact on the unforeseen capacity shortfall at some ACCs (Rhein UAC, Copenhagen ACC, Vienna ACC, Maastricht UAC, London ACC, Zagreb ACC, Athens + Macedonia ACC and Nicosia ACC).

<sup>30</sup> Forecast source: STATFOR medium-term forecast.

- 5.2.25 Figure 55 indicates that delays due to combined sectors, which could be avoided in the absence of staffing issues, increased significantly in 2008.
- 5.2.26 Staff availability, flexible deployment of staff and flexible sector opening schemes will be key to avoid such unforeseen capacity issues in the future.

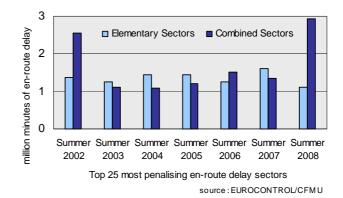


Figure 55: ATFM delays due to combined/elementary sectors

5.2.27 Higher focus needs to be given to the respect of capacity plans and to adequate management of human resources in order to avoid unexpected staff shortages when employment conditions are re-negotiated at short notice. Capacity plans need to take account of collective agreements and those agreements need to be valid for the duration of the plans.

# 5.3 En-route Flight Efficiency

- 5.3.1 Deviations from the optimum trajectory generate additional flight time, fuel burn and costs to airspace users. This section reviews en-route flight efficiency. Flight efficiency in terminal control areas (TMA) and at main airports is addressed in Chapter 6.
- 5.3.2 En-route flight efficiency has a horizontal (distance) and a vertical (altitude) component. The focus of this section is on horizontal en-route flight efficiency, which is of higher economic and environmental importance than the vertical component (see Figure 118). The additional fuel burn due to en-route flight inefficiencies has an environmental impact, which is addressed in more detail in Chapter 9 of this report.
- 5.3.3 The Key Performance Indicator (KPI) for horizontal en-route flight efficiency is En-route extension. En-route extension is defined as the difference between the length of the actual trajectory<sup>31</sup> (A) and the Great Circle Distance (G) between the departure and arrival terminal areas (radius of 30 NM around airports). Where a flight departs or arrives outside Europe, only that part inside European airspace is considered. En-route extension can be further broken down into direct route extension which is the difference between the actual flown route (A) and the TMA interfaces (D).

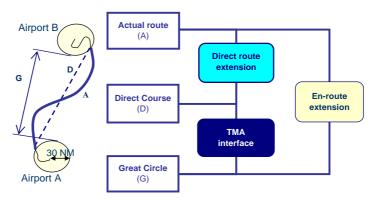


Figure 56: High level horizontal flight efficiency framework

<sup>31</sup> Difference in ground distances (irrespective of wind), not air distances (including wind effect). The actual route distance is computed for all IFR flights based on ETFMS data, i.e. quasi-radar data.

- 5.3.4 The horizontal en-route flight efficiency indicator takes a single flight perspective. It relates observed performance to the great circle distance, which is an ideal (and unachievable) situation where each aircraft would be alone in the system and not be subject to any constraints. In high density areas, flow-separation is essential for safety and capacity reasons with a consequent impact on flight efficiency.
- 5.3.5 Consequently, the aim is not the unachievable target of direct routing for all flights at any time, but to achieve an acceptable balance between flight efficiency and capacity requirements while respecting safety standards. These trade-offs are addressed in Chapter 10

#### EUROPEAN HORIZONTAL FLIGHT EFFICIENCY TARGET

- 5.3.6 In May 2007, the Provisional Council of EUROCONTROL adopted the horizontal flight efficiency target of a reduction of the average route extension per flight by two kilometres per annum until 2010.
- 5.3.7 While the European flight efficiency target was not met in 2008, significant focus has been put on initiatives to improve the European airspace design and network management.

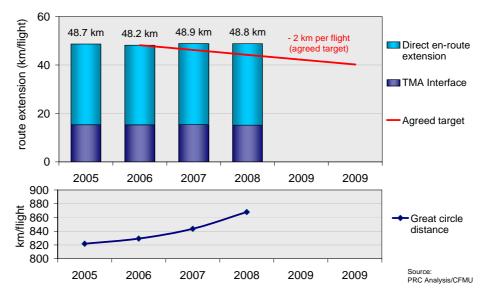


Figure 57: Horizontal flight efficiency target

5.3.8 Some improvements in relative route extension (-0.2%) were achieved in 2008, but were masked by an increase in average Great Circle distance (+3%)<sup>32</sup>, as shown in Figure 57. If the average Great Circle distance had remained constant, the average route extension would have decreased by 1.4 km.

#### EUROPEAN EN-ROUTE FLIGHT EFFICIENCY PERFORMANCE

5.3.9 In 2008, the average route extension was 48.8 km (5.6%), of which 15.2 km (1.7%) comes from the TMA interface and 33.6 km (3.9%) relates to the efficiency of the enroute network, as outlined in Figure 58.

<sup>32</sup> The change in average Great Circle distance (+3%) relates to changes in Origin-Destinations in the European network, irrespective of the route used in-between (horizontal flight-efficiency), and approximately 1.6% due to a change in the reference area used for the calculation.

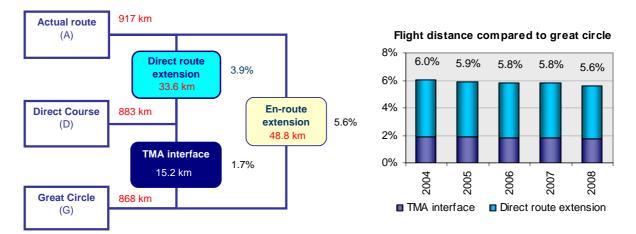


Figure 58: En-route flight efficiency indicator

- 5.3.10 The average relative route extension improved from 6.0% in 2004 to 5.6% in 2008 (a reduction of some 0.1% per year).
- 5.3.11 In order to identify areas for improvement, en-route extension can be further broken down into three components, as shown in Figure 59:
  - (1) En-route design component, measured as the difference between the distance of the shortest available route (S) and of the great Circle (G);
  - (2) Route utilisation component, measured as the difference between the distance of the filed route (F) and the shortest available route (S), and;
  - (3) ATC routing component, measured as the difference between the distance of the Actual route flown<sup>31</sup> (A) and of the filed route (F).

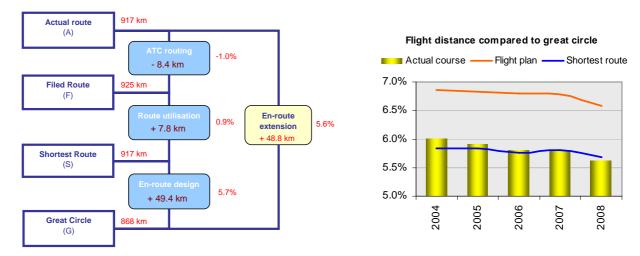


Figure 59: Components of en-route flight efficiency

# **EN-ROUTE ROUTE DESIGN**

- 5.3.12 En-route airspace design is by far the most important driver of en-route extension (5.7% in 2008). In this context, it is important to recall that this indicator relates the shortest available route (network design) with the great circle distance, an unachievable ideal<sup>33</sup>.
- 5.3.13 Although there is apparently no change in route design efficiency at high level, Figure 60 reveals that there are considerable developments of the ATS route network: every four weeks (AIRAC cycle), hundreds of city pairs are affected by changes in the route network.

<sup>33</sup> The great circle is optimum only in absence of wind, but close to optimum except for long flights.

5.3.14 So far, airspace design changes tended to focus on capacity. Figure 60 shows that flight-efficiency and associated environmental impacts are now also taken into account: the number of city pairs whose minimum distance is reduced starts to outweigh those with longer routes<sup>34</sup>.

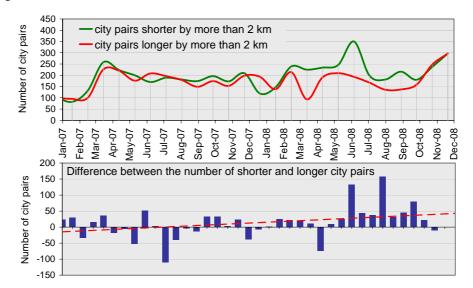


Figure 60: Number of city pairs impacted by route network changes

- 5.3.15 Continuous focus should be put on improving the efficiency of the most penalised city pairs. However, this can only be achieved if continuous focus is also put on developing sufficient en-route capacity and enhancing civil/military cooperation. In fact, capacity headroom is needed to optimise the route structure and use.
- 5.3.16 In the area of "Enhancing European Airspace design", the joint initiative to improve European flight efficiency (IATA, EUROCONTROL, CANSO), is expected to bring a reduction of the route extension up to 0.1% if implemented fully. The objective appears to be relatively modest and represents less than 1 km per flight.

# ROUTE UTILISATION

- 5.3.17 Route utilisation (see §5.3.11) is related to flight planning and accounts for 0.9% of the distance flown in 2008.
- 5.3.18 There are several reasons as to why there is a difference between the shortest plannable route and the one filed by aircraft operators: (1) The shortest route might only be temporarily available due to airspace restrictions; (2) operators may prefer a longer wind optimum route, longer routes not affected by ATFM restrictions or with lower unit rates. (3) Finally, airspace users might simply not be aware of the shortest available route.
- 5.3.19 In order to better understand the reasons for route utilisation, DMEAN<sup>35</sup> has developed a set of indicators comparing the filed route (F) and the shortest available route (S) in a number of scenarios:
  - shortest route without any route availability document (RAD<sup>36</sup>) constraints and all conditional routes (CDRs) open;
  - shortest route with RAD constraints but all CDRs open;
  - shortest route with RAD and all CDRs closed.

<sup>34</sup> Traffic weighting would need to be added in this analysis.

<sup>35</sup> Dynamic Management of the European Airspace network.

<sup>36</sup> The RAD collects restrictions that govern and limit the use of the route network. RAD restrictions contribute to the safety and capacity by ensuring that the ATCO's workload is not impacted by traffic flying unusual routes.

- 5.3.20 Figure 61 shows that RAD is estimated to add some 0.4% to the route extension.
- 5.3.21 Efforts being undertaken to reduce the number and duration of RAD restrictions should be pursued. Initiatives to remove RAD restrictions during night time are envisaged in several States.

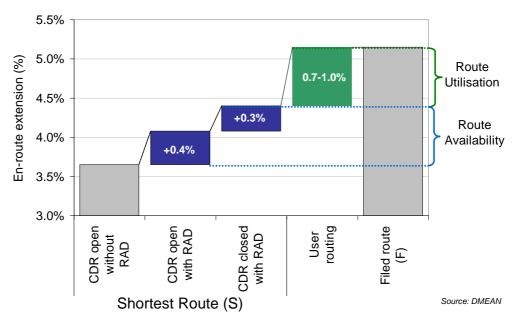


Figure 61: DMEAN flight efficiency indicators <sup>37</sup>

- 5.3.22 The impact of user routing (0.7-1.0%) is larger than the impact of RAD and CDR combined. Savings could be made if airspace users were informed of the shortest available route by the CFMU.
- 5.3.23 "Improving airspace utilisation and route network availability" is one of the main action points of the joint initiative to improve European flight efficiency (IATA, EUROCONTROL, CANSO). Improvements in distance flown are expected to reach 0.7% if implemented fully<sup>38</sup>. This represents some 6 km per flight, which is a very ambitious objective that will require the full collaboration of all parties if it is to be achieved.

# ATC ROUTING

5.3.24 ATC routing (see §5.3.11) is related to tactical changes in routing in the airborne phase given by controllers. ATC shortcuts are usually given as a result of the flexible use of airspace and have overall a positive impact on flight efficiency (-1%).

# NATIONAL AND REGIONAL IMPACT

5.3.25 Figure 62 provides indicators of route extension per Functional Airspace Block (FAB). It furthermore identifies route extension due to internal State airspace design issues (light blue), interfaces across States within the FAB (dark blue) and interfaces with other FABs (yellow). More details can be found in a specific PRR report [Ref. 19].

<sup>37</sup> DMEAN indicators are computed only for intra European traffic. No direct comparison with the percentage shown in Figure 59 should be made.

<sup>38</sup> It should be noted that, in many cases, the shortest route even if not planned is already given on a tactical basis by Air Traffic Control. Improvements in "route utilisation" could reduce potential improvements in "ATC Routing".

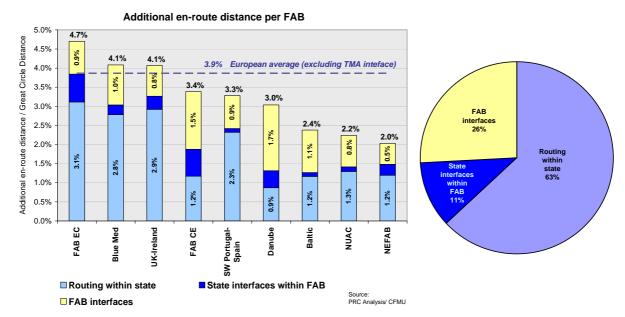


Figure 62: Additional en-route distance per FAB

- 5.3.26 Approximately 63% of route extension is due to domestic airspace design issues, but 26% is linked with cross-FAB airspace design, which illustrates the need for a network approach to airspace design.
- 5.3.27 A further breakdown of the flight efficiency indicators by States is given in Figure 63. For smaller States, a large proportion of the additional distance is often due to the additional distance at the interface with adjacent States, which may not always be under the control of that State. This shows again the importance of having a regional/European approach to flight efficiency.

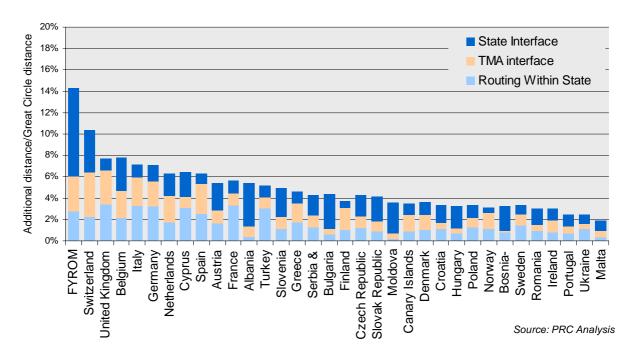


Figure 63: Additional en-route distance per State

#### MOST CONSTRAINING AREAS

5.3.28 Figure 64 displays the most constraining areas<sup>39</sup> in terms of en-route flight efficiency, i.e. areas introducing most distortion in the route network as compared with great circle routes between origins and destinations. The higher the distortion of the route network, the brighter the colour.

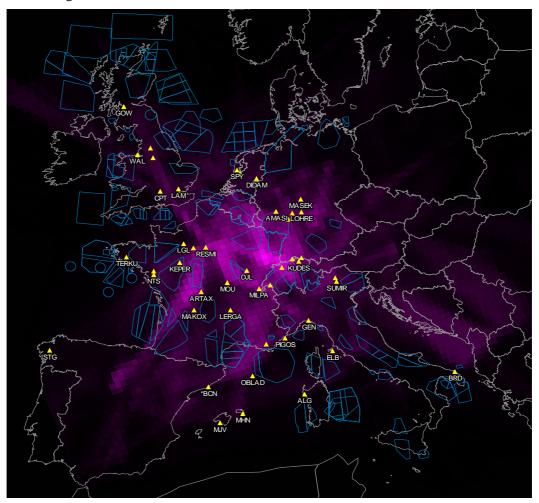


Figure 64: Most constraining areas

5.3.29 The blue boxes in Figure 64 represent "shared airspace<sup>40</sup>", which can be used alternatively for civil traffic and military activities. Those areas can have a significant impact on capacity and flight efficiency when located in areas of dense traffic. The following section takes a more detailed look at the usage of shared airspace.

# 5.4 Access to and use of shared airspace

5.4.1 Access is one of the ICAO key performance areas. This section focuses on access to shared airspace by military and civil users. Of particular relevance is the need to ensure that airspace is used when made available particularly when the shared airspace is temporarily segregated either for military or civil airspace users.

<sup>39</sup> The most constraining areas were calculated by plotting for each flight the area contained between the actual route and the great circle. The higher the number of areas over a given point, the brighter the colour.

<sup>40</sup> Shared airspace is a generic term for Flexible Use of Airspace (FUA) structures, such as Temporary Reserved and/or Segregated Areas as well as Danger Areas.

- 5.4.2 From a civil point of view, the benefit of access to shared airspace is improved flight efficiency (see previous section). Suitable metrics are not yet available to measure the civil use of shared airspace when released.
- 5.4.3 From a military viewpoint, access to shared airspace enables military training programmes. The shared airspace should be located in close proximity to military airbases in order to minimise transit times to the training zone.
- 5.4.4 Shared airspace consists of individual airspace volumes and opening times (also defined as SUA<sup>41</sup> capacity) which are tailored to specific military mission profiles.
- 5.4.5 In 2007, the PRC commissioned a special report on the "Evaluation of Civil-Military airspace utilisation" [Ref. 20]. Two of the main conclusions were that there was a need:
  - for States to increase their commitment to design and implement appropriate airspace structures (routes and sectors etc.) in order to improve airspace utilisation particularly during weekends, taking into account the need for an efficient European route network, and;
  - to establish performance indicators to monitor progress in use of airspace by civil and military users.
- 5.4.6 Since then, EUROCONTROL took initiatives leading to:
  - an agreement on a comprehensive set of KPIs establishing a common methodology to measure the usage of airspace structures for military activities at and above FL 200; and,
  - the development of PRISMIL, a system for military data collection and performance monitoring using on-line performance dashboards, and support for its widespread implementation. Progressive implementation by some States is foreseen in 2009 and 2010. This constitutes an important step forward.
- 5.4.7 Although there is virtually no military activity during weekends, only little improvement performance during weekends can be observed in Figure 65, which shows a comparison of the direct route extension between weekdays and weekends.

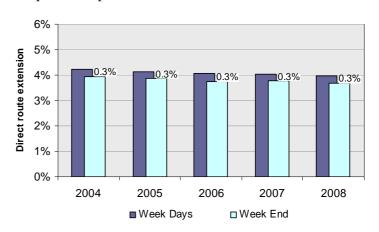


Figure 65: Direct route extension -week/weekend

- 5.4.8 Further work is required to improve the civil use of shared airspace especially during weekends when military activity is minimal. This means both increasing the number of routes offered through shared airspace and ensuring that these routes are made available and effectively used.
- 5.4.9 When shared airspace is booked but not used for military operations, prior notice of 3 hours is adequate for an effective use of the airspace for civil operations. The majority of shared airspace reserved but not used is available for GAT flight-planning or for ATC

.

<sup>41</sup> Special Use Airspace (D, R, P, TSA, TRA...).

routing. However, adequate measurements and performance monitoring system are not yet available to measure the civil use of the released airspace.

- 5.4.10 The sample KPIs shown in Figure 66 are based on Belgium data for 2008. They indicate that:
  - Overall, 55% of the time allocated has been effectively used. The utilisation could be further improved if the ATM system was able to respond to short notice requests for SUA on the day of operation.
  - Of the remaining 45% of the time when the airspace was booked but not used, 93% was released for civil use before the scheduled start time of the training and 69% was released for civil use with more than 3 hours prior notice.
  - The effective time spent in SUA represented 88% of the total airborne time (i.e. 12% of the time was spent in transit from the airbase to the SUA).



Figure 66: KPIs on access to shared airspace in Belgium

## TRADE OFF BETWEEN EN-ROUTE ATFM DELAY AND FLIGHT EFFICIENCY

- 5.4.11 Some re-routing can be accepted on a tactical basis to avoid a congested area. Trade offs exist in this case between the ATFM delay avoided and the costs of flying a longer route.
- 5.4.12 Between 2006 and 2008, there was a marked change in users' priorities between delays and flightefficiency, as shown in Figure 67.
- 5.4.13 In a context of high fuel prices, users appear to prefer ATFM delays instead of taking longer routes to circumnavigate congested areas.
- 5.4.14 Trade-offs exist between cost-effectiveness, delays and flight efficiency. This is addressed in Chapter 10.

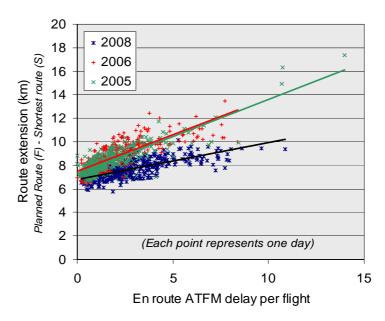


Figure 67: En-route ATFM delay vs. route extension

## 5.5 Conclusions

#### **EN-ROUTE ATFM DELAYS**

- 5.5.1 The en-route delay target was not achieved in 2008. Summer en-route ATFM delays increased for the fourth consecutive year and overshot the agreed target by 90% (1.9 min./flight, Target: 1 min./flight). 4.3% of flights were delayed more than 15 minutes due to en-route ATFM delays (3.3% in 2007).
- 5.5.2 While the majority of ACCs met or exceeded their capacity plans, the failure to deliver capacity as planned or inadequate plans in a few ACCs (notably Warsaw, Copenhagen, Nicosia, Zagreb, Vienna, Rhein and Zurich) negatively impacted the whole European network performance. The re-negotiation of some employment conditions with short notice effect was a significant contributor. Higher focus needs to be given to the respect of capacity plans and to adequate management of human resources.
- 5.5.3 There is typically a three-year time lag in raising ATM capacity through traditional methods (airspace design, recruitment, training, investment). There are at least two implications:
  - 1) It is important that the development of future ANS capacity is not adversely affected during the current global financial crisis and economic downturn. The positive effect on costs would materialise relatively late, and the negative impact on capacity would appear when traffic growth resumes. Rather, lower traffic growth is an opportunity to catch up on the capacity shortfall that has built up over the last 3 years.
  - 2) Capacity plans need to take account of collective agreements and those agreements need to be valid for the duration of the plans. Any revision should not jeopardise the capacity plans (e.g. compensating lower working hours by higher productivity).

## **EN-ROUTE FLIGHT EFFICIENCY**

- 5.5.4 Flight-efficiency has significant economic and environmental impacts.
- 5.5.5 The flight efficiency target was not achieved in 2008. Improvements in relative route extension (-0.2%) were masked by increasing average flight distance (+3%).
- 5.5.6 Short term benefits can be achieved by raising user awareness of shortest available routes. Network management through the CFMU can play a role here.
- 5.5.7 Approximately 63% of route extension is due to domestic airspace design issues, but 26% is linked with cross-FAB airspace design, which illustrates the need for a network approach to airspace design.

## ACCESS TO, AND USE OF, SHARED AIRSPACE

5.5.8 There was progress in 2008, with Military Key Performance Indicators becoming available. Implementation by States should be encouraged. Progress still needs to be made both in developing and offering routes through shared airspace and ensuring that these routes are effectively used by civil users, especially during weekends when military activity is minimal.

# Chapter 6: Operational Performance at main airports

## KEY MESSAGES OF THIS CHAPTER

- Airports are key nodes of the aviation network. Performance of the airport system depends on the actions of many key players, such as airport operators, airlines and ANS.
- Managing performance at airports requires reliable performance indicators, and an understanding of factors influencing performance. The PRC is developing both in cooperation with airports, ANSPs and users.
- Airport capacity utilisation and sustainability of airport capacity in adverse conditions are understood to be important performance drivers.

## 6.1 Introduction

- 6.1.1 Airports are key nodes of the aviation network, and airport capacity is a main challenge to future air traffic growth [Ref. 9]. It is therefore important to measure operational performance at and around airports.
- 6.1.2 This chapter provides an analysis of operational airside<sup>42</sup> performance at 20 major European airports In addition to airport-related ATFM delays, it provides estimated values for excess transit times<sup>43</sup> in the terminal area and the taxi-out phase. It does not evaluate requirements to expand airport capacity (e.g. through new infrastructure such as additional runways or terminals). Safety is addressed in Chapter 3. The framework is presented in Chapter 4. The environmental component of airport system performance is discussed in Chapter 9.
- 6.1.3 This chapter also identifies some of the factors affecting ATM performance at and around airports, but it does not try to attribute or quantify contributions from the various actors. The operational performance at airports is the result of complex activities conducted by numerous actors (Airport operator, Slot coordinator, local ATC provider, CFMU, Airlines, Ground handlers, and other service providers located at the airport). The high level view presented in this chapter reflects the performance of the airport system as a whole rather than the performance of any individual actor.
- 6.1.4 Both performance indicators and influencing factors are being addressed and measured using methodologies developed by the PRU in cooperation with Airport operators, ANSPs and Airspace users.
- 6.1.5 The KPIs and the analysis presented in this chapter are based on data from the Central Flow Management Unit (CFMU) and the Central Office for Delay Analysis (CODA). Within the ATMAP<sup>44</sup> pilot project, some of the indicators may be further reviewed and refined. The ATMAP report [Ref. 21] contains a detailed description of the methodologies.

# 6.2 Service quality observed at the analysed airports

6.2.1 This section evaluates the operational service quality observed at the analysed airports. The examination starts with a high level view at air transport level (on-time performance)

<sup>42 &</sup>quot;Airside" is defined as the aircraft movement area (stands, apron, taxiway system, runways, etc.) to which access is controlled. Delays due to turn-around processes (airline, ground handling, etc.) will not be analysed in detail but their consolidated impact on operations will be taken into account, if applicable.

<sup>43 &</sup>quot;Additional time" is measured as the difference between the actual situation and an ideal (unimpeded) situation when there is no congestion. Unimpeded time is derived by means of monthly statistical analysis and represents an estimate of the theoretical optimum for each airport. The methodology is described in more detail in the ATMAP report.

The ATM Performance at Airports (ATMAP) pilot project aims at developing, together with airport communities, a high-level framework for consistent and continuous review of ANS-related performance at and around airports in Europe.

before taking a more detailed look at the contribution of airport airside operations (including ANS) towards overall performance in each phase of flight.

#### ON-TIME PERFORMANCE AT MAJOR AIRPORTS

- 6.2.2 Figure 68 analyses late arrivals/departures (> 15 minutes) at 20 main airports, showing:
  - Departure delays late off-blocks compared to airline schedule experienced at the various airports of origin by traffic inbound to a given airport (left bar). These delays include all restrictions taken at the last departure airport;
  - Arrival delays late arrivals compared to airline schedule experienced by inbound traffic before landing at a given airport (centre bar);
  - Departure delays late off-blocks compared to airline schedule experienced by traffic departing from a given airport (right bar). London Heathrow (LHR), Rome (FCO) and Paris Charles de Gaulle (CDG) show the highest proportion of departure delays.
- 6.2.3 The bottom of Figure 68 shows the proportion of flights arriving more than 15 minutes ahead of schedule. Early arrivals can be as much a challenge as delayed flights in terms of local resource management (stand allocation, ground handling, etc.).

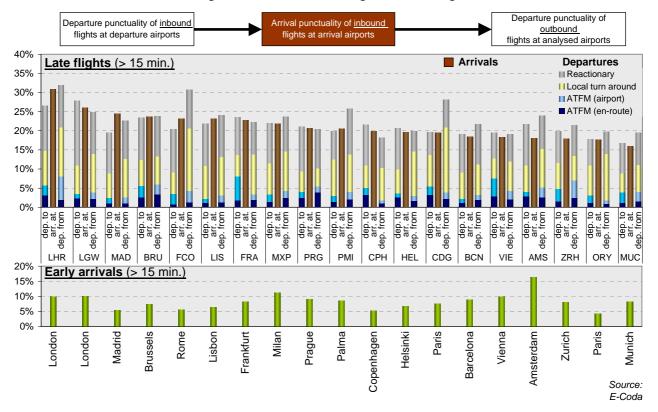


Figure 68: On-time performance in 2008<sup>45</sup>

- 6.2.4 Arrival delays (centre bar) and departure delays of inbound flights (left bar) are generally similar, but one observes differences both ways. This may be explained by the different airline policies in compensating expected delays by using buffers, but also by higher congestion at some airports.
- 6.2.5 Arrival delays to a given airport (centre bar) and Departure delays from that airport (right bar) are also closely related. Departure delays are however significantly higher than arrival delays for some airports. This is particularly the case for Paris Charles De Gaulle (CDG) and Roma Fumicino (FCO).

<sup>45</sup> Dublin is not included due to the small CODA sample.

- 6.2.6 While on-time performance represents a useful high-level measure of operational performance, it is a simplified view which does not fully represent the impact of the airport airside system (including ANS) on airspace users.
- 6.2.7 The next section provides a more detailed analysis of the airport airside contribution towards overall performance by phase of flight. For the interpretation of the results, the following points should be borne in mind:
  - a) "Additional times" are measured as the difference between the actual situation and an ideal (unimpeded<sup>43</sup>) situation when there is no congestion.
  - b) Runway capacity is a valuable scarce resource and a certain level of 'queuing time' is unavoidable and even necessary if an airport is to operate close to its capacity limit.
  - c) In many cases, explicit delay (or on-time performance) criteria are agreed during the airport scheduling process (see paragraph 6.3.8).
  - d) The overall results are presented for the full year, without taking into consideration weather conditions and/or environmental restrictions.
- 6.2.8 Figure 69 presents indicators of "additional time" for the different phases of flight. Additional times have different impacts on aircraft operators and the environment. Whereas ATFM and pre-departure delays result in extra time experienced at the stands, additional times in airborne holdings and in the taxi out phase also generate additional fuel burn.



Figure 69: Measuring "additional time" in different phases of flight

6.2.9 ANS cannot significantly reduce queuing times where airports are already using their runways very close to maximum capacity. However, ANS has scope to relocate part of the queuing time to more favourable places on the stand, or in the air, via en-route speed control, etc.

## AIRPORT ATFM ARRIVAL DELAYS

- 6.2.10 This section reviews *Air Traffic Flow Management* (ATFM) delays originating from airport capacity restrictions. Aircraft that are expected to arrive during a period of a capacity/demand imbalance at the destination airport are held upstream on the ground at their various departure airports.
- 6.2.11 The percentage of flights delayed by more than 15 minutes because of airport-related ATFM regulation is depicted in light blue in Figure 68. Upstream airport arrival ATFM delay can have various ANS-related (ATC capacity, staffing, etc.) and non-ANS related (weather, accident etc.) reasons. Airport ATFM delay represented 11% of the primary causes of delay in 2008.

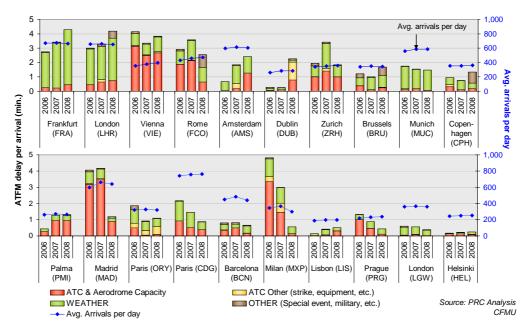


Figure 70: Airport arrival ATFM delay

- 6.2.12 The evolution of airport arrival ATFM delay is shown in Figure 70 (in descending order of delay in 2008). Together, the 20 airports account for 34% of the traffic and 65% of all airport-ATFM delays in 2008.
- 6.2.13 In addition to the 20 airports shown in Figure 70, a particularly high level of airport arrival ATFM delay was reported at London City and Istanbul airports in 2008 (6 min and 4 min per arrival respectively) and actions should be taken to reduce the level of delay (see also Annex III).

## ADDITIONAL TIMES IN THE ARRIVAL SEQUENCING AND METERING (ASMA) AREA

6.2.14 The locally defined TMA is not suitable for comparisons due to considerable variations in shape and size. A standard "Arrival Sequencing and Metering Area" (ASMA) is defined as a ring of 100NM<sup>46</sup> radius around each airport. This is generally adequate to capture tactical arrival control measures (sequencing, merging, spacing and speed control), irrespective of local ANS strategies, as illustrated in Figure 71.

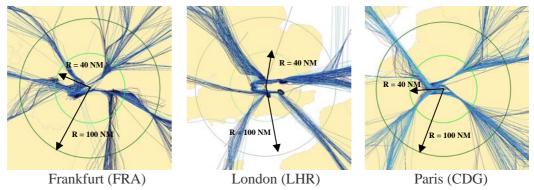


Figure 71: Impact of local ANS strategies on arrival flows

6.2.15 The actual ASMA transit times are affected by a number of parameters such as aircraft type, congestion level, airspace design, airport configuration, pilot performance,

A second ring of 40 NM radius is used to differentiate between delays in the outer ring (40-100 NM) and the inner ring (40NM-landing), which have a different impact on fuel burn and hence on environmental performance. 100NM and 40NM rings are also used in the USA, which facilitates comparisons of operational performance indicators (see Chapter 7).

environmental restrictions, and to some extent the objectives agreed by the airport scheduling committee.

6.2.16 Figure 72 shows the average additional time beyond the unimpeded transit time for each airport<sup>47</sup>.

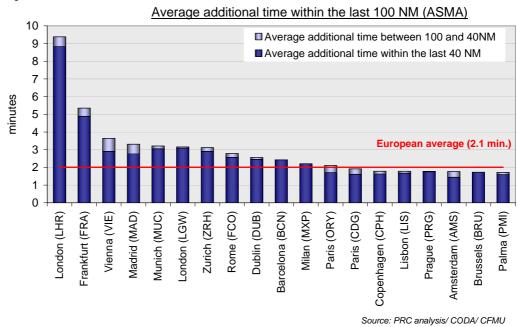


Figure 72: Average additional time within the last 100 NM

6.2.17 London (LHR) is a clear outlier, having by far the highest level of ASMA additional time<sup>48</sup> (>10 minutes)<sup>49</sup>, followed by Frankfurt (FRA), Vienna (VIE) and Madrid (MAD).

## ADDITIONAL TIME IN THE TAXI-OUT PHASE

- 6.2.18 The taxi-out phase<sup>50</sup> is defined as the period between the time when the aircraft leaves the stand (off-block) and the time it takes off.
- 6.2.19 Figure 73 shows the average additional time in the taxi-out phase for each airport, i.e. the difference between the actual observed time and the unimpeded time.

<sup>47</sup> Due to the level of accuracy for landing times at Helsinki (HEL) presently available within EUROCONTROL, the airport was not included in this analysis.

<sup>48</sup> More detailed information can be found in the final ATMAP report.

<sup>49</sup> The performance at London Heathrow (LHR) is consistent with the 10 minute average delay criteria agreed by the airport scheduling committee.

The "taxi-out" phase is influenced by a number of factors such as location of the stand (distance to take-off runway), type of stand (taxi-in/taxi-out or taxi-in/push-out), start-up procedures (depending on aircraft type and airline policies to start up one or more engines), frequency congestion, apron congestion, remote de-icing procedures, waiting at taxiway crossing and runway holding positions, waiting at the runway before take-off, pilot reaction times to ATCO clearances and others.

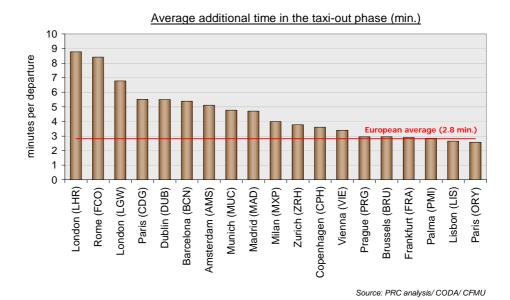


Figure 73: Average additional time in the taxi-out phase

- 6.2.20 London Heathrow (LHR) has the highest additional time in the taxi out phase (>8 min. per departure) followed by Rome (FCO)<sup>51</sup> and London Gatwick (LGW). These results are based on CODA data. The accuracy of these results could be significantly improved if airports provided more information on runways in use and airport stands<sup>52</sup>.
- 6.2.21 One of the aims of Airport "Collaborative Decision Making" CDM processes is to optimise the departure queue while minimising costs to aircraft operators. Departing aircraft are sequenced by managing the push-back times and the taxi out phase to provide the optimum sequence at the runway. The aim is to keep aircraft at the stand in order to keep fuel burn due to additional time in the taxi-out phase to a minimum.
- 6.2.22 In this context, information sharing and common situation awareness (i.e. status of the aircraft) is of vital importance. At CDM airports, aircraft operators need to commit to a *Target Off Block Time* (TOBT) in order to increase the accuracy of departure queue planning. If the operator cannot adhere to this time, the A-CDM platform is informed so that the departure sequence can be adjusted accordingly.
- 6.2.23 Figure 74 shows the reduction of additional time in the taxi-out phase at Munich airport following the implementation of Airport CDM (approx. 1 minute per flight).
- 6.2.24 The first operational trials were launched in July 2006 and by June 2007 a link to the CFMU was fully implemented.

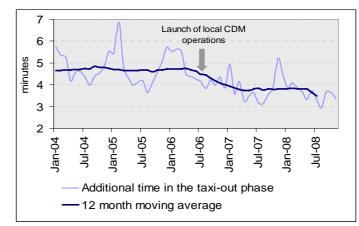


Figure 74: Additional time in taxi-out phase at Munich airport

Note that Runway 16R/34L in Rome (FCO) was effectively closed from January - March 2008 which contributed to increased surface movement delays.

<sup>52</sup> In the specific case of Frankfurt airport, there is a significant difference between the results computed from CODA data and from airport data.

6.2.25 Introduction of CDM procedures at major airports is one of the elements of the flight efficiency plan signed between CANSO, IATA and EUROCONTROL. The benefit of reducing additional time in the taxi-out phase by 1 minute per flight for ECAC major airports (+50K movements per annum - this corresponds to about 50 ECAC airports) represents an annual savings to airlines of some 145.000 tons fuel and €120 M per annum.

#### ESTIMATED TOTAL ADDITIONAL TIME RELATED TO AIRPORT AIRSIDE OPERATIONS

- 6.2.26 Figure 75 provides a consolidated view of estimated additional times related to airport airside performance<sup>47</sup>. The additional times relate to a theoretical optimum. Safety and capacity constraints limit the practicality of reducing those.
- 6.2.27 The left side of Figure 75 illustrates estimated additional times on the inbound traffic flow (airport ATFM arrival + ASMA additional times). The right side shows estimated additional times on the outbound traffic flow (pre-departure and taxi-out phase).

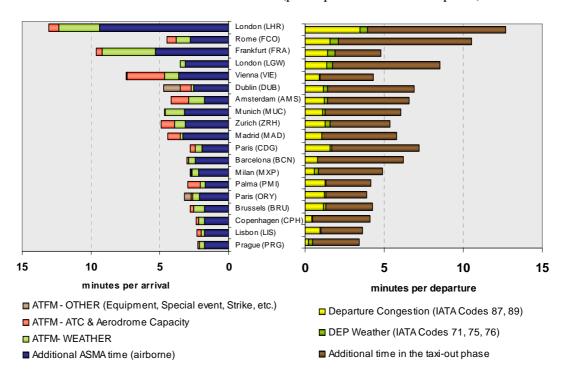


Figure 75: Estimated total additional time related to airport airside operations

- 6.2.28 London Heathrow (LHR) shows by far the highest total additional time, followed by Rome (FCO) and Frankfurt (FRA). However, Figure 75 needs to be seen in context with local airport scheduling policies, airport capacity utilisation and weather conditions.
- 6.2.29 Furthermore, the impact on the airspace users (i.e. level of predictability of the delays in the strategic phase, fuel burn) needs to be considered at some stage. Whereas ATFM delays are largely unpredictable and not evenly spread among airspace users (small percentage of flights but high delays), additional times in the taxi-out phase and in the TMA are of a more predictable nature (more evenly spread and smaller delays). A large proportion of these additional times is usually built in the airlines schedules and taken into account when organising airport operations strategically.
- 6.2.30 Whereas ANS is not responsible for all delays (i.e. some delay is already embedded in the scheduling of operations), the way the traffic is managed has an impact on the distribution of the additional times between air, taxi (engine-on) and at gate (engine-off), and thus on overall costs to airspace users and on the environment.

#### CANCELLATIONS

- 6.2.31 In addition to "delays", there is a need to monitor the number of cancellations at airports in order to get a more complete and balanced view. When there is a severe reduction of airport capacity over a significant period of time (weather, runway closure, strike, etc.), aircraft operators may be forced to reorganise their schedules by cancelling individual flights when the expected delay gets too long. Those cancellations in turn have a positive impact on operations and need to be considered in the overall evaluation of service quality.
- 6.2.32 According to the Association of European Airlines (AEA), 1.1% of short and medium haul and 0.4% of long haul flights were cancelled in Summer 2008. This figure includes cancellations due to commercial reasons, adverse weather, technical reasons and other operational constraints. These figures are yearly averages; cancellations in severely degraded conditions can affect a considerably higher share of flights on individual days.
- 6.2.33 Due to the significant costs they impose on aircraft operators, cancellations and diversions are considered to be an important indicator for the measurement of service quality.
- 6.2.34 Presently, the number of cancellations/diversions at airports is not collected consistently across Europe. There is a need to establish a data flow for cancellations and diversions in order to get a more complete picture for the operational performance measurement at airports.

# 6.3 Factors affecting operational performance at airports

6.3.1 Figure 76 provides a simplified view of the main factors affecting operational airport performance. Airport system performance is affected by airport infrastructure, operational, technical and environmental constraints, traffic patterns and weather conditions.

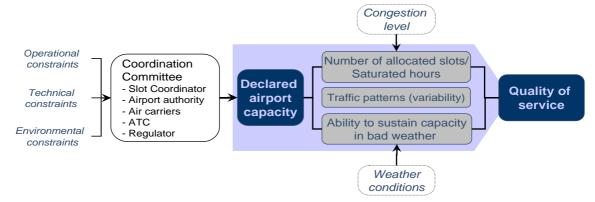
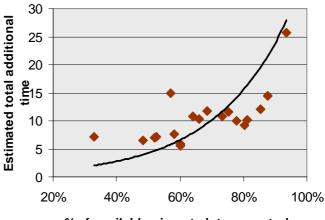


Figure 76: Key components of operational performance at airports

6.3.2 Due to the interrelated nature of the air transport network, a clear cut allocation between ANS and non-ANS related causes in the airport environment is sometimes difficult.

- 6.3.3 The simplified view in Figure 77 suggests a link between the intensity of operations<sup>53</sup> and the level of service quality.
- 6.3.4 Other factors also influence performance and more work required better understand the interrelation quality, between service airport capacity and demand management, traffic variability and other factors such as meteorological conditions.



% of available airport slots operated

Figure 77: Interrelation between intensity of operations and service quality

#### MANAGING DEMAND AT MAJOR AIRPORTS

- 6.3.5 Airports<sup>54</sup> are designated as 'coordinated airports' when the capacity is considered to be insufficient to fulfil airlines' demand during peak hours. The subsequent airport scheduling process aims at matching airline demand and airport capacity several months before the actual day of operations.
- 6.3.6 The declared airport capacity<sup>55</sup> is decided by the coordination committee<sup>56</sup> or by the State itself. Airport slots<sup>57</sup> are then allocated to airlines according to rules laid out in EC Regulation 95/1993 and subsequent amendments.
- 6.3.7 Declared airport capacity determines how many airport slots are offered to aircraft operators. Many different infrastructural (terminal, stands, apron, runway), political and environmental factors affect an airport's declared capacity, of which runway capacity is an important factor.
- 6.3.8 Consequently, the declared airport capacity represents an agreed compromise between the maximisation of airport infrastructure utilisation and the quality of service considered as locally acceptable (level of tolerable delay). This trade-off is usually agreed between the airport managing body, the airlines and the local ATC provider during the airport declaration process.
- 6.3.9 Local performance can also have an impact on the overall performance of the European network. Delays resulting from local decisions may propagate throughout the European network, creating reactionary delays and introducing variability in daily operations at other airports.
- 6.3.10 The relationship between the EC SES legislation and the EC Regulation 95/1993 has yet to be defined. The SES II proposed legislation highlights that En-route, Terminal and Airport ANS services are of different nature. This recognition is the first step to create the proper link.

The intensity of operations is expressed as the share of operated airport slots compared to the total number of available airport slots based on the declared airport capacity (06h00-22h00 local time).

<sup>54</sup> See EC Regulation 95/1993.

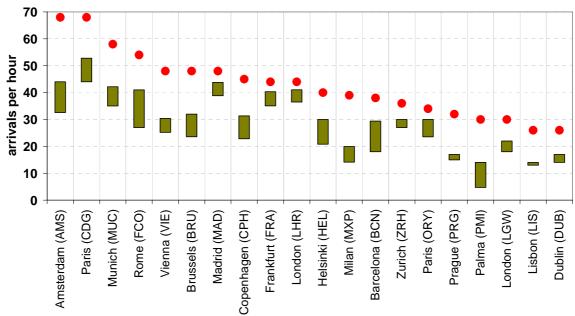
<sup>55</sup> The airport capacity declaration is a local process and can vary by airport. There is no harmonised method to declare an airport's capacity in Europe.

<sup>56</sup> The responsibility to set up a coordination committee lies with the respective States.

The term "airport slot" refers to the permission given by a coordinator to use the full range of airport infrastructure on a specific date and time for the purpose of landing or take off.

#### SUSTAINABILITY OF ARRIVAL CAPACITY IN ADVERSE CONDITIONS

6.3.11 Of particular relevance for air transport performance at airports is the sustainability of arrival capacity in adverse conditions.



- Spread between the 50th and the 10th percentile of weather related ATFM capacity reductions
- Declared peak hour arrival capacity

Source: PRC analysis/ CFMU/ Airports

Figure 78: Weather related ATFM airport arrival capacity reductions in 2008

- 6.3.12 Figure 78 shows significant differences in magnitude of arrival capacity reductions due to weather at the 20 analysed airports. The impact is measured indirectly by comparing the declared arrival rates to the requested arrival rates when the airport was ATFM weather regulated (all causes i.e. winds, visibility, etc.). For instance, in the case of Amsterdam, there were 75 days with ATFM regulation because of weather. In half of the cases, the ATFM flow rate was below 43 and for 10% of the cases (7 cases) the rate was below 33 (less than half of the declared capacity).
- 6.3.13 Airports with a large drop in capacity due to weather are likely to cause extensive local disruptions, which are likely to propagate through the entire European network.
- 6.3.14 Whereas Figure 78 provides a first insight of how severely operations are degraded at the individual airports due to weather, it does not allow for any conclusions on the type of weather conditions (visibility, snow, etc.), or how frequently the airport was affected nor does it provide information on the level of delay or cancellations experienced by aircraft operators.
- 6.3.15 In order to better understand the impact of weather conditions on airport performance, the ATMAP pilot project intends to categorise the days according to the prevailing meteorological conditions into nominal, degraded<sup>58</sup> or disrupted. This will allow for a more balanced view of airport system performance in future reports.

Degraded conditions are expected and the airport system has the means to respond (usually adverse weather) while "disrupted" conditions are unexpected situations such as strike, equipment failures, etc.

## 6.4 Conclusions

- 6.4.1 Airports are key nodes of the aviation network. Performance of the airport system depends on the actions of many key players, such as airport operators, airlines and ANS.
- 6.4.2 Managing performance at airports requires reliable performance indicators. Operational performance indicators related to the arrival and taxi phases are being developed in cooperation with airports, ANSPs and users.
- 6.4.3 The analysis of operational performance at airports reveals a contrasted picture across Europe. London Heathrow (LHR) shows by far the highest level of total additional times, followed by Rome (FCO) and Frankfurt (FRA) airports.
- 6.4.4 Operational performance is affected by a number of factors, including airport infrastructure, airport capacity and demand management (including scheduling), traffic variability, weather conditions, sustainability of airport capacity in adverse conditions and environmental/political restrictions, all of which need to be considered in a balanced assessment of performance.
- 6.4.5 Local performance can also have an impact on the overall performance of the European network. Delays resulting from local decisions may propagate throughout the European network, creating reactionary delays and introducing variability in daily operations at other airports.
- 6.4.6 While there may be a variety of causes for delay, the way the traffic is managed has an impact on the distribution of the delay between air and ground and thus on overall costs to airspace users.
- 6.4.7 Cancellations are also an important service quality indicator and need to be measured consistently throughout Europe.
- 6.4.8 Airport capacity being a main challenge to future air traffic growth, an increased focus needs to be put on the integration of airports in the ATM network and the optimisation of operations at and around airports.

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# **Chapter 7: US/Europe Comparison**

#### KEY MESSAGES OF THIS CHAPTER

- A comparison of operational performance of the US and European Air Navigation systems shows stronger and weaker points on both sides.
- Under different conditions (traffic, weather, etc), in an area of comparable size, one observes similar arrival punctuality levels in the US and Europe, albeit with higher variability in the US. Comparable performance indicators were identified and measured for all phases of flight.
- Observed differences in performance could be linked to differences in modes of operation; such as Air Traffic Flow Management techniques, which differ notably in the timing (when) and the phase of flight (where) ATFM measures are applied.
- Both systems have benefits and shortcomings. Identification of best practices could possibly help in significantly raising the level of performance on both sides of the Atlantic.

## 7.1 Introduction

- 7.1.1 As in any industry, global comparisons and benchmarking can help drive performance and identify best practices.
- 7.1.2 This chapter compares operational performance of the US and Europe Air Navigation Systems, and provides updated key system-level figures. It summarizes the preliminary findings of a report jointly produced by the Federal Aviation Administration (FAA/ATO) and the PRC [Ref. 22].
- 7.1.3 This operational comparison complements a comparison of economic performance (productivity and cost-effectiveness) in selected US and European en-route centres [Ref. 23] that was prepared in collaboration with the FAA and published in 2003. The corresponding methodology has now been adopted by ICAO [Ref. 24].
- 7.1.4 Safety and local conditions (e.g. weather, governance) would also need to be addressed for a comprehensive comparison of performance.
- 7.1.5 The initial focus is on the development of a set of comparable performance measures for comparisons between countries and wider regions. Where possible, reasons for differences in system performance have been explored in more detail in order to provide an understanding of underlying performance drivers or, where necessary, to stimulate more detailed analyses.
- 7.1.6 The specific key performance indicators (KPIs) are based on best practices from both sides. In order to better understand the impact of ATM and differences in traffic management techniques, the analysis is broken down by phase of flight (i.e. pre-departure delay, taxi out, en-route, terminal arrival, taxi-in and arrival delay) as well as aggregate measures. This breakdown by phase of flight supports better measurements of fuel efficiency.

## 7.2 High-level view of the ATM systems in Europe and the US

7.2.1 Figure 79 shows key high-level statistics for the European and the US Air Navigation Systems (ANS). The surface of continental airspace is similar in Europe and the US. However, the FAA controls approximately 80% more flights and handles significantly more Visual Flight Rules (VFR) traffic with the same number of staff and fewer en-route facilities. The fragmentation of European ANS with 38 en-route Air Navigation Service Providers (ANSP) is certainly a driver behind such differences.

| Calendar Year 2007                        | Europe <sup>59</sup> | USA <sup>60</sup> | Difference |  |
|---|----------------------|-------------------|------------|--|
| Geographic Area (million km²)             | 11.5                 | 10.4              | -10%       |  |
| Number of en-route ANSPs                  | 38                   | 1                 |            |  |
| Number of Air Traffic Controllers         | 17 000               | 17 000            | 0%         |  |
| Total staff                               | 56 000               | 35 000            | -38%       |  |
| IFR flights controlled (million)          | 10                   | 18                | +80%       |  |
| Share of General Air Traffic              | 4%                   | 18%               | x4.5       |  |
| Flight hours controlled (million)         | 14                   | 25                | +79%       |  |
| Relative density (flight hours per km²)   | 1.2                  | 2.4               | +97%       |  |
| Average length of flight (within region)  | 548 NM               | 490 NM            | -11%       |  |
| Number of en-route centres                | 66                   | 20                | - 70%      |  |
| En-route sectors at maximum configuration | 684                  | 955               | +40%       |  |
| Number of airports with ATC services      | 450                  | 50361 (280)       | +12%       |  |
| Of which are slot controlled              | > 73                 | 3                 |            |  |
| Source                                    | EUROCONTROL          | FAA/ATO           |            |  |

Figure 79: US/Europe key ATM system figures (2007)

7.2.2 Figure 80 shows the traffic density in US and European en-route centres measured in flight hours per square kilometre for all altitudes. If upper-flight levels only were considered Europe's densities would increase relative to the US (the propeller GA aircraft in the US would be excluded)<sup>62</sup>. Detailed comparisons on complexities are beyond the scope of this report.

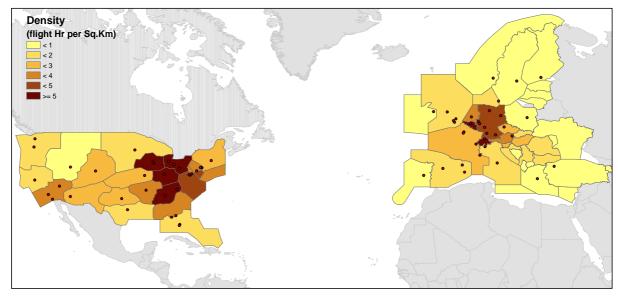


Figure 80: Traffic density (flight hrs per sq. km) in US and European en-route centres

<sup>59</sup> EUROCONTROL States plus Estonia and Latvia, but excluding oceanic areas and Canary Islands.

<sup>60</sup> Area, flight hours and center count refer to CONUS only. The term US CONUS refers to the 48 contiguous States located on the North American continent south of the border with Canada, plus the District of Columbia, excluding Alaska, Hawaii and oceanic areas.

<sup>61</sup> All facilities of which 280 are FAA staffed and 223 contract towers.

New York Center shows as less dense due to the inclusion of a portion of coastal/oceanic airspace. If this portion were excluded, NY would be the Center with the highest density.

7.2.3 Figure 81 shows annual growth of IFR traffic in the US and Europe between 1999 and 2008. In this period, traffic increased by 34% in Europe and decreased by -3% in the US.

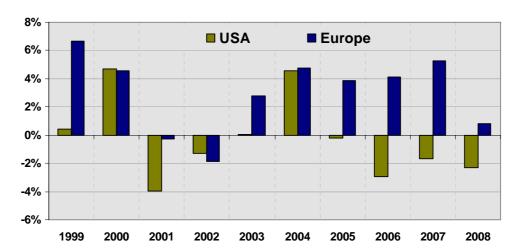


Figure 81: Annual IFR air traffic growth (1999-2008)

- 7.2.4 An important difference between the US and Europe is the share of General Aviation (18% and 4% respectively). In order to ensure comparability of data sets, the scope of the analysis was limited to controlled commercial (IFR) flights to/from the 34 most important airports in the US (OEP34<sup>63</sup>) and Europe. Figure 82 shows some indicators for those airports.
- 7.2.5 Traffic to/from the main 34 airports represents some 69% of all IFR flights in Europe and 64% in the US. General aviation's share of traffic to/from the main 34 airports is more comparable with 4% in the US and 1.6% in Europe. If only scheduled airlines are considered, IFR traffic to/from the main 34 airports is 77% for Europe and 86% for US.

| Main 34 airports in 2007                               | Europe | USA | Difference US<br>vs. Europe |
|--|--------|-----|-----------------------------|
| Average nr. of annual movements per airport ('000)     | 267    | 423 | +58%                        |
| Average nr. of annual passengers per airport (million) | 25     | 32  | +28%                        |
| Passengers per movement                                | 94     | 75  | -20%                        |
| Average number of runways per airport                  | 2.5    | 3.9 | +56%                        |
| Annual movements per runway ('000)                     | 108    | 107 | -1%                         |
| Annual passengers per runway (million)                 | 10.0   | 8.1 | -19%                        |

Figure 82: Some key data for the main 34 airports in the US and Europe

7.2.6 Airport passenger throughput results from the combination of number of flights, average seating capacity per scheduled flight and load factor (see analytical framework in Figure 23). Average seating capacity per scheduled flight is shown in Figure 83.

The list of the Operational Evolution Partnership (OEP) airports - 35 in total - was compiled in 2000, by agreement between the FAA and Congress, drawing on a study that identified the most congested airports in the US. That list has remained unchanged since then. Key FAA performance measures are based on data from this set of airports. For comparison reasons, Honolulu (HNL) was removed from the sample.

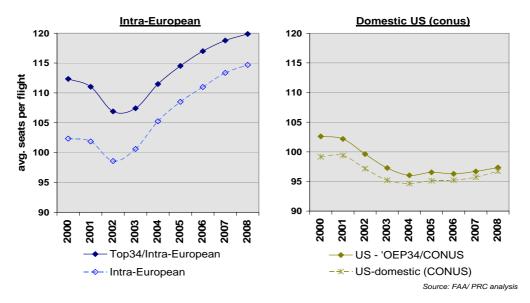


Figure 83: Average seats per scheduled flight

# 7.3 Air traffic flow management techniques

- 7.3.1 Both the US and Europe have established system-wide traffic management facilities to ensure that traffic flows do not exceed what can be safely handled by controllers, whilst trying to optimize the use of available capacity.
- 7.3.2 However, for a number of reasons, Air Traffic Flow Management (ATFM) techniques have evolved differently in the US and in Europe:
  - a) Airline scheduling is capped to "declared capacity" at major European airports, while it is unrestricted at most US airports. In 2007, capacity constraints existed at New York LaGuardia, Chicago O'Hare (ORD), and Washington National (DCA). During Fiscal Year 2008, additional capacity constraints were established at JFK and Newark (EWR) airport while the constraint at Chicago O'Hare expired with the addition of the new runway. The level of demand in the US is decided by airlines depending on the expected cost of delays/predictability and the expected value of operating additional flights.
  - b) At many European airports, there is a higher proportion of Instrument Meteorological Conditions (IMC). These airports are generally scheduled to IMC airport capacity.
  - c) A consequence of a) and b) is greater variability in the difference between demand at US airports and their available capacity on a day-to-day basis. As a result, ATFM tends to concentrate on resolving congestion issues that arise principally at major airports.
  - d) While both air navigation systems are operated with similar technology and operational concepts, there is one service provider in the US. All US Centers use the same automation systems and they actively cooperate on flow management. In Europe, there are 38 en-route service providers, with little obligation or incentives to cooperate on flow management (e.g. sequencing traffic into major airports of other States) and operating their own systems, which may affect the level of coordination in ATFM and ATC capacity. ATFM delays principally originate from en-route capacity shortfalls in Europe, which is not the case in the US.
  - e) Additionally, in many European States, civil ANSPs co-exist with military ANSPs. This can make ATC operations and airspace management more difficult. Moreover, the majority of military airspace in the US is located outside the core areas, while in Europe military airspace is organized at State level and there is a high density of both

- civil and military activity in the core area. More study is needed to measure the share of flights that would enter military airspace if great circle routes were used.
- f) Convective weather/thunderstorms in the summer are more severe and wide-spread in the US (lower altitude) and may require ground holds and continent-wide reroutings of entire traffic flows.
- 7.3.3 The two ATFM systems differ notably in the timing (when) and the phase of flight (where) ATFM measures are applied. There are trade-offs between flow management policies. Holding at the gate with engines-off lowers environmental impact and taxiway/airspace congestion, while taxi/airborne holding is more responsive to changing circumstances and therefore makes better use of available airport capacity.
- 7.3.4 In Europe, the majority of demand/capacity management measures are applied in the strategic (airport capacity declaration) or pre-tactical phases (allocation of ATFM take-off slots). In the US, ATFM measures are applied in the pre-tactical (take-off slots, or other ground delay) and tactical phases, depending on actual traffic situation.

## GROUND BASED FLOW MANAGEMENT

- 7.3.5 In Europe when traffic demand is anticipated to exceed the available capacity in en-route control centres or at an airport, ATC units may call for "ATFM regulations". Aircraft subject to ATFM regulations are held at the departure airport according to "ATFM slots" allocated by the Central Flow Management Unit (CFMU).
- 7.3.6 In the US, ground delay programs are mostly used where there are severe capacity restrictions at an airport when less constraining ATFM measures, such as Miles in Trail (MIT) are not sufficient. The Air Traffic Command Center applies Estimated Departure Clearance Times (EDCT) to delay flights prior to departure. Most of these delays are taken at the gate but some occur during the taxi phase.

## AIRBORNE FLOW MANAGEMENT

- 7.3.7 There is currently no Europe-wide en-route sequencing into airports. When sequencing tools and procedures are developed locally, their application generally stops at the State boundary.
- 7.3.8 In the US, in order to ensure maximum use of available capacity in en-route centres and arrival airports, traffic flows are controlled through MIT and Time Based Metering (TBM). Flow restrictions are passed back from the arrival airport to surrounding centres and so on as far as necessary. MIT can also affect aircraft on the ground. If an aircraft is about to take off from an airport to join a traffic flow on which a MIT restriction is active, the aircraft needs a specific clearance for take-off. The aircraft is only released by ATC when it is possible to enter into the sequenced flow. These Traffic Management System (TMS) delays are predominantly taken in the taxi-out phase and to a limited extent at the gate.
- 7.3.9 Due to the stochastic nature of air transport (weather, technical failures, etc.) and the way both systems are operated today (technology, organization, etc.), a certain level of delay is required to maximize the use of scarce capacity (particularly airport capacity). The two ATM systems handle traffic flows differently and lessons can be learnt from both sides.

## TERMINAL MANAGEMENT AREA

7.3.10 In both the US and European systems, the terminal area around a congested airport is used to absorb delay and keep pressure on the runways. Traffic Management initiatives generally recognize maximizing the airport throughput as paramount.

## 7.4 Comparison of overall air transport performance

7.4.1 This section provides a high level analysis of operational air transport performance in the US and in Europe. The next section assesses delays per phase of flight.

## AIR TRANSPORT PUNCTUALITY (ON-TIME PERFORMANCE)

- 7.4.2 Figure 84 compares the industry-standard indicators for punctuality, i.e. arrivals or departures delayed more than 15 minutes versus schedule.
- 7.4.3 After a continuous decrease between 2004 and 2007, on-time performance in Europe and in the US would appear to have improved in 2008, as shown in Figure 84. However, this improvement needs to be seen in a context of lower traffic growth (and in the case of the US lower overall traffic) as a result of the global financial and economic crisis, and increased schedule padding in the US (see Figure 85).
- 7.4.4 The gap between departure and arrival punctuality is significant in the US and quasi nil in Europe. This can be linked with different flow management (see above) and airport capacity allocation policies.

# On-time performance compared to schedule (flights to/from the 34 main airports)

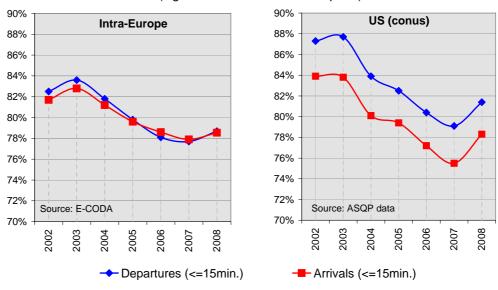


Figure 84: Air Transport Punctuality (On-time performance)

## TRENDS IN AIRLINE SCHEDULING

- 7.4.5 Trends in airline scheduling provide a first insight on the level of predictability at scheduling phase (see also Chapter 4).
- 7.4.6 Figure 85 shows the evolution of airline scheduling times in Europe and the US. The analysis compares the scheduled block times for each flight of a given city pair with the long term average for that city pair over the full period (2000-2008).
- 7.4.7 Between 2000 and 2008, scheduled block times remained stable in Europe while a clear increasing trend is visible in the US. These increases may result from adding block time to improve on-time performance or could be tied to a tightening of turn-around-times. The US has seen a redistribution of demand in already congested airports (e.g. JFK) which is believed to be responsible for growth of actual and scheduled block times.

## **Evolution of Scheduled Block Times**

(flights to/from 34 main airports)

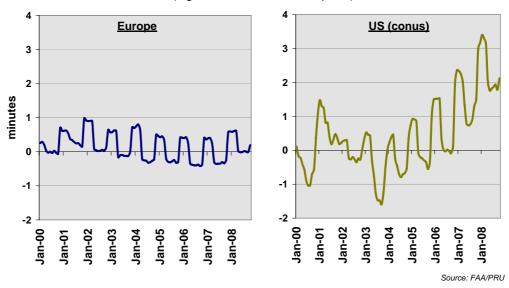


Figure 85: Scheduling of air transport operations

7.4.8 Seasonal effects are visible, scheduled block times being on average longer in winter than in summer. US studies by the former Free Flight Office have shown that most of the increase is explained by higher winds during the winter period [Ref. 25].

## EVOLUTION OF AVERAGE TIMES BY FLIGHT PHASE

7.4.9 Figure 86 shows trends in the duration of the individual flight phases in Europe and the US. The analysis compares actual times for each city pair with the long term average for that city pair over the full period (2003-2008).

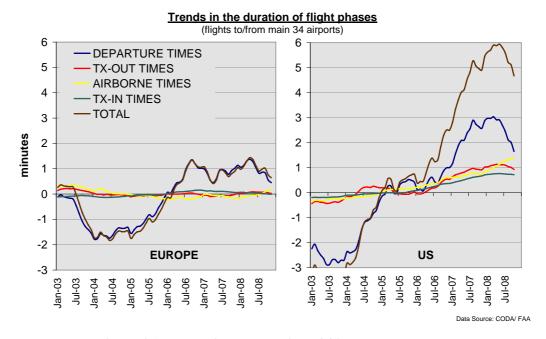


Figure 86: Trends in the duration of flight phases

7.4.10 In Europe, performance is clearly driven by departure delays with only very small changes in the gate-to-gate phase. In the US the trend is different: in addition to a deterioration of departure times, there is a clear increase in average taxi times and airborne times.

#### PREDICTABILITY/VARIABILITY OF OPERATIONS BY FLIGHT PHASE

- 7.4.11 Predictability is measured in Figure 87 from the flight perspective (i.e. airline view) as the difference between the 80th and the 20th percentile for each flight phase. Figure 87 shows that in both Europe and the US, arrival predictability is mainly driven by departure predictability.
- 7.4.12 With the exception of taxi-in times, variability in times for all flight phases is higher in the US as are the seasonal impacts of delays. Increased variability in the US is overall, heavily driven by weather. Over the last 5 years, increased variability in the US is driven by increased flights at congested airports. The higher variability by phase of flight in the US is linked to the operation of the ATM system.
- 7.4.13 US airports schedule flights closer to visual metrological conditions (VMC) such that when low visibility is experienced delays are higher. In the summer, the US has more convective weather which also affects variability [Ref. 26]. Airline scheduling and weather drive the need for a flexible system that can absorb delays in all phases of flight, further driving up the variance of flight times in the US.

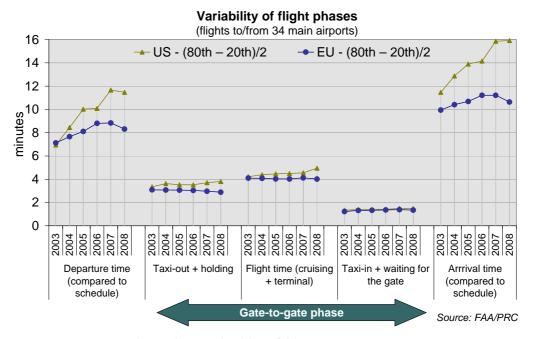


Figure 87: Variability of flight phases

## 7.5 Comparison of ANS contribution towards air transport performance

- 7.5.1 This section focuses particularly on the ANS contribution towards overall air transport performance as measured in the previous section of this chapter (punctuality, variability, average times). In order to account for differences in fuel burn, the following section is broken down by phase of flight. The section concludes with an overview of the estimated ANS contribution in individual flight phases.
- 7.5.2 Before looking at the ANS contribution in more detail, the following points should be borne in mind:
  - a) Not all 'delay' is to be seen as negative. A certain level of 'delay' is necessary and sometimes even desirable if a system is to be run efficiently without underutilization of available resources (e.g. airport capacity).
  - b) A clear cut allocation between ANS and non-ANS related causes is often difficult. While ANS is not always the root cause of the problem (weather, delay embedded in

- scheduling etc.), the way the situation is handled by ANS can have a significant influence on overall performance (i.e. distribution of delay between air and ground) and thus on costs to airspace users.
- c) Some indicators measure the difference between the actual situation and an ideal (unachievable) situation where each aircraft would be alone in the system and would not be subject to any constraints. This is, for example, the case for horizontal flight efficiency which compares actually flown distance to the great circle distance.

## ANS-RELATED DEPARTURE/GATE DELAYS (ATFM VS EDCT)

- 7.5.3 This section reviews ANS-related departure delays in the US and in Europe (EDCT vs. ATFM). Aircraft that are expected to arrive during a period of capacity shortfall en-route or at the destination airport are held on the ground at their various origin airports. Most of these delays are taken at the gate but some occur also during the taxi phase.
- 7.5.4 Figure 88 compares ANS-related departure delays attributable to en-route and airport constraints. In the US, en-route related ground delays are much lower per flight, but the delay per delayed flight is significantly higher. Whereas in the US the use of ground delays (EDCT) is the last resort from a pool of traffic flow management tools, in Europe ground delays (ATFM) are used much more frequently for balancing demand with capacity. These different outcomes are as expected in §7.3.2c.

|        | 2008        |                         | -route rel                 |                                       | Airport related<br>(EDCT/ATFM) |                            |                                       |  |
|--------|-------------|-------------------------|----------------------------|---------------------------------------|--------------------------------|----------------------------|---------------------------------------|--|
|        | flights (M) | % of flights<br>delayed | delay per<br>flight (min.) | delay per<br>delayed flight<br>(min.) | % of flights<br>delayed        | delay per<br>flight (min.) | delay per<br>delayed flight<br>(min.) |  |
| US     | 9.2         | 0.1%                    | 0.1                        | 55                                    | 2.8%                           | 1.9                        | 68                                    |  |
| Europe | 6.9         | 9.8%                    | 1.8                        | 18                                    | 4.5%                           | 1.0                        | 21                                    |  |

Figure 88: ANS-related departure/gate delays (flights to/from 34 main airports)

## TAXI-OUT EFFICIENCY

- 7.5.5 The analysis of taxi-out efficiency in Figure 89 refers to the period between the time when the aircraft leaves the stand and the take off time.
- 7.5.6 This phase of flight is influenced by a number of factors such as push-back times, congestion, and remote de-icing. The additional time is measured as the average additional time beyond an unimpeded reference time<sup>64</sup>. For the US, the additional time observed in the taxi-out phase also includes TMS delays (see 7.3.8) due to local en route departure and MIT restrictions.
- 7.5.7 Figure 89 shows a significantly higher average additional time in the taxi-out phase in the US (6.8 minutes per departure) than in Europe (4.3 minutes per departure).

The unimpeded time is derived by means of statistical analysis and described in more detail in the final report of the US/ Europe study to be published in June 2009.

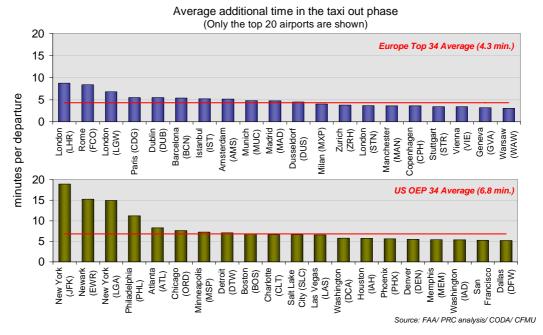


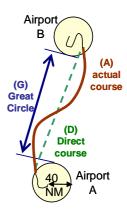
Figure 89: Comparison of additional time in the taxi out phase

7.5.8 Differences in taxi-out times reflect the different flow control policies and the absence of scheduling caps at most US airports. Additionally, the US Department of Transportation collects and publishes data on on-time departures which adds to the focus of getting off gate on time.

#### **EN-ROUTE FLIGHT EFFICIENCY**

- 7.5.9 En-route flight efficiency has a horizontal (distance) and a vertical (altitude) component. The focus of this section is on horizontal en-route flight efficiency, which is of much higher economic and environmental importance than the vertical component (see Figure 118 on page 103).
- 7.5.10 Efficiency or benefit pool calculations that consider full optimal 4-D trajectories must account for aircraft weight and aircraft performance information that is not generally available in the databases used to assess ATM performance. Furthermore, if an ANSP had access to a system that could detect a non-ideal condition, more information would be needed to determine if this was the result of ATC or an operating trade-off made by the user. More research is needed to determine the relation of optimized trajectories to the performance indicators described in this paper.
- 7.5.11 The flight efficiency in the terminal manoeuvring areas (TMA) of airports is addressed in the next section of this chapter. It should be noted that in Europe en-route flight efficiency is mainly affected by the fragmentation of airspace. However, in the US the enroute indicator includes some path stretching due to MIT restrictions which are passed back from airports located in areas with little or no room for aircraft to deviate laterally from the filed route (for example the New York area).

7.5.12 The Key Performance Indicator (KPI) for horizontal en-route flight efficiency is en-route extension. It is defined as the difference between the length of the actual trajectory (A) and the Great Circle Distance (G) between the departure and arrival terminal areas (radius of 40 NM around the airport). This difference would be equal to zero in an ideal (and unachievable) situation where each aircraft would be alone in the system and not be subject to any constraints. Trade-offs and interdependencies in the ATM system such as capacity, safety, weather, noise, and military operations limit potential improvement of route extension.



7.5.13 Figure 90 depicts the estimated direct route extension<sup>65</sup> for flights to/from the top 34 airports within the respective region (Intra-Europe, US–CONUS). "Direct route extension" and corresponding fuel burn are approximately 1% lower in the US<sup>66</sup> for flights of comparable lengths.

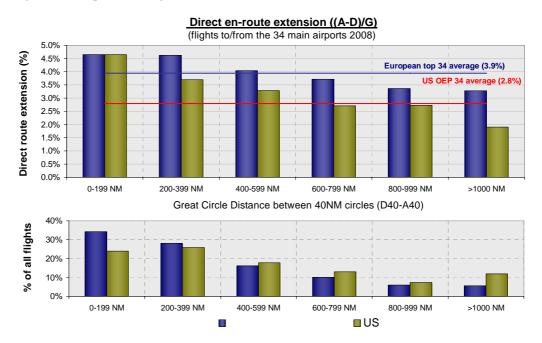


Figure 90: Comparison of direct en-route extension

## ARRIVAL SEQUENCING AND METERING AREA (ASMA) DELAYS

- 7.5.14 The locally defined TMA is not suitable for comparisons due to considerable variations in shape and size. A standard "Arrival Sequencing and Metering Area" (ASMA) is defined as a ring of 100NM radius around each airport. This is generally adequate to capture tactical arrival control measures (sequencing, flow integration, speed control, spacing, stretching, etc.), irrespective of local ATM strategies.
- 7.5.15 Figure 91 shows the additional time within the last 100NM. It is measured as the average additional time beyond the unimpeded<sup>67</sup> transit time for each airport.
- 7.5.16 In view of the stochastic nature of air transport and in the absence of en-route sequencing in Europe, airports like London Heathrow and Frankfurt already include a certain amount

Difference between the actual trajectory (A) and the direct course between the two terminal entry points (D) divided by the Great Circle distance (G).

The figure for the US includes the effect of Miles in Trail.

The unimpeded time is derived by means of statistical analysis and described in more detail in the final report of the US/Europe study to be published in June 2009.

of delay in their capacity declaration to ensure a continuous traffic flow. This means there is significant delay absorbed at lower altitudes around the airport in an effort to maximize throughput. Additional delays beyond what can be absorbed around an airport are taken on the ground at departure.

7.5.17 Similar to US airports which schedule flights closer to VMC capacity, high-intensity airports such as London Heathrow and Frankfurt are more vulnerable to adverse weather.

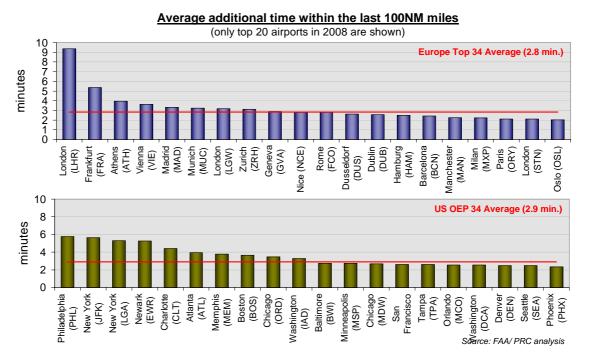


Figure 91: Average additional time within the last 100NM

## 7.6 Estimated total benefit pool actionable by ANS

- 7.6.1 Figure 92 shows the estimated total benefit pool actionable by ANS for the traffic to or from the 34 analysed main airports in Europe and the US.
- 7.6.2 The benefit pool represents a theoretical optimum. Safety and capacity constraints limit the practicality of ever fully recovering these "inefficiencies". Furthermore, inefficiencies will grow with demand in the absence of capacity and efficiency improvements. Maintaining the same level of efficiency while absorbing projected demand increases over the next 20 years will be very challenging.
- 7.6.3 Figure 92 shows that the estimated benefit pool that could be improved is more or less equivalent in the US and Europe. However, the breakdown of additional time per flight phase differs, which may have different implications on fuel burn, environmental impact and predictability.

| Estimated additional time on flights to/from the main 34 airports |                  | TIME p<br>(min | Predictability |        |
|---|------------------|----------------|----------------|--------|
|   |                  | EUR            | US             |        |
| Gate/ departure holdings  | en-route-related | 1.8            | 0.1            | Low    |
|   | airport-related  | 1.0            | 1.9            | Low    |
| Taxi-out phase  |                  | 4.3            | 6.8            | Medium |
| Horizontal en-route flight efficiency                             |                  | 2.2-3.8        | 1.5-2.7        | High   |
| Terminal areas (ASMA/TMA)   |                  | 2.8            | 2.9            | Medium |
| Total estimated additional time per flight                        |                  | 12.1-13.7      | 13.2-14.4      |        |

Figure 92: Estimated total benefits pool actionable by ANS

- 7.6.4 Whereas for ATFM/ EDCT gate delays the fuel burn is quasi-nil, those delays are largely unpredictable and not evenly spread among flights (small percentage of flights but high delays).
- 7.6.5 Additional time in the gate-to-gate phase (taxi-out, en-route, and terminal area) is generally more predictable for airspace users (more evenly spread and smaller delays) but leads to considerably higher fuel burn. A large proportion of these delays are usually built into the airlines' schedules.
- 7.6.6 Further work would be needed to assess better the impact of additional time on flight efficiency and predictability. The goal is to minimize overall direct (fuel, etc.) and strategic (schedule buffer, etc.) costs to airspace users whilst maximizing the utilization of available airport and en-route capacity.

## 7.7 Conclusions

- 7.7.1 The FAA/ATO and the PRC have cooperated to identify and measure comparable indicators of operational ANS performance on both sides of the Atlantic, using consistent data sources and methodologies.
- 7.7.2 One observes similar arrival punctuality levels in the US and Europe, albeit with higher delay variability in the US.
- 7.7.3 A breakdown by flight phases reveals strong and weak points on both sides:
  - a schedule upwards-creep and lower average seating capacity are observed in the US;
  - in the US, departure punctuality is better but taxi-out delays are longer;
  - "Direct route extension" is approximately 1% lower in the US, with corresponding fuel burn benefits;
  - while there is no superior performance in terms of arrival transit time in the TMA, London Heathrow is a clear outlier.
- 7.7.4 These differences possibly originate from different policies in allocation of airport slots and flow management, as well as different weather conditions. The impact on environment, predictability and flexibility in accommodating unforeseen changes may be different. A better understanding of trade-offs would be needed to identify best practices and policies.
- 7.7.5 Identification and application of today's best practices, with existing technology and operational concepts, could possibly help in raising the level of performance on both sides of the Atlantic in the relatively short term, and may have wider applicability.

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# Chapter 8: Cost-effectiveness (2007)

## KEY MESSAGES OF THIS CHAPTER

- At European system level, the real en-route unit cost decreased from 0.87 €km to 0.76 €km between 2003 and 2007, i.e. a reduction of -3.4% per annum. The substantial traffic increase during this period (+26%) has significantly contributed to this improvement. Better cost-control among several ANSPs has also played a key role.
- The cost-effectiveness improvement for the European system is in line with the PRC's notional target (-3% per annum over 2003-2008). Without significant costs increase in some States/ANSPs (e.g. Spain), the unit costs reduction would have been even higher.
- The positive business cycle which started in 2003 ended in 2008. Traffic growth will be significantly lower in 2009 and possibly some time beyond. The economic downturn requires ANSPs to review their plans to ensure that they are consistent with more straitened economic circumstances.
- Latest Member States' projections (Nov. 2008) indicate that the PC objective (-6% reduction of the enroute real unit costs over 2008-2010) will not be met despite States/ANSPs commitment in November 2007.
- There is room for cost-effectiveness and productivity improvement based on best practices identified through benchmarking. ANSPs management together with staff unions have a collective responsibility to address this challenge and to work together towards the implementation of measures that allow short and medium term flexibility in controlling costs, without jeopardizing future traffic growth.
- The setting of binding Community performance targets (SES II) will be a significant step towards
  driving further performance improvements. Initiatives like FABs and SESAR are also expected to
  generate further performance improvements through the rationalisation of investments and a better use
  of resources.

## 8.1 Introduction

8.1.1 The year 2007 is the latest for which actual figures are available at the time of this analysis. In 2007, total en-route and terminal ANS costs amounted to some €360M. ANS costs can be broken down into ATM/CNS, MET, EUROCONTROL and payment to regulatory and national authorities as shown in Figure 93.

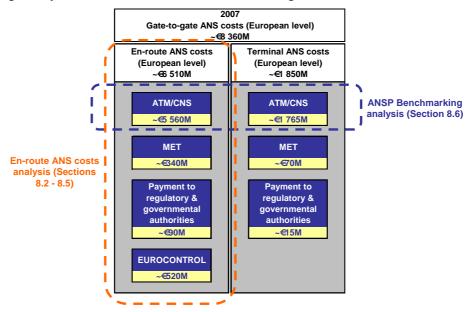


Figure 93: Framework for cost-effectiveness analysis at State and ANSP level

8.1.2 Ideally, performance targets and review should address the full ANS gate-to-gate costs (€360M). However, the reporting mechanism for the terminal ANS costs and charges has just been initiated in 2008 for States bound by SES regulations [Ref. 27]. This reporting mechanism is expected to mature in future years. This will allow the PRC to

address all the cost items in Figure 93. Consequently, this chapter first addresses **enroute costs**<sup>68</sup> that are charged to airspace users (Route Charges at State level) and related performance target (Sections 8.2 to 8.5), and then benchmarks **ATM/CNS provision costs**<sup>69</sup> at ANSP level (Section 8.6). More specifically, this chapter is organised as follows:

- Section 8.2 presents the en-route cost-effectiveness KPI for the EUROCONTROL Area:
- Section 8.3 assesses progress on the European cost-effectiveness target;
- Section 8.4 describes each Member State's en-route ANS unit costs over the 2003-2007 period and its forward-looking projections for 2008-2012;
- A more detailed analysis of the main ANS cost-components (such as ATM/CNS, MET, EUROCONTROL) is presented in Section 8.5, and;
- Finally, Section 8.6 highlights the main results of the ATM Cost-Effectiveness Benchmarking Report (ACE 2007) [Ref. 28], which analyses ANSPs' cost-effectiveness performance.

# 8.2 En-route cost-effectiveness KPI for EUROCONTROL Area (2003-2010)

- 8.2.1 The en-route cost-effectiveness KPI is obtained by dividing the total real en-route costs (i.e. deflated costs) used to compute the Route Charges by the number of kilometres charged to airspace users. This information is derived from Member States submissions for the purposes of the EUROCONTROL Enlarged Committee for Route Charges.
- 8.2.2 Following the implementation of EC regulation 1794/2006 laying down a common charging scheme for ANS [Ref. 27] the quality and quantity of information provided by Member States for the purposes of the Enlarged Committee for Route Charges meetings clearly improved. Nevertheless, several States submitted the information required for the computation of the 2009 unit rate at the very last minute. Undoubtedly, this had a negative impact on the quality of the multilateral consultation held on 19 November 2008.
- 8.2.3 Figure 94 summarises the main relevant cost-effectiveness data and shows the changes in the cost-effectiveness KPI<sup>70</sup> between 2003 and 2010 for the EUROCONTROL Area.

|  | 2003  | 2004  | 2005  | 2006  | 2007  | 2008P | 2009P | 2010P | 07/03 | 10/07 |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Contracting States                         | 30    | 30    | 31    | 31    | 31    | 31    | 31    | 31    | 30    | 31    |
| Total en-route ANS costs (M€2007)          | 5 729 | 5 967 | 6 073 | 6 127 | 6 310 | 6 470 | 6 587 | 6 657 | 10%   | 5%    |
| National costs (M€2007)                    | 5 188 | 5 419 | 5 443 | 5 483 | 5 665 | 5 815 | 5 928 | 5 987 | 9%    | 6%    |
| EUROCONTROL Maastricht (M€2007)            | 120   | 120   | 117   | 119   | 123   | 130   | 139   | 148   | 3%    | 20%   |
| EUROCONTROL Agency (Parts I & IX) (M€2007) | 421   | 428   | 513   | 526   | 521   | 524   | 520   | 522   | 20%   | -1%   |
| Km charged (Million)                       | 6 589 | 7 047 | 7 472 | 7 823 | 8 321 | 8 602 | 8 738 | 9 052 | 26%   | 9%    |
| Real unit costs (€2007/km)                 | 0.87  | 0.85  | 0.81  | 0.78  | 0.76  | 0.75  | 0.75  | 0.74  | -13%  | -3%   |

Figure 94: En-route ANS cost-effectiveness KPI for EUROCONTROL Area (2007 prices)

8.2.4 In 2007, the en-route real unit cost for the European ANS system was €0.76 per km. Given that its value was €0.87 per km in 2003, this implies that between 2003 and 2007, real unit costs decreased by -13% (i.e. around -3.4% per annum). This cost-effectiveness improvement surely results from better cost control and improved efficiency, but it has

The aggregation of en-route cost and traffic data provided by EUROCONTROL States for the purposes of the Enlarged Committee for Route Charges allows the review of en-route costs for the EUROCONTROL Area.

<sup>69</sup> Information disclosure requirements under EUROCONTROL rules allow the review of a **gate-to-gate** ATM/CNS costs and benchmarking of ANSPs.

Note that the growth rates displayed in the last two columns of Figure 94 are computed for consistent samples of Member States for which a time series was available (i.e. 30 in 2004 and 31 over the 2005-2010 period). The information reported in Figure 94 does not include data for Lithuania, Poland, and Serbia and Montenegro, as they were not yet technically integrated to the Route Charges System of 1 January 2007. However, it should be noted that the data displayed in Figure 93 include the costs of the ANSPs operating in Lithuania, Poland, and Serbia and Montenegro.

- also been helped by traffic growth enabling costs to be spread over a rising number of km charged (+26%).
- 8.2.5 Figure 94 also indicates that the decreasing trend in unit costs is expected to significantly decelerate, since real en-route unit costs, according to States' forecasts, are expected to decrease by -3% between 2007 and 2010 (i.e. a yearly reduction in unit costs of -1.0% instead of -3.4% for the 2003-2007 period). This change in trend results from overall lower planned traffic growth for the European system (+9% between 2007-2010) and significant national cost-bases increases in some States/ANSPs, which were not planned last year (see Figure 100 below for more details).
- 8.2.6 On the basis of the information provided by States in November 2008, Figure 95 indicates that many States expect low traffic growth, if not negative, in 2009. On the other hand, several States are still planning for significant traffic growth. There are significant disparities among States within the same geographical area which potentially raises a question on the consistency of the traffic forecasts used to set 2009 en-route unit rates. For example, Spain's traffic growth figure<sup>71</sup> used to set the 2009 unit rate (+13%) is well above the forecasts made in the other larger States: France (+2%), UK (-2%) and Germany (0%). Furthermore, Spain's planned traffic growth strongly diverges from the forecast provided by the CRCO (in September 2008) for Spain Continental (+1.5%)<sup>72</sup>.

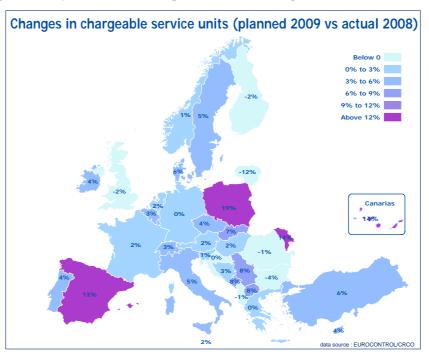


Figure 95: Planned changes in chargeable service units

8.2.7 Figure 95 shows the planned changes in chargeable service units, i.e. the actual 2008 versus 2009 forecast used by Member States in November 2008 to set their 2009 unitrates. It is clear that due to the importance of Spain in the overall European system, the high traffic increase planned for Spain (+13%) in 2009 significantly impacts the level and profile of **planned** unit costs at European system level shown in Figure 94. It is likely that this traffic increase will not materialise in 2009 and that the 2009 unit cost computed from States' forecasts (0.75 €km) is most certainly underestimated. This will have an

Spain presented a downwardly-revised traffic forecast to the March 2009 enlarged Committee Session (0.1% for 2009 compared to 2008), without affecting the 2009 unit rate for Spain.

As EUROCONTROL Member States operate under a full cost recovery mechanism for en-route ANS (except UK), any over-estimation of traffic forecast automatically translates into under-recoveries to be paid back by airspace users in future years, unless States/ANSPs are able to adjust promptly their cost base during the year. This typically results, all else being equal, in further increases in unit rates.

impact on the achievement of the en-route cost-effectiveness performance target (see Section 8.3 below).

## 8.3 En-route cost-effectiveness performance target

8.3.1 Building on the information provided in Figure 94, Figure 96 displays the historic trend of the en-route cost-effectiveness KPI between 1999 and 2007 (the last year for which actual costs data is available) along with forward-looking projections until 2013.

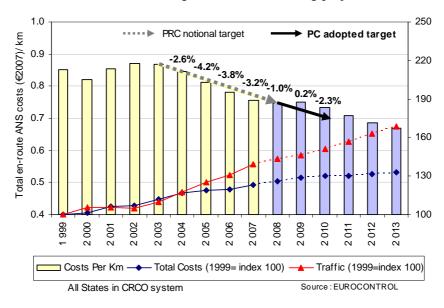


Figure 96: Real en-route unit costs per km (KPI), total costs and traffic

- 8.3.2 According to Figure 96, it is likely that the PRC's notional target (-3% per annum for the period 2003-2008) will be reached (see grey dotted arrow) provided the States' plans for 2008 materialise. This implies that the en-route real unit cost would have decreased by some -14% (an average yearly reduction of -3%) which is clearly a positive achievement. In fact, without significant costs increases in some States/ANSPs (e.g. Spain) during the 2003-2008 period the improvement at European system level would have been even better (see Section 8.4).
- 8.3.3 Reaching the PRC notional target would directly translate into cumulative "savings" of some €3 billion between 2003 and 2008 with respect to constant 2003 unit costs. The robust traffic increase has certainly contributed to the reduction in unit costs observed until 2007, but genuine performance improvements due to tighter cost management and greater cost-effectiveness awareness have also played an important role. This cost-effectiveness improvement should also be seen in the light of the current quality of service performance (see in particular Section 10.3).
- 8.3.4 The Provisional Council (PC 28, November 2007) adopted its objectives until 2010, including an efficiency objective to "Reduce the European average real "en-route" unit cost per km by 3% per annum until 2010, whilst maintaining or improving the current level of service delivered. The Agency will contribute by reducing at least by 3% its real unit cost." In other words, this would correspond to a reduction of the real en-route unit costs of -6% on the period 2008-2010 (see dark arrow in Figure 96 above).
- 8.3.5 Figure 96 indicates that the year 2008 marks the end of a positive business cycle for the European ANS system, as it is clear that a general economic downturn is expected for 2009 in Europe. Figure 96 suggests that the Pan-European target adopted by the PC will not be met by 2010, despite commitment expressed by States/ANSPs in 2007 to execute the plans in order to achieve the objective [See Annex VII]. According to the latest

Member States' projections, en-route real unit costs are expected to decrease by -2.2% between 2008 and 2010 (instead of -6.0% according to the PC objective) or even increase if in 2009 and 2010 traffic is lower than forecasted (see Figure 95).

- 8.3.6 In fact, while traffic growth is planned to significantly slow down, 2009 en-route costs are now planned to increase faster than foreseen in September 2007; in particular for two of the five largest States, namely France and Germany (see Section 8.4). The rise in costs is often associated with an increase in pension-related costs and expensive renegotiation of wages agreements, see the ACE 2007 Benchmarking Report [Ref. 28]. The deviation between the unit costs profile to which States committed in 2007 and projections made in November 2008 is detailed for each State in Annex VII of this Report.
- 8.3.7 The sharp and potentially prolonged economic downturn requires ANSPs to review their plans to ensure that they are consistent with more straitened economic circumstances. ANSPs cannot stand aside and it will be important that they continue and enhance the quest for efficiency. But it will also be important that the breathing space provided by weaker demand is used to build a stronger platform for the eventual resumption of traffic growth, so that there is a better match between capacity and demand and a better ongoing cost-effectiveness performance. Given the current system performance, there is still room for cost-effectiveness and productivity improvement based on adopting best practices throughout the European ANS network (see also Section 8.6 on ANSP benchmarking).
- ANSPs management together with 8.3.8 social partners have a collective responsibility to address this challenge and to work together the implementation towards measures that would allow short and medium term flexibility in controlling and adjusting costs, taking into account the social and institutional environment in which they operate.
- 8.3.9 Several of these measures are in fact being considered and even implemented among ANSPs (see examples of measures in Figure 97).
- 8.3.10 In this context, CANSO has issued a Statement<sup>73</sup> in June 2008 asking all their ANSP members to consider short term initiatives in cooperation with their customers.

# Figure 97: Examples of ANSPs measures to improve cost management

Setting of collective agreements with employment conditions valid for at least 3 years, improves cost and capacity predictability.

Ensure flexible deployment and use of operational staff to meet demand.

Review of the pension arrangements (retirement age, pension scheme, etc) to prevent a potentially out of control increase in future pension liabilities.

Outsourcing of non-core activities, where this is shown to be economical.

Enhancement of the cooperation with other ANSPs in the context of FABs to achieve synergies.

Reassessment of the investment programme to prioritize projects which have the most promising safety and capacity outcomes taking into account airspace users needs.

Stretch assets accounting life to decrease depreciation

<sup>73</sup> So-called "Madeira Statement". The short term initiatives comprise:

Reviewing capacity plans on the basis of updated 5 year traffic forecasts, agreed with the airline community;

Accelerating operational efficiency projects;

<sup>•</sup> Identifying projects that will further improve cost effectiveness; and

<sup>•</sup> Maintaining or even reducing future charges.

- 8.3.11 States can also implement transitional measures in order to stabilise or decrease the chargeable cost-base and hence en-route unit rates. Examples are provided in Figure 98.
- 8.3.12 For example, Switzerland has been bearing the EUROCONTROL costs since 2005. Similarly, since 2005 ENAV, the Italian ANSP, draws on its equity to stabilize the en-route unit rate.

# Figure 98: Examples of States/Shareholders measures to reduce or stabilise ANS chargeable cost-base

Explicit and transparent State subsidies (e.g. EUROCONTROL contributions borne by the State and not charged to users).

Limit/defer costs related to income tax and dividend so as to reduce the cost of capital charged to users.

As main shareholders, States can instruct ANSPs to temporarily make use of equity reserves/cash to finance potential under-recoveries.

8.3.13 No doubt that there is also room for streamlining investment programmes in the context of the SESAR initiative<sup>74</sup>. The total costs of SESAR Development Phase (2008-2013) are estimated at €2.1B, while the investment and operating costs for the Deployment Phase (2014-2020) have been assessed<sup>75</sup> at some €10B for IP1 and €19B for IP2. The Deployment Phase relates to the implementation of the new ATM infrastructure and will require ANSPs and airspace users (both civil and military) to make significantly new capital investments. Given the magnitude of these investments, it will be essential that SESAR brings about a number of solid business cases demonstrating significant performance improvements in terms of labour and capital productivity for the ANS system in the future.

## SES II PERFORMANCE SCHEME

- 8.3.14 The forthcoming SES II package (see Section 1.3) provides an opportunity for States/ANSPs to further improve performance through binding commitment on quantified performance targets. According to Article 11 of the amended Framework Regulation, the performance scheme shall include the "setting of Community-wide performance targets, their respective reference period covering a minimum of three years and a maximum of five years". The PRC considers that the setting of binding Community-wide performance targets is a significant step towards driving further performance improvements in ANS.
- 8.3.15 New features of the proposed SES II package include the departure from the current full cost recovery for en-route ANS, and the mandatory setting of unit rates for a period of three to five years. This would introduce greater incentive for ANSPs to better manage costs and achieve local performance targets and also contribute to improved cost predictability.
- 8.3.16 In fact, the EUROCONTROL Route Charges Principles foresee since 2004 the option for Contracting States to set unit rates in advance for a period of three to five years, however so far none have opted for this possibility. A relatively simple incentive scheme would require defining a mechanism to ensure a fair sharing of the traffic volume risk and financial risk between users and providers in the treatment of the cumulated under/over-recoveries resulting from differences between actual costs and revenues. For transparency, fairness, efficiency and simplicity purposes it is important to preserve the cohesion of the Route Charges System.

<sup>52</sup> SESAR represents the technological pillar of the SES, its objective is to develop the new generation of ATM systems to ensure the safety and efficiency of air transport for the next 30 years.

<sup>75</sup> Industry Consultation Body (ICB/22), 22 May 2008, "Supporting deployment of SESAR IP1".

## 8.4 En-route ANS cost-effectiveness KPI at State level

- 8.4.1 The decrease of en-route unit costs at European system level over the 2003-2012 period (see Figure 96) results from contrasted levels and trends across EUROCONTROL Member States<sup>76</sup>, hence the importance of considering the State level view.
- 8.4.2 When looking across States, the levels of unit costs should be seen in the light of traffic volumes and exogenous factors such as local economic and operational conditions, which considerably vary across States (see also Figure 108). This requires some caution when comparing results and drawing conclusions in terms of economic efficiency.
- 8.4.3 Because of their relative importance in relation to the whole European system (67% of total costs) and for conciseness purposes, this section focuses on the five largest States. Figure 99 displays the changes in real en-route unit costs for the five largest States<sup>77</sup> between 2003-2012. More detailed analysis on the changes in unit costs for smaller States is displayed in Annex VII.

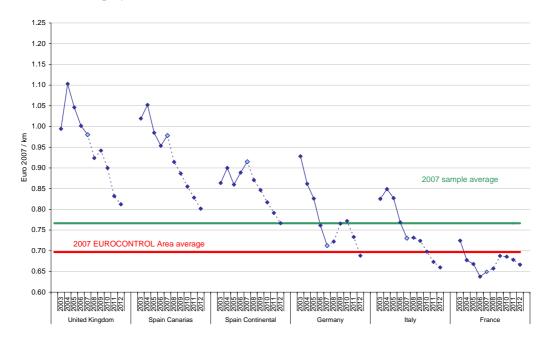


Figure 99: Trend in en-route real unit costs for the five largest States (2003-2012)

8.4.4 First, Figure 99 indicates that there are significant differences in the level of unit costs across the five largest States, although the operational and economic environments are relatively similar. In 2007 the en-route unit costs range from €0.98 per km in the United Kingdom<sup>78</sup> to €0.65 per km in France: a factor of 1.5 at face value. This difference is affected by several factors such as different allocation between en-route and terminal, costs that are not under direct control of the ANSPs, and different regulatory arrangements.

<sup>76</sup> These unit costs reflect en-route national costs passed on to the airspace users by the various States. These costs include costs relating to ATS and MET provision, regulators, but exclude the EUROCONTROL Agency costs. EUROCONTROL Agency costs are analysed in Section 8.5 of this Chapter.

<sup>77</sup> Note that for the purpose of Route Charges, Spain has two different unit rates and unit costs (Continental & Canarias).

In the UK the en-route ANSP (NATS) does not operate under the full cost-recovery regime but under a regime of economic regulation (price cap). Therefore, the costs reported by UK to the Enlarged Committee for Route Charges can differ from the charges collected from en-route airspace users. For comparability purposes, Figure 99 shows the en-route costs charged to UK airspace users. These costs are computed as the product of the chargeable service units with the UK unit rates expressed in £. Planned costs are converted into Euros using the planned exchange rates provided by UK in their submission to the Enlarged Committee for Route Charges. Unit costs are obtained by division of these calculated national costs with the chargeable km.

- 8.4.5 Second, Figure 99 shows the changes in en-route unit costs for the five largest States. Between 2003-2007, en-route real unit costs decreased for Germany (-23%), Italy (-12%), France (-10%), Spain Canarias (-4%) and United Kingdom (-1%). Clearly, due to their relative weights, these reductions in unit costs have a significant impact on the performance improvement at European system level which is identified in Figure 96.
- 8.4.6 On the other hand, en-route real unit costs increased in Spain Continental between 2003 and 2007 (+6%, see Figure 99). The main driver for the unit costs increase in Spain is the large increases in ATCO employment costs in Aena which have not been matched by increases in productivity (see also Figure 109 below).
- 8.4.7 Figure 99 also indicates that, except for France, all the largest States en-route unit costs are planned to decrease between 2007 and 2012. On the other hand, the planned unit cost profile provided in Nov. 2008 by the five largest States is not in line with their five years objectives to which they committed in Nov. 2007 [See Annex VII]. In November 2008, the unit costs profile provided by the five largest States were revised upwards especially for the year 2009. Figure 100 below compares the national costs and traffic planned by the five largest States for the purposes of the Enlarged Committee meeting in Nov. 2008 with the plans provided in Nov. 2007.

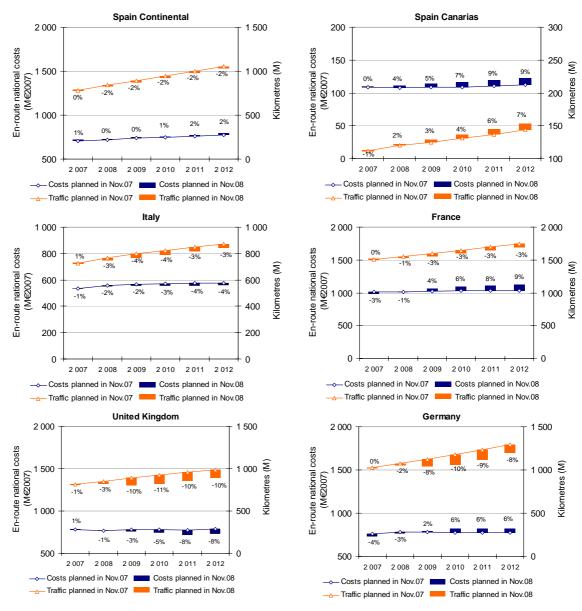


Figure 100: Changes in planned en-route costs and traffic for the five largest States

- 8.4.8 Figure 100 clearly indicates that, with the exception of Spain Canarias, the largest States anticipated the impact of the economic downturn on the traffic growth by adjusting their traffic forecast downwards in November 2008 (orange bars below the orange line).
- 8.4.9 Figure 100 also indicates that UK and Italy planned costs were also adjusted downwards in November 2008 (blue bars below the blue line). On the other hand, costs planned by France, Germany and Spain for the period 2008-2012 have been revised upwards, mostly driven by higher staff costs.
- 8.4.10 Similarly, Annex VII indicates that for several "smaller" States, their planned unit cost profile provided in Nov. 2008 diverges from their five years objectives to which they committed in Nov. 2007 [See Annex VII].
- 8.4.11 Given the economic downturn it is important that States/ANSPs review their plans to ensure that they are consistent with more straitened economic circumstances.

# 8.5 The components of en-route ANS costs (European and State level)

- 8.5.1 According to EC regulation 1794/2006 which lays down a common charging scheme for ANS [Ref.27] Member States shall breakdown ANS costs in various components which are more meaningful for performance comparisons purposes:
  - ATM;
  - Communications;
  - Navigation;
  - Surveillance;
  - SAR;
  - AIS:
  - Supervision;
  - MET; and,
  - EUROCONTROL Agency.

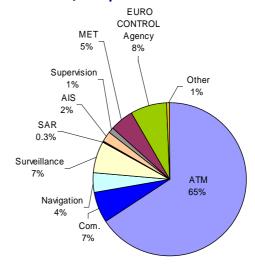


Figure 101: Breakdown of en-route ANS costs at European system level (2008)

- 8.5.2 Figure 101 shows the share of each category in the total ANS costs for the year 2008. Costs associated with the CNS infrastructure amount to some 18% of the total cost-base, while 65% directly relates to ATM.
- 8.5.3 The next section considers each of the ANS components in order to identify the drivers for the European States performance in terms of cost-effectiveness.

# ATM/CNS PROVISION COSTS (INCLUDING AIS, SAR & MAASTRICHT COSTS)

8.5.4 The bulk of total ANS costs (i.e. more than 85%) relate to the provision of ATM/CNS. These costs are largely under the direct control and responsibility of ANSPs. They are linked to the capacity to be provided for a safe and efficient conduct of traffic demand. ATM/CNS provision costs form the basis of the ANSP cost-effectiveness benchmarking analysis presented in Section 8.6 of this chapter.

## AERONAUTICAL MET COSTS

- 8.5.5 Figure 102 shows the trend at European level of MET costs recovered through en-route charges between 2003 and 2009 for a consistent sample of 30 EUROCONTROL Member States for which data for a time-series analysis was available.
- 8.5.6 At European level, en-route MET costs, i.e. some 5% of en-route ANS costs, amounted to some €34M in 2007. It should be noted that the enroute MET costs decreased by -9% in real terms between 2003 and 2007. This is a significant contribution to the en-route ANS cost-effectiveness improvement.

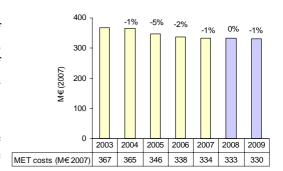


Figure 102: Changes in en-route MET costs at European level (2003-2007)

8.5.7 Figure 103 below shows the changes of MET costs in real terms between 2003 and 2007 at State level and indicates the relative share of each State in en route total MET costs. Figure 103 also shows that the decrease at European system level (-9%) is mainly due to decreases in Italy and Germany (-20% and -33%, respectively) where MET costs represent respectively 14% and 10% of the total MET costs at European system level. In Italy, the decrease is due to the recent implementation of an accounting system which allowed for a more accurate assessment of MET costs. Germany reassessed its cost allocation and rationalised its MET service provision and as of 2007, a portion of Germany MET costs is reallocated from en-route ANS to terminal ANS and recovered through TNC (see blue bar in Figure 103 below for Germany).

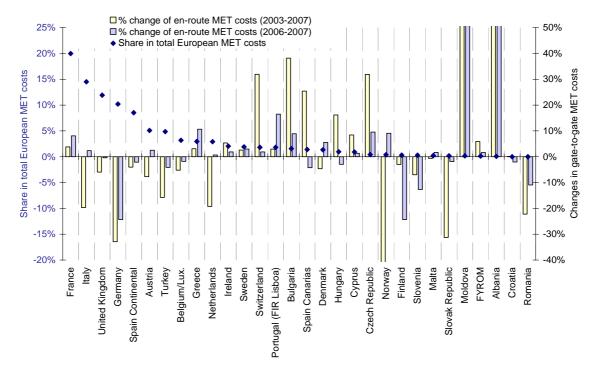


Figure 103: Changes in en-route MET costs at State level (2003-2007)

8.5.8 There are also a number of States which between 2003 and 2007 report an increase of more than 15%. The largest increases are mainly observed in States where the MET cost base was "small" to start with in 2003 such as Moldova, Albania, Bulgaria and Czech Republic. However, Figure 103 also shows that in 2007, MET costs increased in States

whose MET costs represented a larger share in the European MET costs such as France (+8%), Greece (+11%) and Portugal (+16%). These increases should warrant further attention given that several components of MET costs are fixed and should not vary with traffic.

# EUROCONTROL AGENCY COSTS (EXCLUDING MUAC & CEATS)

- EUROCONTROL Agency costs can be split 8.5.9 main categories: two EUROCONTROL cost base (Parts I and IX, €521.2M in 2007) and the CRCO costs (Part II, €18.4M in 2007).
- 8.5.10 In 2007, the EUROCONTROL Agency cost base (Parts I and IX) represents around 8.3% of total European en-route ANS costs, which is lower than in 2006. As indicated in Figure 104 the relative share EUROCONTROL Agency costs is expected to further decrease in 2008 and 2009 below the 8% threshold.

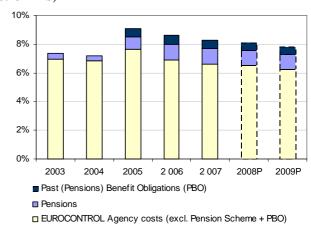


Figure 104: EUROCONTROL Agency costs relative to total European en-route ANS costs

07/03

2469

1029

07/06

6%

8.5.11 Figure 105 displays the breakdown of EUROCONTROL Agency costs per establishment and expenditure between 2003 and 2007.

|  |       |       | Yearl | y costs ( | M€)   |            |            |  | Yearly costs (M€) |       |       |       |       |
|--|-------|-------|-------|-----------|-------|------------|------------|--|-------------------|-------|-------|-------|-------|
| Establishment                            | 2003  | 2004  | 2005  | 2006      | 2007  | %<br>07/03 | %<br>07/06 | Type of expenditure                      | 2003              | 2004  | 2005  | 2006  | 2007  |
| EATM/ASRO/MIL                            | 110.9 | 119.7 | 126.3 | 141.6     | 138.4 | 25%        | -2%        |  |                   |       |       |       |       |
| EAD                                      | 9.5   | 8.0   | 9.7   | 14.5      | 12.6  | 33%        | -13%       | Staff costs                              | 176.1             | 188.1 | 192.9 | 209.0 | 219.6 |
| Logistics                                | 65.5  | 68.2  | 73.5  | 71.5      | 71.1  | 8%         | -1%        | PBO                                      |                   |       | 35.4  | 35.4  | 35.8  |
| CFMU                                     | 91.9  | 91.9  | 103.8 | 97.2      | 107.3 | 17%        | 10%        | Pensions                                 | 20.0              | 20.7  | 48.6  | 65.2  | 69.2  |
| EEC                                      | 70.7  | 72.7  | 75.6  | 71.0      | 66.5  | -6%        | -6%        | Operating costs                          | 71.1              | 89.2  | 99.5  | 141.1 | 143.8 |
| IANS                                     | 12.2  | 13.3  | 13.5  | 13.4      | 13.3  | 9%         | -1%        | Depreciation costs                       | 108.1             | 93.0  | 107.8 | 59.4  | 45.7  |
| Institutional bodies                     | 6.2   | 6.4   | 6.4   | 7.0       | 7.1   | 14%        | 0%         | Interest                                 | 11.6              | 9.7   | 8.6   | 6.8   | 7.2   |
| Pensions                                 | 20.0  | 20.7  | 48.6  | 65.2      | 69.2  | 246%       | 6%         |  |                   |       |       |       |       |
| PBO                                      |       |       | 35.4  | 35.4      | 35.8  | -          | 1%         |  |                   |       |       |       |       |
| Total Parts I & IX                       | 386.9 | 400.8 | 492.7 | 516.8     | 521.2 | 35%        | 1%         | Total Parts I & IX                       | 386.9             | 400.8 | 492.7 | 516.8 | 521.2 |
| Price Index                              | 1.056 | 1.076 | 1.103 | 1.129     | 1.149 | 9%         | 2%         | Price Index                              | 1.056             | 1.076 | 1.103 | 1.129 | 1.149 |
| Real costs (€2007) Total<br>Parts I & IX | 421.0 | 428.1 | 513.4 | 526.2     | 521.2 | 24%        | -1%        | Real costs (€2007)<br>Total Parts I & IX | 421.0             | 428.1 | 513.4 | 526.2 | 521.2 |

Figure 105: EUROCONTROL Agency costs per establishment & expenditure (Parts I &

- 8.5.12 The right-hand side of Figure 105 indicates that between 2006 and 2007, the total costbase for the EUROCONTROL Agency decreased by -1% in real terms. This is the first time on record that the EUROCONTROL cost-base decreases. This decrease is due to a fall in depreciation costs from €59.4M to €45.7M (-€13.7M) which is driven by:
  - (1) a change in the assumptions used to compute depreciation costs of computer hardware assets, and:
  - (2) a decrease in the value of intangible assets (following introduction of IAS 38 in 2006) leading to lower depreciation costs.
- 8.5.13 The left-hand side of Figure 105 indicates that the only establishment (besides pensionrelated costs) which has increased its costs in 2007 is the CFMU (+€10.2M between 2006 and 2007). This increase is mainly due to the back pay of salaries to CFMU operational staff following the ILOAT judgement [Ref. 30].

PRR 2008

In Figure 104 and Figure 105 the item "Pensions" corresponds to the pensions charged to EUROCONTROL budget while the PBO results from the implementation of the 2004 pension reform to rebuild the Projected Benefit Obligations.

**EUROCONTROL** 8.5.14 The Agency business plan for period 2009-2013 [Ref 31 - Edition 1.0, 27 20081 Oct. sets the Agency costeffectiveness objective which consists reducing the Agency real costs per kilometre by -3% per annum until 2010 and then by -5% per from annum 2011 onwards (see Figure 106).

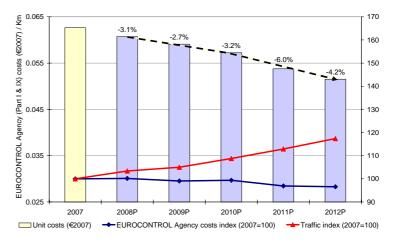


Figure 106: EUROCONTROL Agency unit costs 2008-2012 (Parts I & IX, in €2007)

- 8.5.15 Although a significant amount of the EUROCONTROL Agency activity and costs are not directly related to traffic volumes (and in particular to the number of kilometres charged at European system level), this quantified cost-effectiveness objective is consistent with the Report of the ANSB cost-effectiveness Task Force (Sept. 2007) and it will allow for a straightforward measure of the contribution of the Agency to the European system objective.
- 8.5.16 Figure 106 above shows that EUROCONTROL Agency real unit costs are planned to decrease by -18% between 2007 and 2012 (i.e. an average reduction of -4% per annum). Clearly, if this trend materialises the EUROCONTROL Agency objective of -3% until 2010 will be met. This unit cost profile results from a combination of +17% traffic increase between 2007 and 2012 (i.e. a rise of +3.3% per annum) and from a reduction of the Agency cost base of -3% in real terms (-0.7% per annum). Since the traffic growth shown in Figure 106 is now subject to a great deal of uncertainty it will be a challenge for the EUROCONTROL Agency to meet its cost-effectiveness objective over the 2008-2012 period. Given the more straitened economic circumstances, it is important that the EUROCONTROL Agency commits to the planned cost-base decrease shown in Figure 106.

# 8.6 Gate-to-gate ATM/CNS cost-effectiveness benchmarking (ANSP level)

- 8.6.1 The findings of this section are further detailed in the ATM Cost-Effectiveness (ACE 2007) Benchmarking Report [Ref. 28] which extensively documents the analysis of 36 European ANSPs' cost-effectiveness. This analysis is based on the data submitted by ANSPs in accordance with the EUROCONTROL Specification for Information Disclosure.
- 8.6.2 Figure 107 shows a detailed breakdown of gate-to-gate<sup>80</sup> ATM/CNS provision costs. Since there are differences in cost-allocation between en-route and terminal ANS among ANSPs, it is important to keep a "gate-to-gate" perspective when comparing ANSPs cost-effectiveness.

<sup>80</sup> That is the aggregation of en-route and terminal ANS.

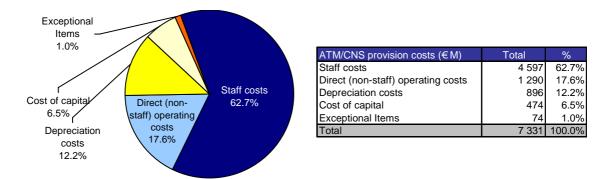


Figure 107: Breakdown of gate-to-gate ATM/CNS provision costs (2007)

## GATE-TO-GATE COST-EFFECTIVENESS

- 8.6.3 This section analyses ANSPs cost-effectiveness according to the framework presented in Figure 93. The ANSP cost-effectiveness focuses on ATM/CNS provision costs which are under the direct control and responsibility of the ANSP.
- 8.6.4 The cost-effectiveness analysis presented in this section is factual. It is important to note that local performance is impacted by several factors which are different across European States, and some of these are typically outside (exogenous) an ANSP's direct control (see Figure 108). A genuine measurement of cost inefficiencies would require full account to be taken of identified and measurable exogenous factors.
- 8.6.5 Progress is clearly needed in this area to better understand the range of exogenous factors that affect apparent ANSP performance.
- 8.6.6 This will in turn help identify best practice and guide ANSPs towards the improvements that can be made. It will also support economic regulation and target setting.



Figure 108: Factors affecting ANSP performance

- 8.6.7 The exogenous factors that could have an impact on ANSP performance have been classified into two main areas (see the top and central set of factors in Figure 108), according to which set of decision-makers have an influence over them.
  - The top set concerns the **legal and socio-economic conditions** prevailing in individual countries (see dark blue box in Figure 108). These are determined either by national policy-makers at a more general level (for example taxation policy), or by national and international macroeconomic conditions (for example, prevailing national wage rates). It also concerns the **operational conditions** under which the ANSP operates what traffic patterns and external conditions it has to deal with (see purple box in Figure 108) MET and geographic conditions. In this case the relevant decisions are made by airports, airlines and, especially, by flying travellers;
  - The central set concerns the **institutional and governance arrangements** (see green box in Figure 108) for ANS in a particular country. These arrangements are set by the policies and specific aviation laws of each country. These factors are exogenous to the ANSP but decision-making concerning some of them is largely driven by

national aviation policy-makers. Some of these factors relate to international requirements such as those imposed by ICAO, EUROCONTROL and the SES. These policies at State and European level are subject to changes given strategic objectives for the sector. A typical example is the current discussion around the new SES II package (see § 8.3.14).

8.6.8 Finally, the bottom set of Figure 108 concerns endogenous factors that are entirely under the ANSP control (see light blue boxes). These comprise **organisational factors**, **managerial and financial aspects**, and factors relating to the **operational and technical setup**. It is the responsibility of ANSPs to optimize these factors through the recognition and movement towards best practices.

## 2003-2007 TRENDS

- 8.6.9 The top of Figure 109 displays the trend at European level of the gate-to-gate "economic" cost-effectiveness indicator between 2003 and 2007 for a consistent sample of 33 ANSPs for which data for a time-series analysis was available.
- 8.6.10 The quality of service provided by ANSPs has an impact on the efficiency of aircraft operations, which carry with them additional costs that need to be taken into consideration for a full economic assessment of ANSP performance. The quality of service associated with ATM/CNS provision by ANSPs is, for the time being, assessed only in terms of ATFM ground delays, which can be measured consistently, can be attributed to ANSPs, and can be expressed in monetary terms. The indicator of "economic" cost-effectiveness is therefore the ATM/CNS provision costs plus the costs of ATFM ground delay, all expressed per composite flight-hour.
- 8.6.11 For the European system as a whole, unit economic costs fell by -6.6% between 2003 and 2007 (-1.7% a year). This is an encouraging trend. However, the unit costs reduction significantly decelerated in 2007 despite even higher traffic growth than in previous years. This is due to an increase of ATM/CNS provision costs in 2007 (+4.8%) much larger than in previous years, and to the rise of ATFM delays unit costs (+7.1%).
- 8.6.12 Figure 109 shows that economic costs per composite flight-hour have increased since 2003 in 13 ANSPs. The largest increases have been in DCAC Cyprus (+94%) and Avinor (+25%). For these two ANSPs, the rise in unit economic costs is mainly due to a significant increase of ATFM delays. In several ANSPs, unit economic costs significantly decreased as a result of improved quality of service and/or greater financial cost-effectiveness. The largest decreases have been observed for ROMATSA (-41%), LGS (-39%), ATSA Bulgaria (-37%), DHMI (-38%), EANS (-34%), MK CAA (-33%) and Oro Navigacija (-31%).
- 8.6.13 The decrease in unit economic costs in four of the five largest ANSPs (DFS (-16%), DSNA (-10%), ENAV (-10%) and NATS (-8%)) significantly contributed to the fall observed at European system level. On the other hand, for Aena the combination of a rise in ATM/CNS provision costs and a rise in ATFM delays led to a significant increase in unit economic costs (+19%) between 2003 and 2007.

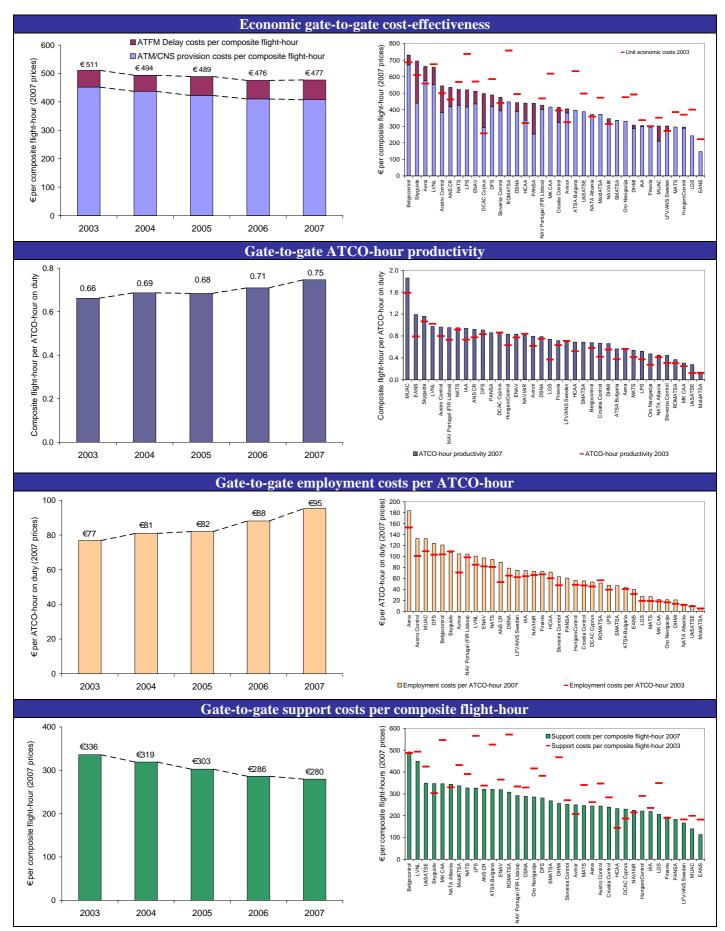


Figure 109: ATM/CNS cost-effectiveness comparisons (2003-2007)

- 8.6.14 The financial cost-effectiveness indicator can be broken down into three main key economic drivers: (1) ATCO-hour productivity, (2) employment costs per ATCO-hour and (3) support costs per composite flight-hour. Figure 110 shows how the various components contributed to the overall improvement in cost–effectiveness (-8.8% decrease in unit costs) between 2003 and 2007.
- 8.6.15 The increase in ATCO employment costs (+24.1%) was not compensated by the increase in ATCO-hour productivity (+12.8%), thereby resulting in increased ATCO employment costs per composite flight-hour (+10.0%). Figure 110 also indicates that support costs remained fairly constant (+0.6%) while traffic volumes significantly increased (+20.8%), resulting in an appreciable decrease of the support costs per composite flight-hour (-16.7%). The central part of Figure 110 shows that between 2003 and 2007, given the respective weights of ATCO costs (31%) and support costs (69%), the overall unit costs decreased by-9.9%.

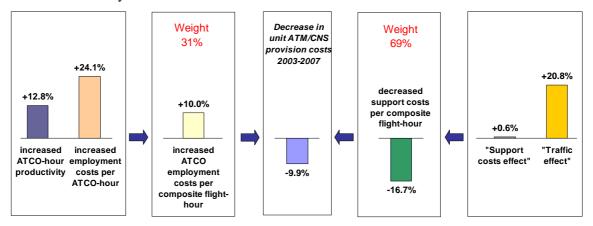


Figure 110: Breakdown of changes in cost-effectiveness, 2003-2007 (real terms)

# GATE-TO-GATE ATCO-HOUR PRODUCTIVITY<sup>81</sup>

- 8.6.16 Between 2003 and 2007, ATCO-hour productivity rose for 28 of the 33 ANSPs reporting consistently over the period. The +12.8% productivity increase at European system level was to some extent the result of convergence, with most of the greatest improvements occurring in those ANSPs that started with a low base in 2003 (right-hand side of Figure 109). Strong productivity increases were achieved by small Central and Eastern Europe ANSPs benefiting from high traffic growth and more effective use of spare capacity and existing resources.
- 8.6.17 However, significant improvements in productivity were also achieved by some ANSPs which started from a higher base in 2003. This is particularly the case of Austro Control (+21%), MUAC (+17%), ANS CR (+19%) and EANS (+51%).
- 8.6.18 Raising the European average productivity (0.75) to the level achieved by ANSPs operating in a complex environment (see Chapter 2), i.e. some 20% improvement in productivity, would bring significant gains in cost-effectiveness. In the context of staff planning processes and contract renegotiation, it is important for ANSPs to monitor this indicator and to set quantitative objectives in terms of ATCO productivity.
- 8.6.19 However, achieving large improvements in ATCO-hour productivity could have an impact on the other components of cost-effectiveness (for example, if more sophisticated tools and technical solutions were required, support costs might rise). Similarly,

<sup>81</sup> The measure of productivity is based on the number of hours on duty, rather than the number of hours on control position, which is significantly less due to breaks and OPS room management practices. Any over-estimation of the number of hours on duty leads to an under-estimation of the ATCO-hour productivity and of the employment costs per ATCO-hour, while the ATCO employment costs per unit of output remain constant.

improvement in ATCO-hour productivity should not be achieved at the expense of the quality of service provided.

# GATE-TO-GATE EMPLOYMENT COSTS PER ATCO-HOUR

- 8.6.20 Figure 109 shows that at European system level, gate-to-gate employment costs per ATCO-hour increased from €77 to €95 (+24.1%). Most of the increases in ATCO employment costs per ATCO-hour are observed for ANSPs starting from a low base in 2003. Since their accession to the EU, several Eastern European economies are facing increasing upwards pressure on salaries, which impacts on ATM.
- 8.6.21 Given the labour intensity of ANS, employment costs need to be effectively managed to ensure future cost-effectiveness improvements. Employment costs are typically subject to complex bargaining agreements between management and staff which usually are embedded into collective agreements. The duration of the agreement, the terms and methods for renegotiation greatly vary across ANSPs. In many cases, salary conditions are negotiated every year. Several increases in employment costs are associated with the implementation of new collective agreements and/or unplanned expensive salary renegotiations.
- 8.6.22 In addition, a significant impact on unit employment costs has arisen because of pensions. In recent years there has been a growing recognition that the costs of providing relatively generous pensions schemes are substantially higher than expected. This arises from a number of factors, including increased life expectancy, strong increases in wages and salaries, and historically inadequate contributions. Furthermore, the SES requirement for ANSPs to adopt IAS has required transparent accounting and reporting for these costs. ANSPs have taken a variety of approaches to deal with this, including increased contributions and one-off payments. However, it appears unavoidable that some costs which were not previously recognised must be recognised today, and that this problem might grow unless actions are taken to deal with future pension obligations.

# GATE-TO-GATE SUPPORT COSTS PER COMPOSITE FLIGHT-HOUR

- 8.6.23 Figure 110 shows that the -9.9% decrease of unit ATM/CNS provision costs is mainly due to a decrease in unit support costs (-16.7%). The right-hand-side of Figure 110 indicates that the -16.7% reduction in support costs per composite flight-hour is mainly due to the fact that between 2003 and 2007, support costs remained fairly constant (+0.6%) while traffic volumes significantly increased (+20.8%). This is an important finding which is consistent with the expectations that support costs are mostly fixed costs which should not vary proportionally with traffic volumes.
- 8.6.24 Figure 109 also displays the changes in unit support costs for each ANSP between 2003 and 2007. Unit support costs decreased for 26 ANSPs but increased for seven ANSPs (in particular DCAC Cyprus (+23%) and Avinor (+20%)).

- 8.6.25 Between 2003 and 2007, unit support costs decreased for all the five largest ANSPs, but more particularly in DFS (-27%) and NATS (-16%).
- 8.6.26 These ANSPs were all able to reduce "support" staff employment costs per composite flight-hour, the largest component of support costs. Significant reductions in support staff were achieved by ENAV, DFS and DSNA, as illustrated in Figure 111.

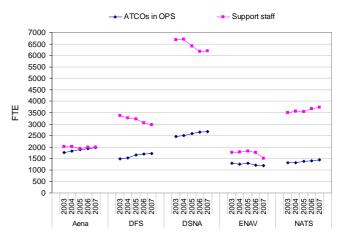


Figure 111: Changes in ATCOs in OPS and support staff for the five largest ANSPs (2007)

# 8.7 Conclusions

- 8.7.1 At European system level, the real en-route unit cost decreased from 0.87 €km to 0.76 €km between 2003 and 2007, i.e. a reduction of -3.4% per annum:
  - The combination of favourable traffic increase (+26%) and tighter cost management allowed a majority of States to improve their cost-effectiveness performance;
  - This improvement is in line with the PRC's notional target (-3% per annum over 2003-2008). Had there not been significant cost increases in some States/ANSPs (e.g. Spain) during the period, the improvement at European system level would have been even better.
- 8.7.2 2008 marks the end of a positive business cycle which started in 2003. Traffic growth will be significantly lower in 2009 and possibly some time beyond. The economic downturn requires ANSPs to review their plans to ensure that they are consistent with more straitened economic circumstances. ANSPs cannot stand aside and it will be important that they continue, and enhance, the quest for efficiency.
- 8.7.3 In contrast, in a majority of ANSPs/States, projections indicate that the en-route cost-base is planned to significantly increase in 2009 despite a slowdown in traffic. This implies that the PC objective (-6% over 2008-2010) will not be met notwithstanding States/ANSPs commitment in Nov 2007. Latest Member States projections indicate that en-route real unit costs are expected to decrease by -2.2% between 2008 and 2010, or even increase if traffic is lower than forecasted in 2009 and 2010.
- 8.7.4 It will also be important that the breathing space provided by weaker demand is used to build a stronger platform for the eventual resumption of traffic growth, so that there is a better match between capacity and demand and a better ongoing cost-effectiveness performance. There is still room for cost-effectiveness and productivity improvement based on benchmarking analysis. Initiatives like FABs and SESAR should contribute to rationalize investments and optimise the use of resources.
- 8.7.5 ANSPs management together with staff unions have a collective responsibility to address this challenge and to work together to implement measures that allow short and medium term flexibility in controlling costs.
- 8.7.6 En-route MET costs (5% of total en-route ANS costs) decreased by -9% in real terms between 2003 and 2007. This is a significant contribution to the en-route ANS cost-effectiveness improvement.

- 8.7.7 In 2007, the total cost-base for the EUROCONTROL Agency (8% of total en-route ANS costs) decreased by -1% in real terms. This is the first time on record that the EUROCONTROL cost-base decreases. Further decreases are expected as part of the EUROCONTROL Agency cost-effectiveness objective until 2012. Given the increasingly straitened economic environment, it is important that the EUROCONTROL Agency commits to the planned cost-base decrease.
- 8.7.8 Setting of binding Community performance targets (SES II) would represent a significant step towards driving further performance improvements in ANS. These targets should be combined with the setting of unit rates in advance for a period of three to five years so as to provide an effective incentive to meet local objectives and improve cost predictability.

# PART III: Trade-offs and Overall Assessment

# **Chapter 9: Environmental Assessment**

## KEY MESSAGES OF THIS CHAPTER

- Sustainable development and global emissions are on the top of the political agenda. Aviation and in particular ANS make significant efforts to reduce their impact on environment, notwithstanding their relatively small overall contribution to global emissions (0.2% of all CO<sub>2</sub> emissions). Bearing in mind the overriding need to maintain safety, only part of these emissions could be saved.
- Improvements in emissions are directly linked with improvements in flight efficiency.
- Long-haul flights (>3 hours), for which there is virtually no substitute, account for 13% of flights, but 60% of fuel burn.
- The implementation of noise abatement procedures may have significant trade-offs, e.g. reduced capacity or increased emissions.

# 9.1 Introduction

- 9.1.1 Sustainable development of aviation is an important objective. As such, ANS tries to reduce its environmental footprint. This chapter focuses on greenhouse gases emissions, in particular CO<sub>2</sub>, local air quality (LAQ) and noise at and around airports. Improvements in emissions are directly linked with improvements in flight efficiency.
- 9.1.2 Improvements in CO<sub>2</sub> emissions are directly linked with improvements in flight efficiency. There is therefore no specific target for environmental impact and action plans addressing flight efficiency also address emissions.

# 9.2 International context

- 9.2.1 The top international level for climate change is the United Nations Framework Convention on Climate Change (UNFCCC). Negotiations between the international partners, that began in Bali in 2007, are set to be finalised in 2009 at the 15<sup>th</sup> Conference of the Parties (COP15) in Copenhagen.
- 9.2.2 Stemming down from this, targets and actions are expected to be set that would include aviation activities. The International Civil Aviation Organisation (ICAO) through its Committee for Aviation Environmental Protection (CAEP) is addressing the specific issues on aviation and environment.
- 9.2.3 At the September 2007 ICAO Assembly all Contracting States agreed on a comprehensive plan of action comprising four major elements:
  - the regular assessment of the impact of aviation on the environment and the continued development of tools for this purpose;
  - the vigorous development of policy options to limit or reduce the environmental impact of aircraft engine emissions and the provision of advice as soon as possible to the COP on technical solutions and market-based measures;
  - the continued development and updating, through CAEP, of standards and guidance for Contracting States, on the application of measures aimed at reducing or limiting the environmental impact of engine emissions; and
  - the formation of a new group to develop a Programme of Action on International Aviation and Climate Change. This high-level group, known as GIACC, is composed of senior government officials representative of all ICAO regions, with equitable participation of developing and developed States. GIACC held its first meeting in February 2008 in Montreal. In all, four meetings are planned, following which the Council of ICAO will convene a high level meeting.

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- 9.2.4 The GIACC has to establish goals for international aviation for the short term (2012); medium term (2020) and longer term (2050). Currently, there is no global agreement on the approach to take but CAEP working arrangements are developing technology and operational environmental goals for approval by CAEP/8.
- 9.2.5 ICAO aims at reaching an agreement in 2009 since the UNFCCC will decide on the post-Kyoto/post-2012 targets including international aviation contribution (global agreement at States/all sectors level to be reached in Copenhagen in December 2009 / COP15).
- 9.2.6 Within the EU, the Directive 2003/87/EC [Ref. 32] has been amended<sup>82</sup> by Directive 2008/101/EC to include civil aviation activities in the Community greenhouse gas emissions trading scheme (EU/ETS) from 2012. This text calls for international aviation to contribute to efforts to combat climate change. It will cover all flights to or from EU airports and has EEA<sup>83</sup> relevance
- 9.2.7 Currently the EU/ETS covers large installations in certain industrial sectors (including power generation, refining, iron and steel, cement, glass, lime, bricks, ceramics, pulp and paper) and also all combustion activities with a rated thermal input exceeding 20MW, but does not cover households, agriculture or transport.
- 9.2.8 ETS currently covers 11500 point emitters and 2 Billion tonnes of CO<sub>2</sub> per year, representing roughly half of total European CO<sub>2</sub> emissions. Aviation emissions covered by the new directive represents circa 240 M tonnes of CO<sub>2</sub>, of which approximately half is within the European airspace.

# Key features EU Emissions Trading Scheme (ETS) for aviation

- All flights arriving or departing from an EU airport will be covered by the EU ETS from 2012. A flight is within the scope of this scheme entirely if it has at least one end within the area covered by the Directive.
- → Emissions allowances distributed to aviation will be capped at 97% of their average 2004-2006 level for year 2012. This will decrease to 95% from 2013, (this may be reviewed as part of the general review of the ETS Directive).
- → Airlines will receive 85% of their emission allowances for free in 2012 (i.e. 15% will be auctioned).
- Commercial air operators with very low traffic levels on routes to, from or within the EU or with low annual emissions (less than 10 000 tonnes CO2 a year) are exempted. This could include among others, many operators from developing countries.
- A special reserve of free allowances has been added for new entrants or very fast-growing airlines. The reserve does not increase the overall cap on allowances and therefore does not affect the environmental impact of the system. Airlines that are growing will be able to benefit from the reserve up to a limit of one million tonnes.
- → Consistent and robust enforcement is to be assured throughout the EU. An operator could be ultimately banned from operating in the EU if it persistently fails to comply with the system and other measures prove ineffective.
- 9.2.9 By virtue of the EU/ETS, operators can trade permits so that emissions reductions can be made where they are most cost-effective. The contribution of aviation to the scheme will not necessarily translate directly into reduction of aviation emissions. It is likely that aviation will be a net buyer in the EU/ETS therefore contributing to the reduction of emissions in other sectors.
- 9.2.10 The European Commission committed itself to study aviation NOx emissions (additional impact of aviation beyond CO<sub>2</sub> covered by the EU ETS): the Commission committed to launch a legislative proposal on NOx but is not yet clear on the way to take. Science

<sup>82</sup> Directive 2008/101/EC of 19 Nov 2008, which amends Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community.

<sup>83</sup> EU27 + Iceland, Norway, and Lichtenstein

remains uncertain and scientists request 3 to 5 years before any meaningful conclusion can be reached on NOx (trade-off with CO<sub>2</sub>).

# 9.3 Aviation contribution to greenhouse gases

9.3.1 Transport is one of the major contributors to GHG emissions (29% of all emissions). Figure 112 shows the range of emissions<sup>84</sup> in grams per passenger-kilometre. In terms of specific consumption aviation is very similar to most other modes, if not more efficient. Considering alternative modes of transport, long haul air travel has virtually no substitute, while the efficiency of short haul flights is comparable to that of high-speed trains and better than most cars (the usual substitutes).

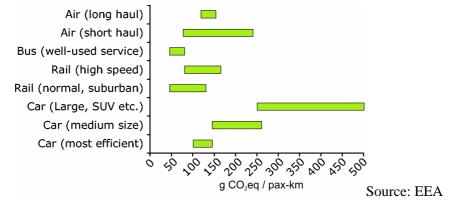
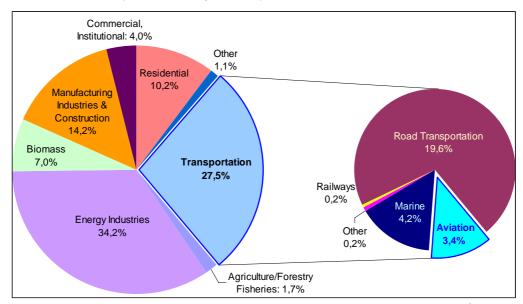


Figure 112: GHG across different modes of transport

9.3.2 While transport is clearly one of the major contributors to GHG, road transport is by far the biggest contributor within the transport sector (see Figure 113). In contrast, aviation contributes 3.4% of anthropogenic (man-made) CO<sub>2</sub> emissions in Europe<sup>85</sup>. Greenhouse gas emissions decreased in all sectors between 1990 and 2006, except for the transport sector, where they increased significantly.



Data source: EEA, reference year 2006

Figure 113: Contribution of CO<sub>2</sub> emissions by sector (EU27 area)

Air, bus and rail assume realistic load factors whereas car assumes one person per car. If more people use the car, the emissions per person will be proportionally lower. Also the real distance travelled must be taken into account, for example planes fly in a more direct line.

<sup>85</sup> Source: European Environment Agency.

- 9.3.3 As indicated in Figure 118, ANS actionable CO<sub>2</sub> emissions are approximately 6.6% of aviation emissions, and therefore 0.2% of all CO<sub>2</sub> emissions in Europe.
- 9.3.4 International transport is not covered by the Kyoto protocol. Thus, within the reporting framework of the Kyoto protocol, States do not normally include emissions from international air and maritime transport, although domestic transport is included.
- 9.3.5 Aviation and ATM have developed objectives on emissions reduction with the aim of achieving sustainable development. Relevant objectives are summarised in Figure 114.

# **Planned reductions**

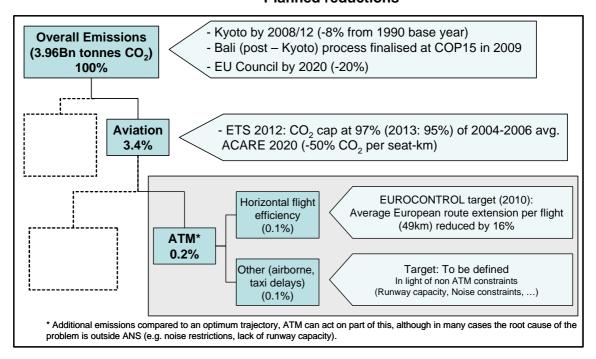


Figure 114: Emissions and reduction targets (EU27 area, 2006 reference year)

9.3.6 Long haul flights (>3 hours) represent 13% of all flights, but account for 60% of fuel burn, as shown in Figure 115. This figure shows that most emissions originate from flights for which there is no alternative mode of transport. It also shows that flights under 1 hour represent 3% of the total fuel burn (i.e. a figure equivalent to the reduction imposed by the EU/ETS regulation for 2012).

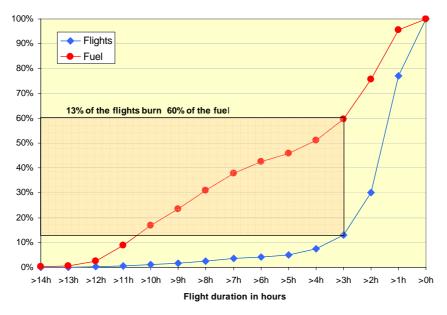


Figure 115: Distribution of flights and fuel burn by duration of the flight

# 9.4 ATM contribution to reducing green house gas emissions

- 9.4.1 The ANS-attributable environmental impact is closely related to flight-efficiency and fuel burn. Given the significant contribution of fuel in airlines' operating costs (see section 2.5), airspace users have an increasing interest in reducing fuel burn and hence emissions.
- 9.4.2 This section focuses on CO<sub>2</sub> emissions in the EUROCONTROL area. This covers intra European flights as well as the part of intercontinental flights flown within the European airspace and represents 138 million tons in 2008.
- 9.4.3 However, the EU/ETS<sup>86</sup> has a different scope: it applies to a smaller area but considers the full length of the flight, as explained earlier in this chapter. This is illustrated in Figure 116.

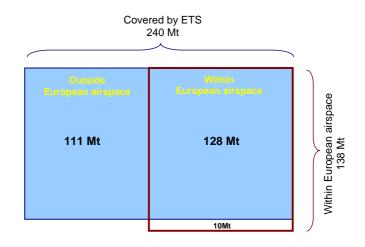


Figure 116: Aviation emissions in ETS

The EU/ETS covers all flights within and from/to the EEA. While the oceanic part of the flights is not covered by this report, it is the subject of other initiatives such as the AIRE initiative between the European Commission and the FAA.

|                                      |                               | Intercontine<br>From/To        | TOTAL             |                                |
|--------------------------------------|-------------------------------|--------------------------------|-------------------|--------------------------------|
|                                      | Intra-<br>European<br>Flights | Within<br>European<br>airspace | Outside<br>Europe | Within<br>European<br>airspace |
|                                      | a                             | b                              |                   | a+b                            |
| Number of flights                    | 8.3 M                         | 1.8                            | M                 | 10.1 M                         |
| Average number of seats              | 124                           | 214                            |                   | 150                            |
| Average Max. Take Off Weight         | 62 t                          | 210                            | 6 t               | 107 t                          |
| Average Distance flown               | 900 km                        | 1 680 km                       | 3 070 km          | 1 032 km                       |
| Average flight time                  | 80 min                        | 124 min                        | 207 min           | 88 min                         |
| Fuel per flight (including taxi)     | 3.1 t                         | 10.0 t                         | 21.2 t            | 4.4 t                          |
| Total Fuel                           | 25 Mt                         | 19 Mt                          | 39 Mt             | 44 Mt                          |
| CO <sub>2</sub> (3.15kg/ kg of fuel) | 80 Mt                         | 59 Mt                          | 122 Mt            | 138 Mt                         |
| %                                    | 58%                           | 42%                            |                   | 100%                           |

Figure 117: Aviation emissions within European airspace in 2008

9.4.4 Figure 118 brings together the different contributions to flight efficiency. Horizontal flight path is addressed in Chapter 5, airborne and taxi delays in Chapter 6. A first estimate of vertical flight efficiency was published last year [Ref. 33], which tends to indicate that this is of lower magnitude.

|   | Fuel/flight             | Fuel Total | CO <sub>2</sub> total | %      |
|---|-------------------------|------------|-----------------------|--------|
| Aviation emissions within the European airspace | 4.4 t                   | 44Mt       | 138 Mt                |        |
| Actionable by ATM                               |                         |            |                       |        |
| Horizontal flight path                          | 162 kg                  | 1.6Mt      | 5.2 Mt                | 3.7%87 |
| Vertical Flight profile                         | 25 kg                   | 0.3Mt      | 0.8 Mt                | 0.6%   |
| Airborne delays                                 | 57 kg ( <sup>88</sup> ) | 0.6Mt      | 1.8 Mt                | 1.3%   |
| Taxi delays                                     | 34 kg ( <sup>89</sup> ) | 0.3Mt      | 1.1 Mt                | 0.8%   |
| Total flight efficiency                         | 278 kg                  | 2.8Mt      | 8.9 Mt                | 6.4%   |



Figure 118: Share of aviation emissions actionable by ATM in 2008

- 9.4.5 In performing the above calculations, consideration was also given to the carriage by aircraft of extra fuel (i.e. additional weight). However, this issue seems to be only marginal for intra-European flights, but may become more important for intercontinental flights.
- 9.4.6 EUROCONTROL, IATA and CANSO have launched a Flight-Efficiency Plan addressing en-route, terminal areas and taxiing in European airspace [Ref. 34]. If implemented in full, it should save 1.6 Mt of CO<sub>2</sub> per annum in the short term. This represents a reduction by 17% of the total part of emissions ATM can act upon. It is an ambitious plan although it does not specify a clear deadline by which those benefits shall be delivered.

<sup>87 3.6%</sup> of fuel burn for the entire flight is equivalent to 5.6% of fuel burn for the en route phase, see Figure 58.

<sup>68</sup> kg per flight is equivalent to 76 kg per European departure, as not all flights take-off from Europe.

<sup>89 37</sup> kg per European departure.

|    |  | CO <sub>2</sub> reduction expected |      |              |  |
|----|--|------------------------------------|------|--------------|--|
| Nr | ACTION   | tonnes                             | Plan | total<br>ATM |  |
| 1  | Enhancing European en-route airspace design 0.1% reduction in flight distance                            | 0.08Mt                             | 5%   | 1%           |  |
| 2  | Improving airspace utilisation and route network availability 0.7% reduction in flight distance          | 0.6Mt                              | 39%  | 7%           |  |
| 3  | Efficient TMAs design and utilisation  Continuous descent approach (CDA) at 20% of the European airports | 0.4Mt                              | 26%  | 4%           |  |
| 4  | Optimising airport operations:  1 minute reduction of taxi time at 50 airports                           | 0.48Mt                             | 31%  | 5%           |  |
|    | Expected reduction in CO <sub>2</sub> emissions per year   | 1.56Mt                             | 100% | 17%          |  |

Figure 119: Expected benefits from the Flight Efficiency Plan

- 9.4.7 Comparing in detail the benefits expected from this plan (Figure 119) and the figures shown in Figure 118 the following comments can be made:
  - the benefits expected from improvements in en-route design (action 1) appear to be very modest. In fact, most of them have already been realised in 2008. Further progress could be achieved through additional airspace design improvements and FABs:
  - most of the expected benefits related to en-route flight efficiency come from the route utilisation (action 2). To realise the expected benefits, all flights should use the shortest available route:
  - benefits expected from action 3 and action 4 represent 50% of the absolute maximum presented in Figure 118 concerning respectively the Vertical flight profile and the Taxi delays.
- 9.4.8 No action target was specifically defined for airborne delays. CDA (action 3) might contribute to reducing airborne delays. However, focus should move from improving a single flight trajectory to improving the system as a whole. More specifically there are two ways by which ATM can reduce airborne delays: (1) making best use of available capacity and (2) reducing the amount of emissions by moving part of the airborne delays in other phases of the flight (slowing down flights en-route, or delaying departures at the gate).

# 9.5 Local Air Quality

- 9.5.1 Local air quality concerns emissions such as Carbon monoxide (CO), Nitrogen oxides (NOx), as well as particulate matters (PM) at and around airports.
- 9.5.2 Internationally, ICAO has identified the 'Landing and Take-Off' Cycle (LTO Cycle) as the sequence of aircraft operations that is of most significance for air quality (e.g. aircraft operations <3,000ft). In practice, and depending on meteorology, emissions above 1,000ft often play no part in local air quality. Importantly, aircraft operations account for only part of an airport's air quality relevant emissions, with land-side ground transport often being a major source.

- 9.5.3 Within the EU, air quality has been covered by legislation<sup>90</sup> for a number of years. Standards were set for concentrations of a number of pollutants, as well as reporting practices. This legislation is being periodically updated.
- 9.5.4 Directive 2008/50/EC [Ref. 35] on ambient air quality and cleaner air for Europe came into force on 11th June 2008. This Directive merges the four existing Directives and one Council Decision into a single Directive on air quality. It sets new standards and target dates for reducing concentrations of fine particles (PM2.5), which together with coarser particles known as PM10 already subject to legislation, are among the most dangerous pollutants for human health.
- 9.5.5 Under the Directive, Member States are required to reduce exposure to PM2.5 in urban areas by an average of 20% by 2020 based on 2010 levels. It obliges them to bring exposure levels below 20  $\mu$ g/m³ by 2015 in these areas. Throughout their territory Member States will need to respect the PM2.5 limit value set at 25  $\mu$ g/m³. This value must be achieved by 2015 or, where possible, already by 2010. It should be noted that the proportion of particulates in engine exhaust typically increases as thrust reduces.
- 9.5.6 NOx emitted by aero engines is a critical pollutant for ATM. At and around airports, especially when close to a major city or motorway, NOx is often the principal aircraft emission of concern as it may offer a greater risk of limit breach (e.g. NOx is one of the critical issues for the Heathrow third runway debate, given Heathrow's proximity to a major motorway). It should be noted that the NOx proportion in engine exhaust typically increases with thrust.
- 9.5.7 All these new standards and deadlines are likely to impose new constraints on airports, which are responsible, among others, for maintaining the local air quality. Generally, any initiatives that can reduce fuel use below 3,000ft (and especially below 1,000ft) can be considered to be beneficial from an air quality standpoint (e.g. CDM to reduce taxi times and airfield congestion, engine out taxiing etc).

# 9.6 Noise

- 9.6.1 Directive 2002/30/EC [Ref. 36] establishes rules and procedures with regard to the introduction of noise-related operating restrictions. It does so in the framework of a "balanced approach" to noise management which implements and develops further at Community level the ICAO guidance<sup>91</sup> on noise management.
- 9.6.2 In parallel, Directive 2002/49/EC relating to the assessment and management of environmental noise [Ref. 37] requires competent authorities to draw up action plans to address noise issues around inter alia the major European airports across the Union. These action plans must be based on strategic noise maps established using common indicators, but their content (i.e. the measures to address noise) is left to the discretion of the competent authorities. In particular, although this Directive defines the notion of limit value for noise, it does not require authorities to set any such limits.
- 9.6.3 The three main objectives of this directive are:
  - to determine the noise exposure of the population through noise mapping;
  - to make information on environmental noise available to the public, and;

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<sup>90</sup> Framework Directive 96/62/EC, 1-3 daughter Directives 1999/30/EC, 2000/69/EC, 2002/3/EC, and Decision on Exchange of Information 97/101/EC.

Assembly Resolution A35/5 "Consolidated statement of continuing ICAO policies and practices" (in particular Appendices C "Policies and programmes based on a balanced approach to aircraft noise management" and E "local noise-related operating restrictions at airports").

- to establish action plans based on the mapping results, to reduce noise levels where necessary, and to preserve environmental noise quality where it is good.
- 9.6.4 Exposure of population to aircraft noise around the top 50 European airports (in terms of population affected) was listed in Annex VII, page 105 of PRR 2007 [Ref. 17].
- 9.6.5 A study commissioned in 2007 by the European Commission [Ref. 38] surveyed three-quarters of the 70 airports in the EU and Switzerland within the scope of this Directive<sup>92</sup>.
- 9.6.6 According to this study, more than half of the surveyed airports use differentiated charges to restrict the use of noisy aircraft (see Figure 120).

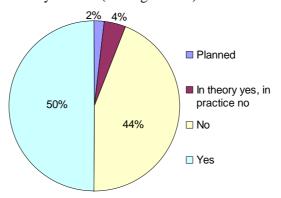


Figure 120: Noise-differentiated charges at European airports

9.6.7 ATM measures to manage noise exposure at and around airports include airspace procedures and design, runway configuration and operation mode, improved navigational standards and controller tools. In general, any initiative that reduces engine run time on the ground can help to mitigate ground noise (e.g. CDM). For noise further out, which is becoming increasingly important, ATM measures such as airspace design and AMAN can mitigate noise impact.

# 9.7 Trade-offs

9.7.1 Establishing environmental restrictions at airports would most likely lead to capacity constraints at that airport. The study mentioned above investigated this subject and it shows that more than half of the surveyed airports already have or are likely to have some sort of capacity limitation due to environmental restrictions (see Figure 121).

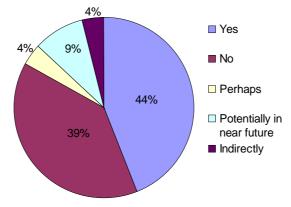


Figure 121: Percentage of airports with capacity constraints due to noise

<sup>50000</sup> jet movements per annum (Civil subsonic jet aeroplanes with a maximum certificated take-off mass of 34000 kg or more, or with a certified maximum internal accommodation of more than 19 passenger seats).

- 9.7.2 Environmental restrictions may also influence each other, e.g. affecting the flight path to minimise noise exposure on the ground would most likely lead to reduced flight efficiency and thus increased emissions.
- 9.7.3 Noise can also affect ATM. For example, lengthy legal and consultation processes triggered where noise impact is changed can delay much needed airspace improvements around airports.

# 9.8 Conclusions

- 9.8.1 Aviation's total contribution to  $CO_2$  emissions in the EU, including international aviation, is 3.4%. The ultimate improvement that could ideally be achieved in the absence of any ATM constraint (such as safety, capacity etc.) is a reduction of 0.2% of all  $CO_2$  emissions in the EU.
- 9.8.2 Directive 2008/101/EC regarding the EU emissions trading scheme has been adopted. It includes international aviation as of 2012. All flights arriving and/or departing from an EU/EEA airport will be covered for their entire length. The emissions covered by this Directive represent circa 240Mt CO<sub>2</sub> a year.
- 9.8.3 If the EUROCONTROL flight efficiency target were met, there would be clear environmental benefits related to en-route emissions. Thus far, this target has not been met.
- 9.8.4 Long-haul flights (>3 hours) account for 13% of flights, but 60% of fuel burn.
- 9.8.5 It would appear that at least half of the airports covered by the Noise Directive see their capacity affected by environmental (noise) restrictions. Furthermore, environmental restrictions may influence each other, i.e. affecting the flight path to minimise noise exposure on the ground would likely lead to reduced flight efficiency and thus increased emissions. Therefore, care must be taken and priorities clearly set before imposing such restrictions.

# **Chapter 10: Economic Assessment**

# 10.1 Introduction

- 10.1.1 This chapter brings together performance assessments in Part 2 and presents a high level economic assessment of Key Performance Areas (KPA) other than Safety and Security.
- 10.1.2 Apart from Safety and Security, which must satisfy minimum agreed levels, performance in other KPAs (Delays, Flight-Efficiency, Cost-Effectiveness) can be expressed in monetary terms as ANS economic cost. This consists of direct costs (route and terminal charges) and indirect costs (delays, non-optimum flight profiles).
- 10.1.3 In Europe<sup>93</sup>, ANS economic costs are fully borne by users, and typically amount to 5-10% of their operating costs. Transport ministers adopted an economic objective "to reduce the direct and indirect ATM-related costs per unit of aircraft operations" (ATM 2000+ Strategy [Ref. 13] which remains very relevant today.
- 10.1.4 This corresponds to the "Total ANS user costs" box in the high level draft air-side performance influence diagram presented in the next chapter. It feeds directly into the Competitiveness objective of the European Union. The top part of this diagram is reproduced in Figure 122 for ease of reference.

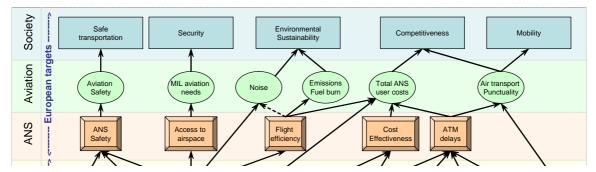


Figure 122: Air-side performance influence diagram - European perspective

10.1.5 This chapter focuses on en-route performance. Further work is needed to fully measure and assess the economic impact at and around airports. Emerging findings from Chapter 6 indicate that these are potentially significant.

# 10.2 Estimated economic costs related to en-route performance

- 10.2.1 Direct costs for the provision of capacity (user charges) and indirect costs for ATM related delay or flight inefficiencies are ultimately borne by airspace users in Europe. This section aims at estimating the costs related to ATFM delays and route extension. The total economic cost borne by airspace users for en-route is addressed in next section.
- 10.2.2 Costs incurred by airspace users due to en-route related ATFM delays (applied at the departure airport) or non-optimum flight efficiency en-route arise from extra time and additional fuel burn. Inevitably there are margins of uncertainty in those cost estimates, which should therefore be handled with caution.

# ESTIMATED EN-ROUTE ATFM DELAY COSTS

10.2.3 Long ATFM delays cause more disruption in aircraft operations and may lead to passenger compensation under EU law. Delay costs borne by airspace users increase much faster than delay length. Average costs of "tactical" delay on the ground (engine off) are approximated to be close to zero for the first 15 minutes and €79 per minute, on

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<sup>93</sup> In the US, users do not pay directly for the service, which may bias their interests towards quality of service.

average, for ground delays longer than 15 minutes (€2007 prices). These user costs mainly arise from crew costs, passenger compensation and the value of passenger loyalty<sup>94</sup> [Ref 39].

10.2.4 Figure 123 shows an approximation of "tactical" costs incurred by airspace users due to ATFM delays and associated reactionary delays.

| Year | Total ATFM delays (min.) | ATF      | /I Delays > 15 m | inutes | Estimated cost of ATFM delays (Euro - 2007 Prices) |         |          |  |
|------|--------------------------|----------|------------------|--------|--|---------|----------|--|
|      |                          | En-route | Airport          | Total  | En-route   | Airport | Total    |  |
| 2001 | 27.6 M                   | 16.2 M   | 5.7 M            | 21.9 M | €1 300 M   | €450 M  | €1 750 M |  |
| 2002 | 18.0 M                   | 9.0 M    | 4.9 M            | 13.9 M | €700 M   | €400 M  | €1 100 M |  |
| 2003 | 14.8 M                   | 5.7 M    | 5.5 M            | 11.2 M | €450 M   | €450 M  | €900 M   |  |
| 2004 | 14.9 M                   | 5.3 M    | 5.9 M            | 11.3 M | €400 M   | €450 M  | €850 M   |  |
| 2005 | 17.6 M                   | 6.6 M    | 7.1 M            | 13.6 M | €500 M   | €550 M  | €1 050 M |  |
| 2006 | 18.4 M                   | 7.7 M    | 6.7 M            | 14.4 M | €600 M   | €550 M  | €1 150 M |  |
| 2007 | 21.5 M                   | 9.2 M    | 7.7 M            | 16.9 M | €750 M   | €600 M  | €1 350 M |  |
| 2008 | 23.8 M                   | 11.2 M   | 7.6 M            | 18.9 M | €900 M   | €600 M  | €1 500 M |  |

source: EUROCONTROL

Figure 123: Estimated costs of ATFM en-route delay

# ESTIMATED COSTS DUE TO ROUTE EXTENSION

- 10.2.5 When costs of delays and flight inefficiencies are estimated, it is important to recall that these costs represent the difference between the observed situation and an ideal (but unachievable) situation where each aircraft would be alone in the system and not be subject to any constraint.
- 10.2.6 Figure 124 provides estimates of costs related to route extension, including both the costs of extra fuel burnt and additional flight time. The methodology for measuring flight efficiency has been developed in 2004 and hence data are not available before 2004.
- 10.2.7 In the case of route extension, the additional time is predictable in most cases and normally reflected in scheduled flight times. The "strategic" cost buffer included in airline schedules is estimated at €40 per minute (€2007 prices) on average for a flight in Europe to which should be added the cost of fuel [Ref 39].

|      | DISTANCE                     |                                   | ŗ                            | ГІМЕ                        | FU                             | EL  |                               |  |
|------|------------------------------|-----------------------------------|------------------------------|-----------------------------|--------------------------------|---|-------------------------------|--|
| Year | Total extra distance<br>(km) | Extra distance per flight<br>(km) | Extra time per flight (min.) | Cost of time (€2007 prices) | Extra fuel<br>per flight (kg.) | Costs of total extra fuel<br>(€2007 prices) | Total costs<br>(€2007 prices) |  |
| 2004 | 435 M km                     | 50.2                              | 4 min                        | €1 350 M                    | 174 kg                         | €550 M                                      | €1 900 M                      |  |
| 2005 | 427 M km                     | 48.7                              | 4 min                        | €1 300 M                    | 162 kg                         | €750 M                                      | €2 050 M                      |  |
| 2006 | 440 M km                     | 48.2                              | 4 min                        | €1 350 M                    | 160 kg                         | €850 M                                      | €2 200 M                      |  |
| 2007 | 470 M km                     | 48.9                              | 4 min                        | €1 450 M                    | 162 kg                         | €900 M                                      | €2 350 M                      |  |
| 2008 | 473 M km                     | 48.8                              | 4 min                        | €1 450 M                    | 162 kg                         | €1 150 M                                    | €2 600 M                      |  |

Figure 124: Estimated costs of sub-optimal horizontal flight efficiency

<sup>94</sup> This estimate includes direct costs, the network effect (i.e. the costs of reactionary delays that are generated by primary delays) and the cost to airlines for passengers changing to competitors (these costs represent an estimate of the value an airline places on passenger loyalty in order to avoid the loss of future earnings). The cost of time lost by passenger is partly reflected.

# 10.3 Total economic En-route costs

- 10.3.1 Total ANS user costs related to en-route can be estimated<sup>95</sup> as the sum of route charges (see section 8.2) and costs due to ATFM en-route delays and route extension (see section 10.2 above). Costs related to the airports and TMA would need to be assessed separately.
- 10.3.2 The Key Performance Indicator (KPI) for ANS economic cost is the real unit economic cost, i.e. the deflated ANS cost per km. Figure 125 shows the derivation of this indicator, and its evolution in time.

| €2007 PRICES                  | 2004       | 2005       | 2006       | 2007       | 2008 P         |
|-------------------------------|------------|------------|------------|------------|----------------|
| Cost of capacity              | €5 967 M   | €6 073 M   | €6 127 M   | €6 310 M   | €6 470 M       |
| Cost of ATFM en-route delays  | € 400 M    | € 500M     | € 600 M    | € 750 M    | € 900 M        |
| Cost of route extension       | €1 900 M   | €2 050 M   | €2 200 M   | €2 350 M   | €2 600 M       |
| Total economic cost           | €8 267 M   | €8 623 M   | €8 927 M   | €9 410 M   | <b>€</b> 970 M |
| Total distance charged        | 7 047 M km | 7 472 M km | 7 823 M km | 8 321 M km | 8 602 M km     |
| Real unit economic cost (€km) | €1.17      | €1.15      | €1.14      | €1.13      | €1.16          |

Figure 125: Total economic en-route costs

10.3.3 As shown in Figure 126, the significant improvements in en-route cost-effectiveness since 2004 (see section 8.3) were almost cancelled-out by increases in delays and route extension. The real unit economic cost went down at a slow rate of approximately -1% per annum until 2007, but increased by nearly 2.5% in 2008. This indicates the importance of managing the entire system performance.

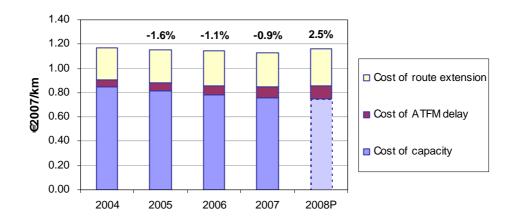


Figure 126: Real unit economic cost (en-route)

10.3.4 In the more straitened economic circumstances, this will require additional efforts by all stakeholders. Reduction of the unit cost of capacity will be more challenging with lower traffic growth, which could be alleviated by more efforts on flight-efficiency and delays (see Chapter 5).

#### 10.4 Dynamics of performance management and trade-offs

10.4.1 There are trade-offs between KPAs. More capacity entails higher direct costs (user charges), but reduces delays. A certain level of route structure, and hence flight

Costs related to the terminal and ground areas are not yet assessed precisely.

- inefficiency, is needed to achieve an optimum balance between flight efficiency and enroute capacity while ensuring safe separations between aircraft.
- 10.4.2 A success test for trade-offs between KPAs, apart from Safety and Security, for which minimum levels must be guaranteed, is that the total economic unit cost decreases. This is in line with ministerial objective recalled in the introduction to this chapter.
- 10.4.3 Structural decisions concerning capacity (recruitment, investment, major airspace redesign, operational arrangements within FABs) typically have an operational effect after 3-5 years, while the economic impact may be quicker.
- 10.4.4 There is therefore a need to plan and manage future performance 3-5 years in advance. The timeframe for target setting in SES II (see art 11.1 e in Annex I) is consistent with this observation.
- 10.4.5 In contrast, reactive and opportunistic behaviour in managing performance, i.e. waiting for capacity issues to appear before solving them, or pressing on costs in periods of low delays, leads to cyclic performance results. Periods of high delays and low cost, or viceversa, can be observed until 1999, as shown in Figure 127. The unit economic cost remains approximately constant, and there is no improvement in ANS economic costs borne by users.

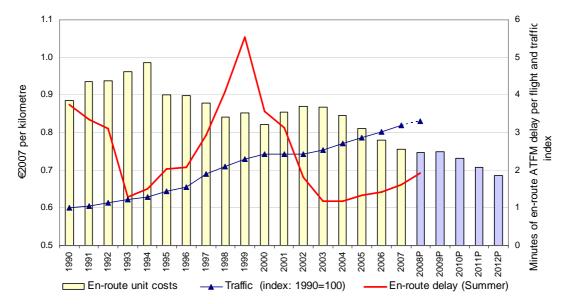


Figure 127: Evolution of en-route ATFM delays, unit costs and traffic

- 10.4.6 Such cycles can be avoided and overall performance improved with proactive capacity management <sup>96</sup>, based on proper performance indicators and performance management in this case capacity management as applied since 2001. Figure 126 shows that cost-effectiveness significantly improved while the cost of delays and route extension were contained since 2004.
- 10.4.7 Progress in terms of real economic cost is however relatively slow. Explicit performance targets, as provided for in SES II regulations, and performance management, both taking account of trade-offs and time lags, would be needed for quicker performance improvement.

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<sup>96</sup> Proactive capacity management compensates the lag in raising capacity (typically 3-5 years) by proper planning.

# 10.5 Conclusions

- 10.5.1 Costs borne by users for en-route capacity (charges), ATFM delays and flight-inefficiencies in 2008 are estimated at €6.5 Billion, €0.9 Billion and €2.6 Billion respectively (2007 prices). There are trade-offs between them. It is the total economic cost borne by users (cost of capacity+ delays+ route extension) that should be minimised.
- 10.5.2 The significant improvements in en-route cost-effectiveness since 2004 have been almost cancelled-out by increases in delays and route extension. The real unit economic cost went down at a slow rate of approximately -1% per annum until 2007, but increased by nearly 2.5% in 2008.
- 10.5.3 An objective to progressively reduce the real unit economic cost was agreed by Ministers in 2000 and should be actively pursued, even more so in the current straitened economic circumstances. Reduction of the unit cost of capacity will be more challenging with lower traffic growth, which could be alleviated by more efforts on flight-efficiency and delays.

# PART IV: Going forward

# **Chapter 11: Going forward**

# 11.1 Introduction

- 11.1.1 This chapter presents PRC conclusions and recommendations from a comprehensive assessment of ANS performance shown in PART II and high-level economic and environmental assessments shown in PART III.
- 11.1.2 It first takes stock of the proposed second package of Single European Sky regulations (SES II), a principal element of which is the Performance Scheme (see Annex I). This Performance Scheme includes formal target setting, and it is useful to recall where we are in this respect, and to anticipate next steps.

# 11.2 Current performance targets

11.2.1 Upon PRC recommendations, the Provisional Council adopted European performance targets (May 2007), as follows:

## Safety

"PC confirmed that all National Regulators and ANSPs providing en-route services should strive at reaching the agreed minimum level of safety management and regulation maturity (70%) by end 2008."

# **Delay**

"PC agreed that the European performance target for en-route ATFM delays remains set at 1 minute per flight for each summer period (May to October inclusive) until 2010."

# Flight efficiency

"PC agreed, as a flight-efficiency target, a reduction in the European average route extension per flight of two kilometres per annum until 2010."

# **Environment**

"PC noted that achieving the flight-efficiency target would reduce carbon dioxide emissions in proportion."

# Cost-effectiveness

In May 2007, "PC agreed, in principle, to the cost-effectiveness forecast of reducing the European average real unit cost by 3% per annum until 2010."

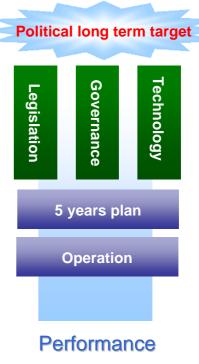
- 11.2.2 In November 2007, local objectives were agreed by ANSPs. "PC noted that individual ANSPs, States and the Agency confirm their individual commitment to meet, and ideally exceed, the five-year multi-annual unit cost reduction forecast as shown in Annex 1 of working paper PC/07/28/18". This is reproduced in Annex VIII. Pending the availability of SES II targets, such local objectives will be used to assess ANSP performance against their own targets.
- 11.2.3 All performance targets adopted by the Provisional Council remain valid at least until 2010, except the safety target for which a decision will be required in 2009. New decisions about performance targets will likely be taken in the dual contexts of EUROCONTROL and SES II.

# 11.3 Driving ANS performance

# SES II PERFORMANCE SCHEME

11.3.1 The current performance review and target setting system under EUROCONTROL has fostered significant progress in ANS performance, but would need to be reinforced to ensure continued improvement.

- 11.3.2 The legislative pillar of SES II includes a Performance Scheme (see Annex I). It will most likely apply in EU and associated States, and could be extended to all EUROCONTROL States by decision of its governing bodies.
- 11.3.3 The SES Performance Scheme will include European targets, and also binding national/FAB performance targets, for which accountability must be clearly assigned.
- 11.3.4 SES performance targets or regulatory requirements (e.g. interoperability) would need to be set in such a way as to align the objectives of concerned parties (ANSPs, users, airports, network manager, airport co-ordination committees, SESAR JU, etc) with the agreed European targets.
- 11.3.5 The system level airside performance influence diagram shown in Figure 128 is a first attempt to identify the critical roles and accountabilities in managing performance on the air-side of the aviation network. The definition of KPIs on which binding targets are set would naturally follow from an agreed version of such a system level methodology.
- 11.3.6 In order to take trade-offs into account (capacity versus quality of service, en-route delays versus flight efficiency), performance targets for ATFM delays and flight-efficiency would need to be set so as to minimise the ANS economic cost (see chapter 10).
- 11.3.7 With slower traffic growth and more volatile traffic demand ahead, it is even more important to balance the different areas of performance, and to improve the terms of trade-offs, so as to contain costs and improve quality of service whilst improving safety.
- 11.3.8 This can be done in the short term through higher efficiency and flexibility in the use of scarce resources (human, financial, airspace, airport capacity, R/F spectrum), and in the longer term through appropriate regulation (in particular the SES II proposed performance scheme), governance, and deployment of technology, as illustrated here.
- 11.3.9 The proposed SES II performance scheme is designed to be a powerful driver of ANS performance improvements. The PRC is prepared to contribute to these improvements.



# **SESAR**

- 11.3.10 The SES II package also includes a technological pillar, i.e. SESAR. It will be important to ensure the consistency of the SES II Performance Scheme and SESAR performance framework. Both are under EC responsibility, which makes resolution of any issue easier.
- 11.3.11 An initial version of the SESAR performance framework is included in document D6 [Ref 40], which was prepared by the SESAR consortium prior to adoption of SES II regulations, and may need to be reviewed in this light.
- 11.3.12 The SESAR programme constitutes the R&D branch of the SES initiative. As such, it should deliver proven technological solutions and operational concepts, and document expected benefits and costs before implementation decisions are taken. This appears in the Learning and Growth part of Figure 128.

- 11.3.13 Actual performance will depend not only on operational concepts and solutions from SESAR, but also on actual implementation and management of social aspects (collective agreements, employment conditions, etc) in the service provision area, and on regulations and oversight in the regulatory area.
- 11.3.14 Design targets and indicators for SESAR should therefore be appropriate to its R&D role. Moreover, specific targets and milestones should be met within the SESAR JU life time, i.e. before 2016.

# ANSP AND FAB GOVERNANCE

11.3.15 Finally, there would need to be minimum requirements, guidelines and/or rules for governance of ANSPs or FABs, wherever performance accountability lies under SES II.

# 11.4 Recommendations

11.4.1 The PRC's recommendations are set out in the following paragraphs:

# **SAFETY**

- 11.4.2 Currently, safety trends and targets at State level are generally unclear. The PRC maintains that safety performance of ANS providers, whose prime duty is to ensure safety in a public service, should be more transparent.
- 11.4.3 The USOAP and ESIMS safety audit programmes will terminate in 2011 and no followup is foreseen for the latter. The PRC considers that a structured ANS safety oversight scheme tailored to the European environment is needed, which could be based on a combination of surveys, peer reviews (as provided for in the SES legislation) and audits.
- 11.4.4 Thus far, inconsistencies in ATM incident reporting and analysis by States have hampered the quantification of safety risks in the European ATM system. The safety performance framework developed under SAFREP represents an opportunity for the harmonisation of incident reporting and severity assessment in all ECAC States.
- 11.4.5 The introduction of automated tools would complement human reporting of losses of separation, reduce its inherent subjectivity and ensure a wider and more stable coverage. Such tools are successfully implemented in some ANSPs, and even used to set national targets. Their applicability is linked with "Just Culture".
- 11.4.6 The PRC invites the Provisional Council:
  - (i) **to request** States to provide greater transparency of safety data, and particularly the public availability of States' ESIMS and USOAP audit reports concerning ANS safety, including Corrective Action Plans;
  - (ii) **to request** the Director General to present a plan to ensure the continuity of safety oversight, taking due account of any future EASA responsibilities;
  - (iii) **to require** the use by States/ANSPs of automated detection and reporting tools to complement manual reporting of incidents;

# FLIGHT EFFICIENCY-ENVIRONMENT

- 11.4.7 The PC flight-efficiency performance target has not been met to date, and there are significant economic and environmental negative impacts resulting from route extensions. Although challenging, this target appears to be achievable.
- 11.4.8 Further enhancements in airspace design offer the best prospect for improvement. The

shortest available routes should be used, wherever possible.

# 11.4.9 The PRC invites the Provisional Council:

- (iv) **to confirm** the already agreed target for flight efficiency of an annual reduction of the average route extension per flight of 2 Km, and related environmental impact (May 2007);
- (v) **to request** that the CFMU and airspace users co-operate to increase the use of shorter alternative routes at the flight planning stage, including conditional routes;
- (vi) **to request** further development of route structures coordinated by EUROCONTROL, and that conditional routes are open as often as possible, particularly at week-ends;

# **COST-EFFECTIVENESS**

- 11.4.10 Lower traffic in 2009, and possibly beyond, will lead to revenue shortfalls for many States and ANSPs. The States and ANSPs concerned have a duty to minimise the impact on airspace users through appropriate measures.
- 11.4.11 The PRC invites the Provisional Council:
  - (vii) **to agree** that there should be no mid-term upward revision by States of the 2009 unit rates and that States/ANSPs implement necessary measures to deal with any revenue shortfall in 2009;

# **CAPACITY**

- 11.4.12 It is important that the development of future ANS capacity is not adversely affected during the current global financial crisis and economic downturn. The positive effect on costs would materialise relatively late, and the negative impact on capacity would appear when traffic growth resumes. Rather, lower traffic growth is an opportunity to catch up on the capacity shortfall that has built up over the last 3 years.
- 11.4.13 The PRC invites the Provisional Council:
  - (viii) **to urge** States and Air Navigation Service Providers not to jeopardise future capacity provision during the current economic situation;

# NETWORK MANAGEMENT

- 11.4.14 Effective European network management will be fundamental to improving ATM efficiency and ensuring cohesion of the European network.
- 11.4.15 The PRC invites the Provisional Council:
  - (ix) **to request** the Director General to propose the role of, and propose performance indicators for, the network management function;
  - (x) **to request** the States to promote the use of airport collaborative decision-making.

# Sample Air-side performance influence diagram

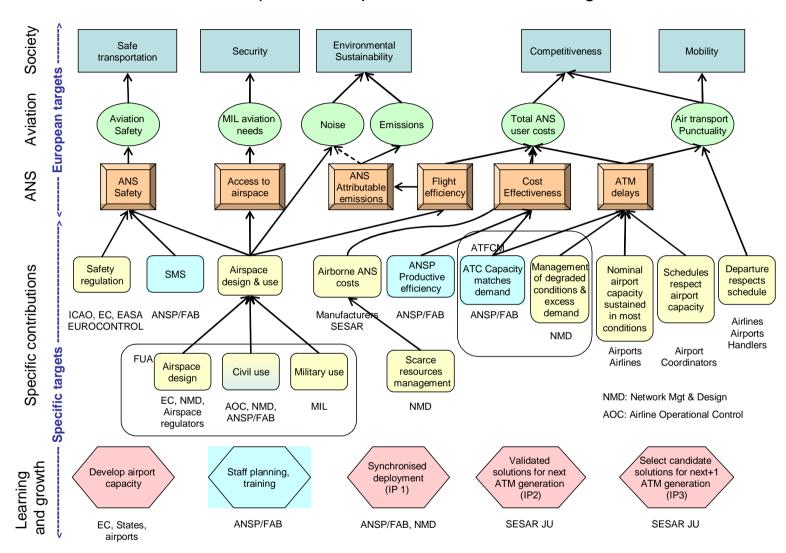


Figure 128: Overview of main performance outcomes and contributing factors- ANS view

# ANNEX I - ARTICLE 11 OF SES II FRAMEWORK REGULATION

This text was adopted by the European Parliament and the Transport Ministers in March 2009.

# Article11

# Performance scheme

- 1. To improve the performance of air navigation services and network functions in the Single European Sky, a performance scheme for air navigation services and network functions shall be set up. It shall include:
  - (a) Community-wide performance targets on the key performance areas of safety, the environment, capacity and cost-efficiency;
  - (b) national plans or plans for functional airspace blocks, including performance targets, ensuring consistency with the Community-wide performance targets; and
  - (c) periodic review, monitoring and benchmarking of performance of air navigation services and network functions.
- 2. In accordance with the regulatory procedure referred to in Article 5(3), the Commission may designate Eurocontrol or another impartial and competent body to act as a "performance review body". The role of the performance review body shall be to assist the Commission, in coordination with the NSAs, and to assist the NSAs on request in the implementation of the performance scheme referred to in paragraph 1. The Commission shall ensure that the performance review body acts independently when carrying out the tasks entrusted to it by the Commission.
- 3. (a) The Community-wide performance targets for the air traffic management network shall be adopted by the Commission in accordance with the regulatory procedure referred to in article 5(3), after taking into account the relevant inputs from NSAs at national level or at the level of functional airspace blocks.
  - (b) The national or functional airspace block plans referred to in paragraph 1(b) shall be elaborated by NSAs and adopted by the Member State(s). These plans shall include binding national targets or targets at the level of functional airspace blocks and an appropriate incentive scheme as adopted by the Member State(s). Drafting of the plans shall be subject to consultation with air navigation service providers, airspace users' representatives, and, where relevant, airport operators and airport coordinators.
  - (c) The consistency of the national or functional airspace block targets with the Community-wide performance targets shall be assessed by the Commission using the assessment criteria referred to in paragraph 6(d).

In the event that the Commission identifies that one or more national or functional airspace block targets do not meet the assessment criteria, it may decide, in accordance with the procedure referred to in article 5(2), to issue a recommendation that the NSA(s) concerned propose revised performance target(s). The Member State(s) concerned shall adopt revised performance targets and appropriate measures which shall be notified to the Commission in due time.

Where the Commission finds that the revised performance targets and appropriate measures are not adequate, it may decide, in accordance with the regulatory

procedure referred to in Article 5(3), that the concerned Member States shall take corrective measures.

Alternatively, the Commission may decide, with adequate supporting evidence, to revise the Community-wide performance targets in accordance with the regulatory procedure referred to in Article 5(3).

- (d) The reference period for the performance scheme shall cover a minimum of three years and a maximum of five years. During this period, in case the national or functional airspace block targets are not met, the Member States and/or the national supervisory authorities shall apply the appropriate measures they have defined. The first reference period shall cover the first three years following the adoption of the implementing rules referred to in paragraph 6.
- (e) The Commission shall perform regular assessments of the achievement of the performance targets and present the results to the Single Sky Committee
- 4. The following procedures shall apply to the performance scheme referred to in paragraph 1:
  - (a) collection, validation, examination, evaluation and dissemination of relevant data related to performance of air navigation services and network functions from all relevant parties, including air navigation service providers, airspace users, airport operators, national supervisory authorities, Member States and Eurocontrol;
  - (b) selection of appropriate key performance areas on the basis of ICAO Document N°9854 "Global Air Traffic Management Operational Concept", and consistent with those identified in the Performance Framework of the ATM Master Plan, including safety, environment, capacity and cost-efficiency areas, adapted where necessary in order to take into account the specific needs of the single European sky and relevant objectives for these areas and definition of a limited set of key performance indicators for measuring performance;
  - (c) establishment of Community-wide performance targets that shall be defined taking into consideration inputs identified at national level or at the level of functional airspace blocks;
  - (d) assessment of the national or functional airspace block performance targets on the basis of the national or functional airspace block plan;
  - (e) monitoring of the national or functional airspace block performance plans, including appropriate alert mechanisms;

The Commission may add procedures to the list of the procedures referred to in this paragraph. These measures designed to amend non-essential elements of this Regulation, by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 5(4).

- 5. The establishment of the performance scheme shall take into account that en route services, terminal services and network functions are different and should be treated accordingly, if necessary also for performance-measuring purposes.
- 6. For the detailed functioning of the performance scheme, the Commission shall adopt, at the latest two years following the entry into force of this Regulation and within a suitable timeframe with a view to meeting the relevant deadlines laid down in this Regulation, implementing rules in accordance with the regulatory procedure referred to in Article 5(3). These implementing rules shall cover the following:

- (a) the content and timetable of the procedures referred to in paragraph 4;
- (b) the reference period and intervals for the assessment of the achievement of performance targets and setting of new targets;
- (c) criteria for the setting up by the national supervisory authorities of the national or functional airspace block performance plans, containing the national or functional airspace block performance targets and the incentive scheme shall:
  - (i) be based on the business plans of the ANSPs;
  - (ii) address all cost components of the national or functional airspace block cost base;
  - (iii) include binding performance targets consistent with the Community-wide performance targets;
- (d) criteria to assess whether the national or functional airspace block targets are consistent with the Community wide performance targets during the reference period and to support alert mechanisms;
- (e) general principles for the setting up by Member States of the incentive scheme;
- (f) principles for the application of a transitional mechanism necessary for the adaptation to the functioning of the performance scheme not exceeding twelve months following the adoption of the implementing rules."

#### ANNEX II -ACC TRAFFIC AND DELAY DATA (2005-2008)

| State                | ACC Name          |      | Daily Tra | affic |            | Delay | y per flight (r | min/flight) |      | Airport  | delay sha | re of total      | delay    |
|----------------------|-------------------|------|-----------|-------|------------|-------|-----------------|-------------|------|----------|-----------|------------------|----------|
|                      |                   | 2005 | 2006      | 2007  | 2008       | 2005  | 2006            | 2007        | 2008 | 2005     | 2006      | 2007             | 2008     |
| Albania              | Tirana            | 318  | 327       | 389   | 405        | 0.1   | 0.0             | 0.0         | 0.1  | 0%       | 0%        | 0%               | 0%       |
| Austria              | Wien              | 1819 | 1897      | 2072  | 2108       | 1.0   | 1.1             | 1.4         | 2.1  | 80%      | 73%       | 44%              | 34%      |
| Belgium              | Brussels          | 1502 | 1556      | 1630  | 1606       | 0.2   | 0.4             | 0.3         | 0.6  | 87%      | 73%       | 76%              | 69%      |
| Bosnia-Herzegovina   | Sarajevo          | 2    | 2         | 2     | 3          | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 0%       |
| Bulgaria             | Sofia             | 609  | 619       | 705   | 1187       | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 49%      |
| Bulgaria             | Varna             | 433  | 434       | 458   | 344        | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 0%       |
| Croatia              | Zagreb            | 818  | 829       | 974   | 1039       | 2.4   | 1.6             | 8.0         | 2.1  | 0%       | 1%        | 5%               | 0%       |
| Cyprus               | Nicosia           | 568  | 590       | 660   | 739        | 0.9   | 0.8             | 1.6         | 2.7  | 1%       | 1%        | 5%               | 3%       |
| Czech Republic       | Praha             | 1565 | 1597      | 1690  | 1782       | 1.2   | 1.0             | 0.9         | 0.5  | 32%      | 18%       | 14%              | 11%      |
| Denmark              | Kobenhavn         | 1378 | 1429      | 1493  | 1456       | 0.2   | 0.6             | 0.3         | 2.6  | 97%      | 41%       | 61%              | 13%      |
| Estonia              | Tallinn           | 237  | 332       | 386   | 433        | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 0%       |
| Finland              | Rovaniemi         | 91   | 96        | 92    | 92         | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 0%       |
| Finland              | Tampere           | 494  | 475       | 460   | 474        | 0.3   | 0.1             | 0.1         | 0.1  | 65%      | 70%       | 83%              | 97%      |
| France               | Bordeaux          | 2055 | 2178      | 2313  | 2324       | 0.2   | 0.2             | 0.1         | 0.1  | 11%      | 16%       | 11%              | 21%      |
| France               | Brest             | 2243 | 2320      | 2490  | 2460       | 0.5   | 0.5             | 0.2         | 0.1  | 0%       | 1%        | 2%               | 1%       |
| France               | Marseille AC      | 2555 | 2659      | 2868  | 2867       | 0.1   | 0.1             | 0.0         | 0.1  | 0%       | 0%        | 0%               | 0%       |
| France               | Paris             | 3259 | 3357      | 3476  | 3449       | 1.2   | 1.2             | 1.0         | 1.0  | 65%      | 67%       | 49%              | 48%      |
| France               | Reims             | 2181 | 2305      | 2450  | 2457       | 0.5   | 0.4             | 0.6         | 0.5  | 0%       | 1%        | 2%               | 0%       |
| FYROM                | Skopje            | 294  | 315       | 330   | 336        | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 0%       |
| Germany              | Berlin            | 1445 | 913       | 0     | 0          | 0.0   | 0.4             | 0.0         | 0.0  | 38%      | 42%       | 0%               | 0%       |
| Germany              | Bremen            | 949  | 1001      | 1741  | 1762       | 0.1   | 0.1             | 0.1         | 0.3  | 72%      | 75%       | 68%              | 42%      |
| Germany              | Langen            | 3405 | 3504      | 3596  | 3577       | 0.5   | 0.6             | 0.8         | 1.2  | 91%      | 88%       | 87%              | 75%      |
| Germany              | Munchen           | 2940 | 3521      | 3914  | 4021       | 0.6   | 0.4             | 0.4         | 0.4  | 77%      | 60%       | 55%              | 50%      |
| Germany              | Rhein             | 3349 | 3709      | 3921  | 4012       | 0.2   | 0.1             | 0.3         | 0.9  | 0%       | 0%        | 0%               | 0%       |
| Greece               | Athinai+Macedonia | 1453 | 1492      | 1642  | 1699       | 0.5   | 0.8             | 1.4         | 2.2  | 97%      | 78%       | 59%              | 32%      |
| Hungary              | Budapest          | 1476 | 1553      | 1588  | 1602       | 0.5   | 0.1             | 0.0         | 0.0  | 73%      | 67%       | 63%              | 100%     |
| Ireland              | Dublin            | 539  | 567       | 622   | 620        | 0.2   | 0.2             | 0.1         | 1.5  | 69%      | 77%       | 86%              | 76%      |
| Ireland              | Shannon           | 1101 | 1146      | 1205  | 1204       | 0.0   | 0.0             | 0.0         | 0.1  | 0%       | 13%       | 0%               | 6%       |
| Italy                | Brindisi          | 752  | 778       | 837   | 865        | 0.2   | 0.1             | 0.1         | 0.0  | 94%      | 99%       | 93%              | 90%      |
| Italy                | Milano            | 1703 | 1786      | 1893  | 1783       | 1.3   | 1.4             | 0.8         | 0.2  | 78%      | 79%       | 95%              | 96%      |
|                      | Padova            | 1639 | 1715      | 1879  | 1799       | 0.5   | 0.3             | 0.6         | 0.2  | 26%      | 21%       | 39%              | 78%      |
| Italy                |                   |      |           |       |            |       |                 |             |      |          |           |                  | 98%      |
| Italy                | Roma              | 2413 | 2478      | 2705  | 2699       | 0.9   | 0.8             | 0.8         | 0.5  | 84%      | 76%       | 93%              |          |
| Latvia               | Riga              | 354  | 416       | 476   | 515        | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 0%       |
| Lithuania            | Vilnius           | 282  | 356       | 476   | 583        | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 0%       |
| Maastricht           | Maastricht        | 3973 | 4207      | 4410  | 4395       | 0.1   | 0.3             | 0.6         | 0.5  | 0%       | 0%        | 0%               | 0%       |
| Malta                | Malta             | 207  | 207       | 223   | 231        | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 100%      | 0%               | 0%       |
| Moldova              | Chisinau          | 70   | 75        | 94    | 110        | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 0%       |
| Netherlands          | Amsterdam         | 1372 | 1433      | 1490  | 1439       | 0.7   | 0.4             | 8.0         | 1.1  | 86%      | 80%       | 91%              | 96%      |
| Norway               | Bodo              | 504  | 508       | 527   | 530        | 0.1   | 0.5             | 0.0         | 0.1  | 18%      | 8%        | 28%              | 75%      |
| Norway               | Oslo              | 768  | 830       | 886   | 929        | 0.6   | 0.1             | 0.4         | 0.2  | 25%      | 48%       | 46%              | 91%      |
| Norway               | Stavanger         | 479  | 523       | 556   | 558        | 0.1   | 0.1             | 0.1         | 0.1  | 8%       | 1%        | 11%              | 22%      |
| Poland               | Warszawa          | 1071 | 1246      | 1411  | 1559       | 0.8   | 1.5             | 2.3         | 2.2  | 37%      | 30%       | 15%              | 4%       |
| Portugal             | Lisboa            | 978  | 1035      | 1096  | 1121       | 0.0   | 0.1             | 0.4         | 0.4  | 96%      | 82%       | 30%              | 55%      |
| Portugal             | Santa Maria       | 256  | 258       | 265   | 283        | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 0%       |
| Romania              | Bucuresti         | 1121 | 1136      | 1182  | 1212       | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 100%     |
| Serbia and Montenegr | Beograd           | 950  | 1045      | 1218  | 1314       | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 4%        | 9%               | 0%       |
| Slovak Republic      | Bratislava        | 840  | 855       | 840   | 891        | 0.4   | 0.1             | 0.5         | 0.2  | 0%       | 0%        | 0%               | 0%       |
| Slovenia             | Ljubjana          | 520  | 539       | 624   | 671        | 0.3   | 0.0             | 0.3         | 0.0  | 0%       | 0%        | 3%               | 19%      |
| Spain                | Barcelona AC+AP   | 2002 | 2115      | 2321  | 2250       | 1.2   | 0.9             | 0.5         | 0.4  | 37%      | 20%       | 37%              | 48%      |
| Spain                | Madrid            | 2565 | 2688      | 2904  | 2860       | 1.1   | 1.6             | 1.9         | 1.1  | 31%      | 63%       | 54%              | 32%      |
| Spain                | Palma             | 668  | 712       | 749   | 733        | 0.3   | 0.3             | 0.6         | 0.9  | 99%      | 99%       | 99%              | 99%      |
| Spain                | Sevilla           | 976  | 1025      | 1100  | 1067       | 0.1   | 0.4             | 0.3         | 0.1  | 21%      | 11%       | 20%              | 7%       |
| Spain Canarias       | Canarias          | 798  | 830       | 844   | 840        | 0.3   | 0.5             | 0.4         | 0.5  | 26%      | 31%       | 35%              | 35%      |
| Sweden               | Malmo             | 1281 | 1323      | 1366  | 1448       | 0.4   | 0.0             | 0.0         | 0.1  | 0%       | 13%       | 11%              | 2%       |
| Sweden               | Stockholm         | 1083 | 1107      | 1116  | 1128       | 0.2   | 0.0             | 0.5         | 0.1  | 30%      | 90%       | 97%              | 89%      |
| Switzerland          | Geneva            | 1648 | 1704      | 1832  | 1813       | 1.2   | 0.8             | 1.0         | 0.8  | 21%      | 18%       | 30%              | 36%      |
| Switzerland          | Zurich            | 1994 | 2040      | 2127  | 2156       | 1.1   | 1.6             | 1.8         | 1.1  | 53%      | 21%       | 33%              | 27%      |
| Turkey               | Ankara            | 1196 | 1310      | 1427  | 1544       | 0.3   | 0.1             | 0.2         | 0.5  | 12%      | 100%      | 78%              | 55%      |
| Turkey               | Istanbul          | 1077 | 1165      | 1470  | 1567       | 2.2   | 0.5             | 0.3         | 0.9  | 100%     | 96%       | 100%             | 100%     |
| Ukraine              | Dnipropetrovs'k   | 56   | 59        | 61    | 60         | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 0%       |
| Ukraine              | Kharkiv           | 200  | 246       | 276   | 324        | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 0%       |
| Ukraine              | Kyiv              | 0    | 0         | 477   | 547        | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 100%             | 0%       |
| Ukraine              | L'viv             | 0    | 0         | 371   | 428        | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 0%       |
| Ukraine              | Odesa             | 0    | 0         | 183   | 208        | 0.0   | 0.0             | 0.0         | 0.0  | 0%       | 0%        | 0%               | 0%       |
| Ukraine              | Simferopol        | 0    | 0         | 460   | 208<br>481 | 0.0   | 0.0             | 0.0         | 0.0  | 0%<br>0% | 0%        | 0%               | 0%<br>0% |
| Ukraine              | Donets'k          | 0    | 0         | 460   | 481<br>37  | 0.0   | 0.0             | 0.0         | 0.0  | 0%<br>0% | 0%        | 0%               | 0%       |
|                      |                   |      |           |       |            |       |                 |             |      |          |           |                  |          |
| United Kingdom       | London AC         | 5188 | 5349      | 5508  | 5427       | 0.4   | 0.6             | 0.6         | 0.6  | 0%       | 1%        | 0%               | 1%       |
| United Kingdom       | London TC         | 3623 | 3738      | 3854  | 3780       | 0.7   | 0.8             | 1.0         | 1.1  | 84%      | 89%       | 85%              | 93%      |
| United Kingdom       | Manchester        | 1608 | 1620      | 1666  | 1569       | 0.4   | 0.6             | 0.3         | 0.2  | 27%      | 20%       | 37%              | 39%      |
| United Kingdom       | Scottish          | 1699 | 1739      | 1784  | 1800       | 0.2   | 0.1             | 0.2         | 0.2  | 35%      | 30%       | 8%<br>roo : EUDC | 12%      |

New allocation of delay between en-route and airport has been used, as against that used in PRR 2007

 $Regulations \ on \ traffic \ volumes \ EGLL 60, EHFIRAM, LEBLFIN, LECMARR 1 \ have been \ reclassified \ as \ airport \ regulations.$ 

data source : EUROCONTROL

The table below provides an overview of key information for the 14 most penalising ACCs in

Europe in 2008 (see Chapter 5, Figure 51).

| Europe in 2008 (see Chapter 3, Figure 31). |  |                               |                                       |                              |                              |   |  |                            |                                     |         |                                       |                                   |
|--|--|-------------------------------|---------------------------------------|------------------------------|------------------------------|---|--|----------------------------|-------------------------------------|---------|---------------------------------------|-----------------------------------|
|  |  |                               | TRA                                   | FFIC                         |                              |   |  | ATFM                       | DELA                                | /S      |                                       |                                   |
| 14 most congested<br>ACCs in 2008          | Nr. Of days with enroute delay > 1min. | IFR flights in 2008<br>('000) | 3Y Avg. annual<br>growth rate (08/05) | 07/06 growth year on<br>year | 08/07 growth year on<br>year | Total en-route ATFM<br>delay in 2008 (min.) | % of total en-route<br>ATFM delays in 2008 | ATC CAPACITY &<br>Staffing | ATC Other (strike, equipment, etc.) | Weather | OTHER (Special event, military, etc.) | Avg. en-route delay<br>per flight |
| Total 2007                                 |  |                               |                                       |                              |                              | 12 131                                      | 100%                                       | 78.9%                      | 5.5%                                | 11.4%   | 4.3%                                  |                                   |
| Total 2008                                 |  |                               |                                       |                              |                              | 14 587                                      | 100%                                       | 76.0%                      | 6.2%                                | 9.7%    | 8.1%                                  |                                   |
| Warszawa                                   | 269                                    | 571                           | 13.4%                                 | 13.3%                        | 10.8%                        | 1 190                                       | 8.2%                                       | 97.9%                      | 0.9%                                | 1.1%    | 0.2%                                  | 2.1                               |
| Kobenhavn                                  | 251                                    | 533                           | 2.0%                                  | 4.5%                         | -2.2%                        | 1 231                                       | 8.4%                                       | 44.0%                      | 0.4%                                | 0.1%    | 55.5%                                 | 2.3                               |
| Nicosia                                    | 197                                    | 271                           | 9.3%                                  | 11.8%                        | 12.4%                        | 720   | 4.9%                                       | 95.7%                      | 3.7%                                |         | 0.6%                                  | 2.7                               |
| Zagreb                                     | 138                                    | 380                           | 8.4%                                  | 17.4%                        | 6.9%                         | 808   | 5.5%                                       | 73.6%                      | 6.7%                                | 18.4%   | 1.2%                                  | 2.1                               |
| Wien                                       | 136                                    | 771                           | 5.1%                                  | 9.2%                         | 2.0%                         | 1 047                                       | 7.2%                                       | 84.3%                      | 0.8%                                | 14.9%   |                                       | 1.4                               |
| Rhein                                      | 130                                    | 1 468                         | 6.3%                                  | 5.7%                         | 2.6%                         | 1 321                                       | 9.1%                                       | 78.9%                      | 0.1%                                | 19.9%   | 1.0%                                  | 0.9                               |
| Zurich                                     | 108                                    | 789                           | 2.7%                                  | 4.2%                         | 1.7%                         | 617   | 4.2%                                       | 85.7%                      | 0.1%                                | 12.8%   | 1.4%                                  | 0.8                               |
| Madrid                                     | 98                                     | 1 047                         | 3.8%                                  | 8.0%                         | -1.2%                        | 772   | 5.3%                                       | 99.5%                      | 0.2%                                | 0.3%    | 0.1%                                  | 0.7                               |
| Athinai+Macedonia                          | 94                                     | 622                           | 5.4%                                  | 10.0%                        | 3.8%                         | 945   | 6.5%                                       | 94.0%                      | 6.0%                                |         | 0.0%                                  | 1.5                               |
| Reims                                      | 63                                     | 899                           | 4.2%                                  | 6.3%                         | 0.6%                         | 491   | 3.4%                                       | 72.9%                      | 12.5%                               | 7.2%    | 7.4%                                  | 0.5                               |
| Geneva                                     | 52                                     | 664                           | 3.3%                                  | 7.5%                         | -0.8%                        | 324   | 2.2%                                       | 77.9%                      | 0.7%                                | 15.3%   | 6.1%                                  | 0.5                               |
| London AC                                  | 47                                     | 1 986                         | 1.6%                                  | 3.0%                         | -1.2%                        | 1 094                                       | 7.5%                                       | 66.6%                      | 8.8%                                | 10.7%   | 13.8%                                 | 0.6                               |
| Maastricht                                 | 41                                     | 1 608                         | 3.5%                                  | 4.8%                         | -0.1%                        | 778   | 5.3%                                       | 74.5%                      | 4.9%                                | 6.4%    | 14.2%                                 | 0.5                               |
| Canarias                                   | 33                                     | 307                           | 1.8%                                  | 1.7%                         | -0.2%                        | 100   | 0.7%                                       | 86.2%                      |                                     | 13.8%   | 0.0%                                  | 0.3                               |

The 14 most penalising ACCs in 2008 by cause of delay

The table provides an overview of key information for 20 airports with the highest airport ATFM

delay in Europe in 2008.

| delay ili Europe ili 2008. |                                   |                            |                              |                              | ATFM DELAYS                  |  |                            |                                     |         |                                       |  |  |
|----------------------------|-----------------------------------|----------------------------|------------------------------|------------------------------|------------------------------|--|----------------------------|-------------------------------------|---------|---------------------------------------|--|--|
|                            |                                   | TRA                        | FFIC                         |                              |                              |  | ATFN                       | I DELA                              | YS      |                                       |  |  |
|                            | Arrival flights in<br>2008 ('000) | 3Y Avg. annual growth rate | 07/06 growth year<br>on year | 08/07 growth year<br>on year | Minutes of ATFM delay ('000) | % of total airport<br>ATFM delays in<br>2008 | ATC CAPACITY &<br>Staffing | ATC Other (strike, equipment, etc.) | Weather | OTHER (Special event, military, etc.) | Avg. airport ATFM<br>delay per arrival |  |
| Total 2007                 |                                   |                            |                              |                              | 9 354                        | 100%   | 48.6%                      | 4.4%                                | 42.4%   | 4.5%                                  |  |  |
| Total 2008                 |                                   |                            |                              |                              | 9 232                        | 100%   | 39.7%                      | 6.8%                                | 43.1%   | 10.4%                                 |  |  |
|                            |                                   |                            |                              |                              |                              |  |                            |                                     |         |                                       |  |  |
| Frankfurt                  | 243                               | -0.7%                      | 0.6%                         | -1.4%                        | 1 041                        | 11.3%  | 10.5%                      | 0.0%                                | 89.3%   | 0.1%                                  | 4.3                                    |  |
| London/Heathrow            | 240                               | 0.0%                       | 0.8%                         | -0.6%                        | 1 003                        | 10.9%  | 17.3%                      | 0.4%                                | 70.8%   | 11.6%                                 | 4.2                                    |  |
| Vienna                     | 145                               | 5.1%                       | 7.7%                         | 4.5%                         | 556                          | 6.0%   | 69.9%                      | 1.9%                                | 26.8%   | 1.4%                                  | 3.8                                    |  |
| Amsterdam                  | 221                               | 2.0%                       | 3.3%                         | -1.8%                        | 544                          | 5.9%   | 51.4%                      |                                     | 48.6%   | 0.0%                                  | 2.5                                    |  |
| Istanbul/Ataturk           | 130                               | 8.0%                       | 8.3%                         | 5.7%                         | 509                          | 5.5%   | 58.6%                      | 3.0%                                | 10.4%   | 28.1%                                 | 3.9                                    |  |
| Rome/Fiumicino             | 173                               | 4.0%                       | 6.1%                         | 3.5%                         | 445                          | 4.8%   | 24.6%                      |                                     | 41.3%   | 34.1%                                 | 2.6                                    |  |
| Munich                     | 215                               | 2.8%                       | 5.2%                         | 0.2%                         | 316                          | 3.4%   | 4.6%                       |                                     | 95.3%   | 0.2%                                  | 1.5                                    |  |
| Paris/Charles-De-Gaulle    | 280                               | 2.3%                       | 2.1%                         | 1.4%                         | 292                          | 3.2%   | 36.4%                      | 0.2%                                | 61.7%   | 1.7%                                  | 1.0                                    |  |
| London/City                | 47                                |                            |                              | 3.3%                         | 283                          | 3.1%   | 60.1%                      | 1.2%                                | 29.9%   | 8.9%                                  | 6.0                                    |  |
| Madrid/Barajas             | 235                               |                            | 11.1%                        | -2.9%                        | 279                          | 3.0%   | 73.8%                      | 0.2%                                | 18.0%   | 8.0%                                  | 1.2                                    |  |
| Dublin                     | 104                               | 4.7%                       | 8.1%                         | 0.7%                         | 252                          | 2.7%   | 37.6%                      | 52.1%                               | 6.5%    | 3.8%                                  | 2.4                                    |  |
| Zurich                     | 131                               | 1.1%                       | 2.8%                         | 3.1%                         | 245                          | 2.7%   | 55.0%                      |                                     | 42.4%   | 2.6%                                  | 1.9                                    |  |
| Brussels                   | 126                               | 0.9%                       | 3.9%                         | -2.0%                        | 212                          | 2.3%   | 14.9%                      | 1.8%                                | 47.7%   | 35.6%                                 | 1.7                                    |  |
| Paris/Orly                 | 117                               | 1.0%                       | 1.5%                         | -1.2%                        | 194                          | 2.1%   | 10.0%                      | 53.4%                               | 34.3%   | 2.3%                                  | 1.7                                    |  |
| Geneva                     | 88                                | 5.0%                       | 9.2%                         | 1.8%                         | 179                          | 1.9%   | 74.0%                      | 1.5%                                | 23.1%   | 1.4%                                  | 2.0                                    |  |
| Copenhagen/Kastrup         | 132                               | -0.6%                      | -0.3%                        | 2.6%                         | 177                          | 1.9%   | 14.5%                      | 0.4%                                | 27.2%   | 57.9%                                 | 1.3                                    |  |
| Antalya                    | 63                                | 7.3%                       | 16.3%                        | 11.9%                        | 165                          | 1.8%   | 4.7%                       | 88.4%                               | 2.0%    | 4.9%                                  | 2.6                                    |  |
| Palma De Mallorca          | 96                                | 1.9%                       | 3.8%                         | -2.1%                        | 156                          | 1.7%   | 73.3%                      |                                     | 23.2%   | 3.5%                                  | 1.6                                    |  |
| Venice/Tessera             | 40                                | 0.4%                       | 7.9%                         | -10.1%                       | 154                          | 1.7%   | 26.0%                      | 0.3%                                | 7.3%    | 66.4%                                 | 3.9                                    |  |
| Dusseldorf                 | 114                               | 4.5%                       | 5.8%                         | 0.4%                         | 149                          | 1.6%   | 46.4%                      | 1.4%                                | 37.5%   | 14.7%                                 | 1.3                                    |  |

Top 20 airports with the highest airport ATFM delay in Europe in 2008

#### **ANNEX IV - TRAFFIC COMPLEXITY**

The PRU, in close collaboration with ANSPs, has defined a set of complexity indicators that could be applied in ANSP benchmarking. The complexity indicators are computed on a systematic basis for each day of the year. This annex presents for each ANSP the complexity score computed over the full year (365 days).

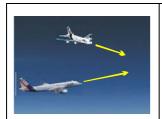
The complexity indicators are based on the concept of "interactions". Interactions arise when there are two aircraft in the same "place" at the same time. For the purpose of this study, an interaction is defined as the simultaneous presence of two aircraft in a cell of 20x20 nautical miles and 3,000 feet in height.

For each ANSP the complexity score is the product of two components:

Complexity score = Traffic density x Structural index

**Traffic density indicator** is a measure of the potential number of interactions between aircraft. The indicator is defined as the total duration of all interactions (in minutes) per flight-hour controlled in a given volume of airspace.

The structural complexity originates from horizontal, vertical, and speed interactions. The Structural index is computed as the sum of the three indicators:



**Horizontal interactions indicator**: A measure of the complexity of the flow structure based on the potential interactions between aircraft on different headings. The indicator is defined as the ratio of the duration of horizontal interactions to the total duration of all interactions.



**Vertical interactions indicator**: A measure of the complexity arising from aircraft in vertical evolution based on the potential interactions between climbing, cruising and descending aircraft. The indicator is defined as the ratio of the duration of vertical interactions to the total duration of all interactions.

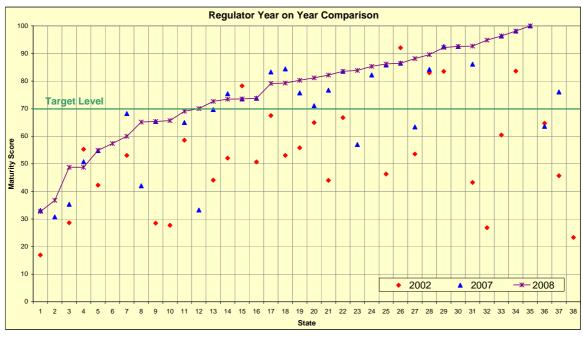


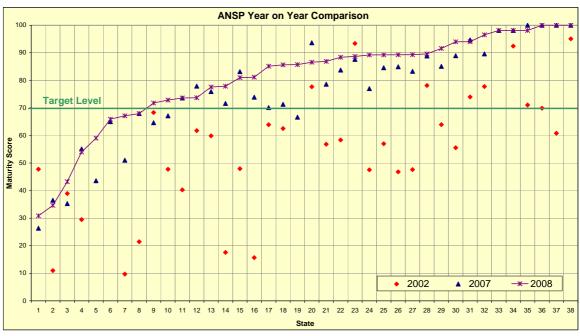
**Speed interactions indicator**: A measure of the complexity arising from the aircraft mix based on the potential interactions between aircraft of different speeds. The indicator is defined as the ratio of the duration of speed interactions to the total duration of all interactions.

**ANSP Complexity score (2008)** 

|       |                           | Complexity | Adjusted |          | Structura  | al index |         |
|-------|---------------------------|------------|----------|----------|------------|----------|---------|
| State | ANSP                      | score      | Density  | Vertical | Horizontal | Speed    | Total   |
|       |                           | a *e       | a        | b        | c          | d        | e=b+c+d |
| BE    | Belgocontrol              | 13.7       | 9.8      | 0.44     | 0.54       | 0.42     | 1.39    |
| UK    | NATS                      | 12.8       | 11.6     | 0.40     | 0.42       | 0.28     | 1.10    |
| СН    | Skyguide                  | 12.4       | 11.5     | 0.30     | 0.56       | 0.22     | 1.08    |
| DE    | DFS                       | 11.7       | 10.7     | 0.31     | 0.54       | 0.25     | 1.09    |
|       | MUAC                      | 10.0       | 10.8     | 0.26     | 0.51       | 0.16     | 0.93    |
| NL    | LVNL                      | 9.4        | 10.0     | 0.25     | 0.37       | 0.32     | 0.94    |
| AT    | Austro Control            | 8.0        | 8.3      | 0.24     | 0.49       | 0.23     | 0.97    |
| CZ    | ANS CR                    | 7.0        | 7.2      | 0.21     | 0.53       | 0.23     | 0.97    |
| FR    | DSNA                      | 6.6        | 9.4      | 0.16     | 0.39       | 0.14     | 0.70    |
| IT    | ENAV                      | 5.9        | 5.6      | 0.29     | 0.55       | 0.22     | 1.06    |
| SI    | Slovenia Control          | 4.8        | 5.7      | 0.17     | 0.50       | 0.17     | 0.83    |
| LY    | SMATSA                    | 4.7        | 8.2      | 0.05     | 0.45       | 0.07     | 0.58    |
| HU    | HungaroControl            | 4.7        | 7.1      | 0.09     | 0.44       | 0.13     | 0.66    |
| SK    | LPS                       | 4.3        | 4.9      | 0.17     | 0.51       | 0.19     | 0.88    |
| ES    | Aena                      | 4.3        | 5.9      | 0.19     | 0.40       | 0.13     | 0.73    |
| DK    | NAVIAIR                   | 3.7        | 4.1      | 0.18     | 0.54       | 0.20     | 0.92    |
| SE    | LFV/ANS Sweden            | 3.5        | 3.9      | 0.21     | 0.45       | 0.23     | 0.89    |
| HR    | Croatia Control           | 3.4        | 5.3      | 0.07     | 0.49       | 0.09     | 0.65    |
| PL    | PANSA                     | 3.4        | 3.9      | 0.14     | 0.53       | 0.22     | 0.88    |
| MK    | MK CAA                    | 3.0        | 4.8      | 0.11     | 0.42       | 0.09     | 0.62    |
| TR    | DHMI                      | 2.9        | 4.5      | 0.15     | 0.38       | 0.11     | 0.64    |
| RO    | ROMATSA                   | 2.7        | 5.0      | 0.07     | 0.35       | 0.12     | 0.54    |
| NO    | Avinor                    | 2.4        | 2.2      | 0.37     | 0.49       | 0.25     | 1.11    |
| PT    | NAV Portugal (FIR Lisboa) | 2.4        | 3.8      | 0.16     | 0.40       | 0.07     | 0.63    |
| CY    | DCAC Cyprus               | 2.4        | 3.8      | 0.15     | 0.39       | 0.09     | 0.63    |
| GR    | HCAA                      | 2.2        | 3.7      | 0.13     | 0.37       | 0.10     | 0.60    |
| BU    | ATSA Bulgaria             | 2.2        | 6.2      | 0.05     | 0.24       | 0.06     | 0.35    |
| FI    | Finavia                   | 2.1        | 2.3      | 0.27     | 0.32       | 0.33     | 0.92    |
| LV    | LGS                       | 2.1        | 3.1      | 0.10     | 0.43       | 0.15     | 0.68    |
| EE    | EANS                      | 2.0        | 3.4      | 0.15     | 0.28       | 0.17     | 0.60    |
| IE    | IAA                       | 2.0        | 4.9      | 0.10     | 0.22       | 0.09     | 0.41    |
| LT    | Oro Navigacija            | 2.0        | 2.7      | 0.12     | 0.45       | 0.17     | 0.73    |
| AL    | NATA Albania              | 1.8        | 4.0      | 0.06     | 0.33       | 0.05     | 0.44    |
| UA    | UkSATSE                   | 1.6        | 2.7      | 0.06     | 0.37       | 0.16     | 0.58    |
| MD    | MoldATSA                  | 0.7        | 1.0      | 0.10     | 0.45       | 0.16     | 0.71    |
| MT    | MATS                      | 0.6        | 1.0      | 0.12     | 0.35       | 0.11     | 0.58    |
|       | Average                   | 6.4        | 7.3      | 0.24     | 0.45       | 0.19     | 0.88    |

#### ANNEX V - SAFETY MATURITY (ANSPS/REGULATORS)

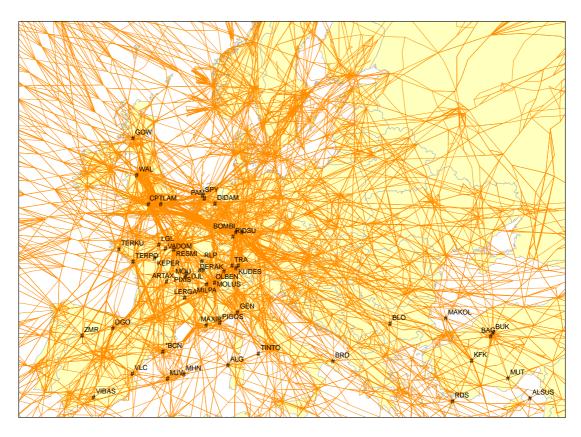




#### **ANNEX VI - TOP 50 MOST-CONSTRAINING POINTS**

|          |                  |              |                     | Extra m        | iles          |
|----------|------------------|--------------|---------------------|----------------|---------------|
| Waypoint | State            | On<br>border | Constrained flights | Total<br>000's | Per<br>flight |
| MOU      | France           | No           | 59 934              | 1 371          | 23            |
| RIDSU    | Germany          | No           | 30 688              | 1 321          | 43            |
| RESMI    | France           | No           | 52 516              | 1 313          | 25            |
| KUDES    | Switzerland      | No           | 49 774              | 922            | 19            |
| MAKOL    | Bulgaria/ Turkey | Yes          | 31 141              | 821            | 26            |
| BOMBI    | Germany          | No           | 63 683              | 806            | 13            |
| TRA      | Switzerland      | No           | 39 631              | 777            | 20            |
| ARTAX    | France           | No           | 53 803              | 772            | 14            |
| SPY      | Netherlands      | No           | 37 062              | 718            | 19            |
| LOHRE    | Germany          | No           | 37 135              | 699            | 19            |
| LERGA    | France           | No           | 47 161              | 673            | 14            |
| MJV      | Spain            | No           | 25 305              | 621            | 25            |
| BAG      | Turkey           | No           | 37 085              | 616            | 17            |
| MUT      | Turkey           | No           | 16 944              | 601            | 35            |
| ALG      | Italy            | No           | 30 717              | 597            | 19            |
| VADOM    | France           | No           | 15 112              | 585            | 39            |
| ALSUS    | Cyprus           | No           | 16 961              | 570            | 34            |
| GOW      | UK               | No           | 23 724              | 543            | 23            |
| BRD      | Italy            | No           | 18 825              | 532            | 28            |
| MILPA    | France           | No           | 28 943              | 522            | 18            |
| TINTO    | Italy            | No           | 13 159              | 518            | 39            |
| CPT      | UK               | No           | 39 022              | 517            | 13            |
| *BCN     | Spain            | No           | 31 306              | 510            | 16            |
| GEN      | Italy            | No           | 31 546              | 502            | 16            |
| DJL      | France           | No           | 34 381              | 495            | 14            |

|          |             |              |                     | Extra m        | niles         |
|----------|-------------|--------------|---------------------|----------------|---------------|
| Waypoint | State       | On<br>border | Constrained flights | Total<br>000's | Per<br>flight |
| KFK      | Turkey      | No           | 46 255              | 494            | 11            |
| OLBEN    | Switzerland | No           | 22 597              | 488            | 22            |
| LAM      | United      | No           | 24 087              | 474            | 20            |
| VIBAS    | Spain       | No           | 33 642              | 470            | 14            |
| MOLUS    | Switzerland | No           | 21 600              | 469            | 22            |
| PAM      | Netherlands | No           | 23 609              | 467            | 20            |
| WAL      | UK          | No           | 56 243              | 446            | 8             |
| KEPER    | France      | No           | 17 988              | 441            | 25            |
| VLC      | Spain       | No           | 39 658              | 440            | 11            |
| TERPO    | France      | No           | 20 290              | 437            | 22            |
| MAXIR    | France      | No           | 15 726              | 426            | 27            |
| ZMR      | Spain       | No           | 41 785              | 425            | 10            |
| PIGOS    | France      | No           | 16 858              | 420            | 25            |
| DERAK    | France      | No           | 19 399              | 420            | 22            |
| RLP      | France      | No           | 28 257              | 413            | 15            |
| PIXIS    | France      | No           | 23 397              | 406            | 17            |
| DGO      | Spain       | No           | 34 270              | 398            | 12            |
| ROMIR    | Switzerland | No           | 13 446              | 396            | 29            |
| MHN      | Spain       | No           | 15 988              | 394            | 25            |
| DIDAM    | Netherlands | No           | 26 106              | 393            | 15            |
| LGL      | France      | No           | 25 250              | 392            | 16            |
| TERKU    | France      | No           | 14 906              | 392            | 26            |
| RDS      | Greece      | No           | 22 945              | 383            | 17            |
| BLO      | Bulgaria    | No           | 6 490               | 380            | 59            |
| BUK      | Turkey      | No           | 22 011              | 380            | 17            |



Most constraining points in 2008

### ANNEX VII - MONITORING OF FIVE-YEAR MULTIANNUAL REAL EN-ROUTE UNIT COST REDUCTION FORECASTS PER STATE (NOV. 2007 VERSUS NOV. 2008)

#### Five-year multi-annual real en-route unit cost forecasts per State (Nov 2007)

In September 2007, ANSPs developed, within the ANSB Cost-effectiveness Task Force [Ref. 29], local individual en-route unit-cost profiles, consistent with the overall European targets of -3% per annum.

In November 2007, on the basis of the conclusions of this task force, the PC "noted that individual ANSPs, States and the Agency confirm their individual commitment to meet, and ideally exceed, the five-year multi-annual unit cost reduction forecast as shown in Annex 1 of working paper PC/07/28/18". This is reproduced in the figure below.

Pending the availability of SES II targets, such local objectives will be used to assess ANSP performance against their own forecasts.

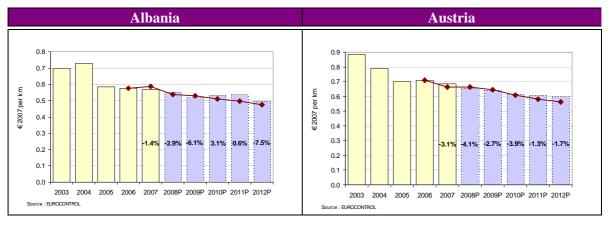
| State   | State                  | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Average<br>Change<br>2006-2012 | Average change 2008-2012 |
|---------|------------------------|------|------|------|------|------|------|------|--------------------------------|--------------------------|
| EH      | The Netherlands        | 0.44 | 0.42 | 0.57 | 0.56 | 0.55 | 0.53 | 0.52 | + 2.7%                         | - 2.3%                   |
| LK      | Czech Republic         | 0.46 | 0.52 | 0.55 | 0.54 | 0.53 | 0.52 | 0.50 | + 1.4%                         | - 2.2%                   |
| LZ      | Slovak Republic        | 0.49 | 0.53 | 0.57 | 0.61 | 0.59 | 0.56 | 0.54 | + 1.4%                         | - 1.3%                   |
| LF      | France                 | 0.64 | 0.67 | 0.67 | 0.66 | 0.65 | 0.63 | 0.62 | - 0.4%                         | - 1.6%                   |
| EF      | Finland                | 0.40 | 0.39 | 0.40 | 0.40 | 0.39 | 0.39 | 0.38 | - 0.8%                         | - 1.2%                   |
| LJ      | Slovenia               | 0.59 | 0.58 | 0.60 | 0.58 | 0.61 | 0.59 | 0.57 | - 0.9%                         | - 1.5%                   |
| EN      | Norway                 | 0.69 | 0.67 | 0.68 | 0.68 | 0.66 | 0.65 | 0.63 | - 1.4%                         | - 2.1%                   |
| EI      | Ireland                | 0.46 | 0.44 | 0.49 | 0.46 | 0.44 | 0.43 | 0.42 | - 1.5%                         | - 3.6%                   |
| LS      | Switzerland            | 0.77 | 0.78 | 0.75 | 0.76 | 0.73 | 0.72 | 0.70 | - 1.6%                         | - 2.0%                   |
| GC      | Spain Canarias         | 0.91 | 0.89 | 0.89 | 0.86 | 0.83 | 0.83 | 0.82 | - 1.8%                         | - 2.1%                   |
| EK      | Denmark                | 0.58 | 0.59 | 0.63 | 0.60 | 0.57 | 0.54 | 0.51 | -2.0%                          | -5.1%                    |
| ES      | Sweden                 | 0.53 | 0.50 | 0.50 | 0.49 | 0.48 | 0.47 | 0.46 | -2.4%                          | -2.1%                    |
| LC      | Cyprus                 | 0.46 | 0.42 | 0.45 | 0.44 | 0.41 | 0.41 | 0.40 | -2.6%                          | -3.1%                    |
| LA      | Albania                | 0.54 | 0.50 | 0.54 | 0.54 | 0.52 | 0.48 | 0.45 | - 2.9%                         | - 4.4%                   |
| LE      | Spain Continental      | 0.84 | 0.78 | 0.81 | 0.78 | 0.73 | 0.72 | 0.69 | - 3.2%                         | - 3.8%                   |
| ED      | Germany                | 0.68 | 0.68 | 0.65 | 0.63 | 0.61 | 0.58 | 0.56 | - 3.2%                         | - 3.8%                   |
| Agency  | EUROCONTROL Agency     | 0.08 | 0.08 | 0.07 | 0.07 | 0.07 | 0.07 | 0.06 | - 3.4%                         | - 3.2%                   |
| LI      | Italy                  | 0.73 | 0.69 | 0.69 | 0.66 | 0.64 | 0.62 | 0.59 | - 3.4%                         | - 4.0%                   |
| LP      | Portugal Lisboa        | 0.60 | 0.59 | 0.58 | 0.56 | 0.52 | 0.50 | 0.48 | - 3.7%                         | - 4.4%                   |
| EG      | UK                     | 0.85 | 0.88 | 0.83 | 0.79 | 0.76 | 0.72 | 0.67 | - 3.8%                         | - 5.2%                   |
| LR      | Romania                | 0.70 | 0.60 | 0.61 | 0.61 | 0.58 | 0.57 | 0.55 | - 3.9%                         | - 2.6%                   |
| LW      | FYROM                  | 0.65 | 0.66 | 0.62 | 0.57 | 0.55 | 0.53 | 0.50 | -4.3%                          | -5.1%                    |
| LO      | Austria                | 0.68 | 0.64 | 0.60 | 0.57 | 0.55 | 0.54 | 0.52 | - 4.5%                         | - 3.7%                   |
| AZ      | Portugal - Santa Maria | 0.29 | 0.27 | 0.26 | 0.25 | 0.24 | 0.23 | 0.22 | - 4.5%                         | - 3.9%                   |
| EB_EL   | Belgium-Luxembourg     | 0.67 | 0.63 | 0.61 | 0.58 | 0.55 | 0.52 | 0.50 | - 4.8%                         | - 5.0%                   |
| LH      | Hungary                | 0.47 | 0.39 | 0.40 | 0.37 | 0.35 | 0.35 | 0.34 | - 5.3%                         | - 4.1 %                  |
| LU      | Moldova                | 0.44 | 0.46 | 0.47 | 0.42 | 0.37 | 0.34 | 0.30 | - 6.1%                         | - 10.5%                  |
| LT      | Turkey                 | 0.40 | 0.38 | 0.35 | 0.33 | 0.30 | 0.29 | 0.27 | - 6.2%                         | - 6.2%                   |
| LB      | Bulgaria               | 0.61 | 0.60 | 0.56 | 0.52 | 0.47 | 0.44 | 0.42 | -6.3%                          | -7.1%                    |
| LD      | Croatia                | 0.58 | 0.55 | 0.42 | 0.42 | 0.41 | 0.40 | 0.38 | - 6.6%                         | - 2.5%                   |
| LG      | Greece                 | 0.56 | 0.51 | 0.46 | 0.42 | 0.40 | 0.37 | 0.35 | - 7.6%                         | - 6.8%                   |
| LM      | Malta                  | 0.52 | 0.46 | 0.44 | 0.42 | 0.36 | 0.34 | 0.31 | -8.1%                          | -8.5%                    |
| LQ      | Bosnia-Herzegovina     | 0.42 | 0.39 | 0.28 | 0.23 | 0.20 | 0.18 | 0.16 | - 14.7%                        | - 13.1%                  |
|         |                        |      |      |      |      |      | _    |      |                                |                          |
| Network | Network                | 0.74 | 0.73 | 0.72 | 0.70 | 0.68 | 0.66 | 0.64 | -2.5%                          | -3.0%                    |

States' cost-effectiveness objectives (Real en-route national costs per km - €2005)

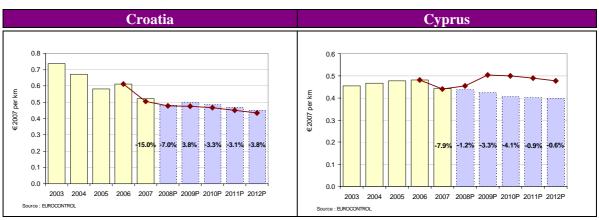
#### Monitoring of the five-year multi-annual real en-route unit cost forecasts per State

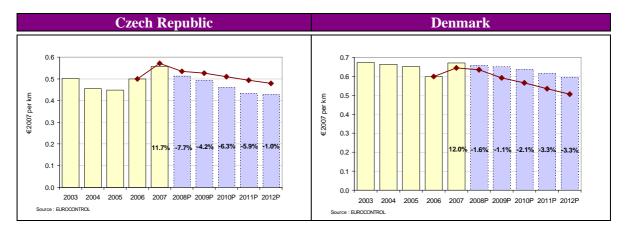
The data reported in the charts below were provided by EUROCONTROL Member States for the purposes of the Enlarged Committee for Route Charges in November 2007 (red line) and in November 2008 (yellow and blue bars). It should be noted that some States slightly amended their traffic and costs forecast between September and November 2007. This implies that for those States, the information provided below slightly differ from the data reported in the Table above (i.e. Report of the ANSB Cost-effectiveness Task Force in September 2007).

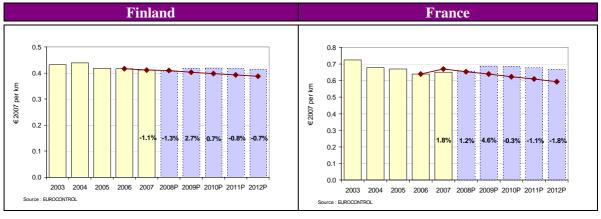
# LEGEND State objective for the real en route national costs per km (Nov. 2007) - €2007 State real en-route national costs per km (Nov. 2008) - €2007 % State real en-route national costs per km annual growth rate

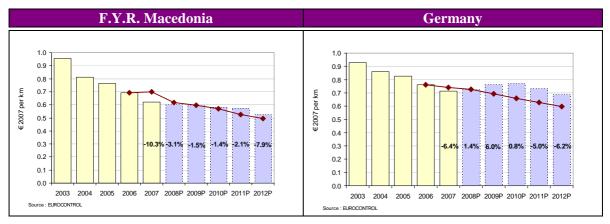


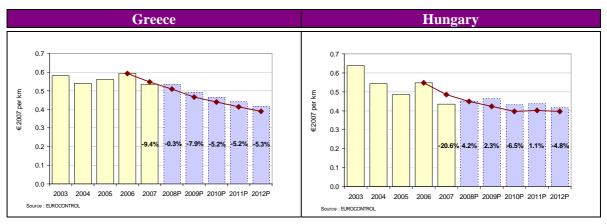


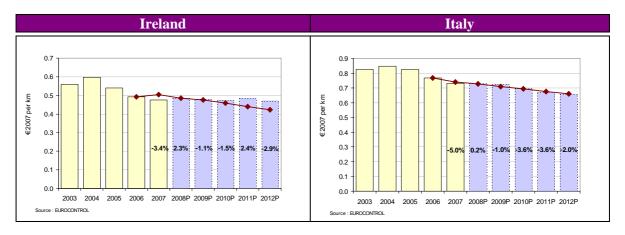


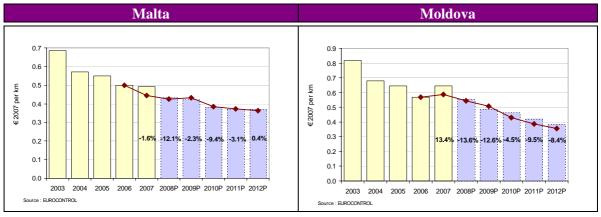


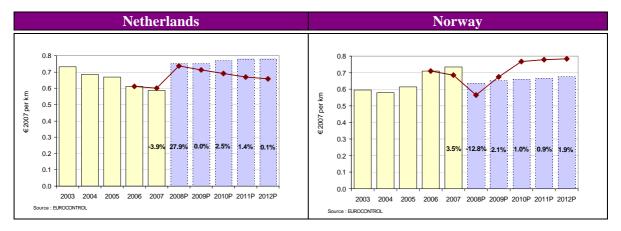


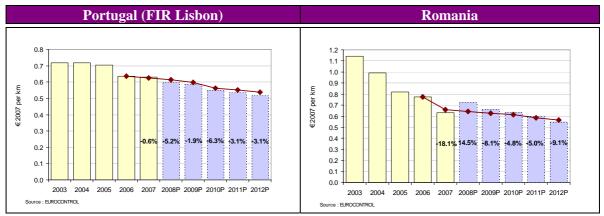


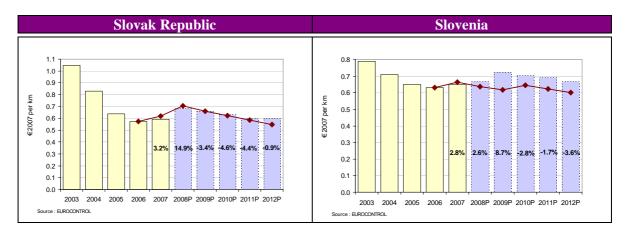


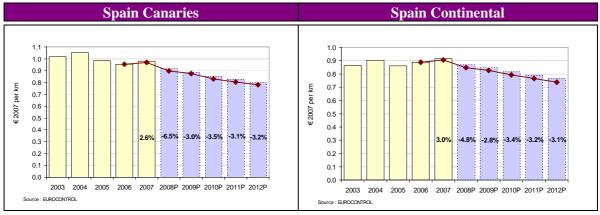


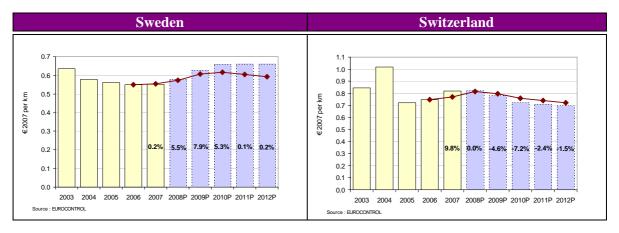


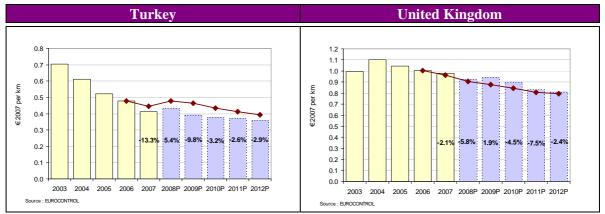




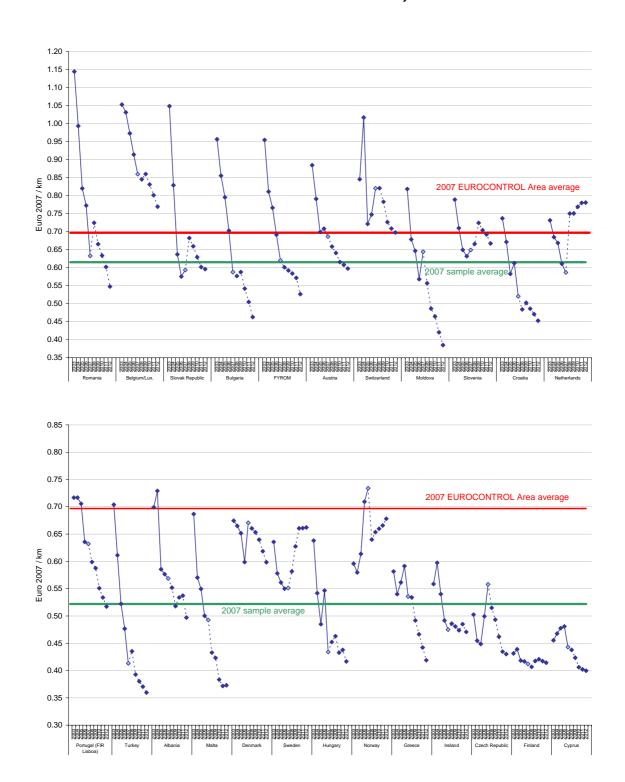








## ANNEX VIII - CHANGES IN REAL EN-ROUTE UNIT COSTS FOR STATES (EXCEPT THE FIVE LARGEST) BETWEEN 2003 AND 2012



#### **ANNEX IX - ANSP PERFORMANCE SHEETS**

The table below gives the data sources used to compile the ANSP Performance sheets. Please note that data from ACE are provisional: they are those available on 6 May 2009.

| IFR flights controlled by the ANSP. For EANS, LGS, On Mayingaigh; source is ACE. DIO - Total IFR flights controlled by the ANSP. F4 - IFR flights controlled by the ANSP. F4 - IFR flights controlled by the ANSP. F4 - IFR flights controlled by the ANSP (forecast).  FR flights controlled Complexity metrics for ANSP Benchmarking analysis (report by the ACE Working group on Complexity) Ref. I II.  FOR TANS LOS, On Mayingaigh; source is ACE. DIO - Total IFR flights controlled by the ANSP. For EANS, LGS, On Mayingaigh; source is ACE. DIO - Total IFR flights controlled by the ANSP. FOR flight hours controlled (COO)  FFR flight hours controlled (COO) FFR flight hours controlled (COO) FFR flight hours controlled by the ANSP. FOR FLANS LGS, ON Mayingaigh; source is ACE. DIO - Total IFR flight hours controlled by the ANSP. FOR FLANS LGS, ON Mayingaigh; source is ACE. DIO - Total IFR flight hours controlled by the ANSP. FOR FLANS LGS, ON Mayingaigh; source is ACE. DIO - Total IFR flight hours controlled by the ANSP. FOR FLANS LGS, ON Mayingaigh; source is ACE. DIO - Total IFR flight hours controlled by the ANSP. FOR FLANS LGS, ON Mayingaigh; source is ACE. DIA - Total IFR flight hours controlled by the ANSP. FOR FLANS LGS, ON Mayingaigh; source is ACE. DIA - Total IFR flight hours controlled by the ANSP. FOR FLANS LGS, ON Mayingaigh; source is ACE. DIA - Total IFR flight hours controlled by the ANSP. FOR FLANS LGS, ON Mayingaigh; source is ACE. DIA - Total IFR flight hours controlled by the ANSP. FOR FLANS LGS, ON Mayingaigh; source is ACE. ATTHM Delays (COO) ATTHM Delays and the ANSP Corecast). ATTHM Delays (COO) ATTHM Delays (COO) ATTHM Delays and the ANSP LOS ANSP Corecast). ATTHM Delay (COO) ATTHM Delays (COO) ATTHM Delay | TRAFFIC   | Data source         |  |
|--|---|---------------------|--|
| Seasonal Variation CFMU  Report Complexity Ref. 11].  KEY DATA  TOTAL IFR flights controlled by the ANSP. (Forecast).  KEY DATA  TOTAL IFR flights controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D10 - Total IFR flights controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D10 - Total IFR flights controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D10 - Total IFR flights controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D10 - Total IFR flights bours controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D14 - Total IFR flight hours controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D14 - Total IFR flight hours controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D14 - Total IFR flight hours controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D14 - Total IFR flight hours controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D16 - IFR airport movements controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D16 - IFR airport movements controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D16 - IFR airport movements controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D16 - IFR airport movements controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D16 - IFR airport movements controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D16 - IFR airport movements controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D16 - IFR airport movements controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D16 - IFR airport movements controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D16 - IFR airport movements controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D16 - IFR airport movements controlled by the ANSP. For EANS, LOS, On Navigacija: source is ACE. D16 - IFR airport movements controlled by the ANSP. For EANS, LOS, On Navigacija: source i | IFR Flight  | CFMU                |  |
| Report   Complexity   Refer     |   |                     |  |
| Seasonal Variation   CFMU   Report   Complexity metrics for ANSP Benchmarking analysis (report by the ACE Working group on Complexity) [Ref.11].   |   |                     | · ·  |
| Report   Complexity metrics for ANSP Benchmarking analysis (report by the ACE Working group on Complexity) [Ref.11].   | Seasonal Variation  | CFMU                | 14 - If Kinghas conducted by the Artist (Forecast).  |
| Complexity) [Ref.11].  |   |                     | Complexity metrics for ANSP Benchmarking analysis (report by the ACE Working group on  |
| Total IFR flights controlled (1909)   Fig. Earls, LGS, Oro Navigacija: source is ACE.  | . ,   | •                   |  |
| For EANS, LGS, Orn Navigacija: source is ACE.  | KEY DATA  |                     |  |
| DIO – Total IFR flights controlled by the ANSP. F4 – IFR flights controlled by the ANSP (Forecast).  IFR flight hours controlled (1000)  IFR flight hours controlled by the ANSP (Forecast).  IFR flight hours controlled by the ANSP. For EANS, LGS, Oro Navigacija : source is ACE. D14 – Total IFR flight hours controlled by the ANSP. F6 – Total IFR flight hours controlled by the ANSP. F6 – Total IFR flight hours controlled by the ANSP. F6 – Total IFR flight hours controlled by the ANSP. F6 – Total IFR flight hours controlled by the ANSP. F7 – IFR airport movements a airports controlled by the ANSP. F7 – IFR airport movements a controlled by the ANSP. F7 – IFR airport movements controlled by the ANSP (Forecast).  ER Route ATFM delays (1000)  ER Route ATFM delay (1000)  ER Route ATFM delays (1000)  ER Route ATFM delays (1000)  ER Route ATFM delays (100 | Total IFR flights controlled  | CFMU                | IFR flights controlled by the ANSP.  |
| F4 - IFR flights hours controlled   CFMU   FR flights hours controlled by the ANSP (Forecast).   | (000)   |                     |  |
| IFR flight-hours controlled (1000)   |   |                     |  |
| For EANS, LGS, Oro Navigacija : source is ACE   D14-Total IFR flight hours controlled by the ANSP (Forecast).  | IFR flight-hours controlled   | CFMU                |  |
| Fo -Total IFR flight hours controlled by the ANSP (Forecast).   For EANS, LGS, Oro Navigacija : source is ACE. D16-IFR airport movements at airport movements controlled by the ANSP (Forecast).   For EANS, LGS, Oro Navigacija : source is ACE. D16-IFR airport movements controlled by the ANSP (Forecast).   En Route ATFM delays (**O00 minutes)  | =   | Crivic              |  |
| IFR airport movements   CFMU   IFR airport movements at airports controlled by the ANSP   For EANS, LGS, Gor Navagacjaic source is ACE.   D16-IFR airport movements controlled by the ANSP   For EANS, LGS, Gor Navagacjaic source is ACE.   D16-IFR airport movements controlled by the ANSP   For EANS, LGS, Gor Navagacjaic source is ACE.   D16-IFR airport movements controlled by the ANSP (Forecast).   |   |                     |  |
| For EANS, LGS, Oro Navigacija : source is ACE.  D16- IFR airport movements controlled by the ANSP. F7- IFR airport movements controlled by the ANSP (Forecast).  En Route ATFM delays ('000 minutes)  ATFM delays due to a regulation applied on a sector or an en-route point. ATFM delays see Glossary.  AIFM delays; see Glossary.  Total Staff  ACE ***  C14-TOTAL STAFF [En route + Terminal] (FTE = full time equivalent).  ATCOs in OPS  ACE C4-ATCOs in OPS [En route + Terminal] (FTE = full time equivalent).  ATM/CNS provision costs (million & ACE **)  ATM/CNS provision costs (million & ANSP **)  ATM/CNS provision costs in real term (Composite Flight hours.  Composite Flight hours see Glossary.  Employment Cost Per ACE **  Employment Cost in real term: (ATM/CNS provision costs - Employment Cost)  Composite flight hours see Glossary.  ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  EN ROUTE ATFM DELAY **  Days with En route delay per flight > 1 min in the ACC.  (Composite flight hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  EN ROUTE ATFM DELAY **  The Noute ATFM delay per flight > 1 min in the ACC.  (Composite flight hours |   | GEN 61              |  |
| D16- IFR airport movements controlled by the ANSP.   F7- IFR airport movements controlled by the ANSP (Precast).   |   | CFMU                |  |
| F7. IFR airport movements controlled by the ANSP (Forecast). ATFM delays due to a regulation applied on a sector or an en-route point. ATFM delays were do regulation applied on a sector or an en-route point. ATFM delays due to a regulation applied on an airport or a group of airports controlled by the ansper or a sector or an en-route point. ATFM delays due to a regulation applied on an airport or a group of airports controlled by the ansper or a sector or an en-route point. ATFM delays due to a regulation applied on an airport or a group of airports controlled by the ansper or ansper or a sector or an en-route point. ATFM delays due to a regulation applied on an airport or a group of airports controlled by the ansper or ansper or ansper or ansper or an en-route point. ATFM delays due to a regulation applied on an airport or a group of airports controlled by the ansper or an en-route point. ATFM delays due to a regulation applied on an airport or a group of airports controlled by the ansper or an en-route point. ATFM delays due to a regulation applied on an airport or a group of airports controlled by the ansper or an en-route point. ATFM delays due to a regulation applied on an airport or a group of airports controlled by the ansper or an en-route point. ATFM delays due to a regulation applied on an airport or a group of airports controlled by the ansper or an en-route point. ATFM delays see Glossary.  ATM/CNS provision costs and ansper of any ansper or "ATFM and ansper or and ansper or ange or "ATFM and ansper or ange or   | controlled ( 000)   |                     |  |
| ATFM delays: see Glossary.  Airport ATFM Delays ('000 minutes)  ATFM delays due to a regulation applied on an airport or a group of airports controlled by the ANSP of the ANS |   |                     |  |
| Airport ATEM Delays (*000 minutes)  ACE *** C14 - TOTAL STAFF [En route + Terminal] (FTE = full time equivalent).  ACOS in OPS ACE C4 - ATCOS in OPS [En route + Terminal].  ATM:CNS provision costs (million €2004)  ATM:CNS provision costs (million €2004)  ATM:CNS provision costs (million €2004)  ACE ATCOS in OPS [En route + Terminal].  ATM:CNS provision costs (million €2004)  ACE ATCOS in OPS (En route + Terminal] in real term.  F14 - TOTAL "Controllable ANSP costs" [En-route + Terminal] in real term.  F14 - TOTAL "Controllable ANSP costs" [En-route + Terminal] in real term.  F14 - TOTAL "Controllable ANSP costs" [En-route + Terminal] in real term.  F14 - TOTAL "Controllable ANSP costs" [En-route + Terminal] in real term.  F14 - TOTAL "Controllable ANSP costs" [En-route + Terminal] in real term.  F14 - TOTAL "Controllable ANSP costs" [En-route + Terminal] in real term.  C3 pital Investment (M ⊕) ACE F34 : TOTAL En route+Terminal CAPEX (see Glossary).  SAFETY ANSP Annual Report published by the ANSP + other reports.  COST-EFFECTIVENESS  ATM:CNS provision costs in real term / Composite Flight hours.  Composite Flight Hours: see Glossary.  Employment Cost Per ACE Employment Cost in real term: (ATM:CNS provision costs - Employment Cost].  Composite Flight hours: 2000 in 300 ("ATCO in OPS" hours on duty [ACC+APP+TWR].  En route ATFM DELAY **  Days with En route delay per flight hours: see Glossary.  ATCO hours: D200 Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  EN ROUTE ATFM DELAY **  Days with En route delay per flight - I min in the ACC.  En-route ATFM delay per flight - I minute in the year covered by the report.  En route ATFM delay Per flight - I minute in the year covered by the report.  En route ATFM delay Per flight - I minute in the year covered by the route ATFM regulation divided by the total number of flights delayed Glight Occasion of flights.  AIRPORT ATFM Delay per Arrival flight (Weather – Other)  ATFM Delay per Arrival flight (Weather – Other)  ATFM Delay per Arrival flight (Weather – Other)  A  | -   | CFMU                |  |
| minutes)  ANSP **  Total Staff*  |   | CED III             |  |
| ACE C4 - ATCOs in OPS [En route + Terminal]. F10 + F13 :Number of "ATCOs in OPS" planned to be operational at year end [ACC+APP+TWR].  ATM/CNS provision costs (million €2004) Capital Investment (M ←) ACE F14 - TOTAL "Controllable ANSP costs" [En-route + Terminal] in real term. F14 - TOTAL "Controllable ANSP costs" [En-route + Terminal] in real term. F14 - TOTAL "Controllable ANSP costs" [En-route + Terminal] in real term.  ATM/CNS provision Cost F14 - TOTAL En route+Terminal CAPEX (see Glossary).  ATM/CNS provision Cost Per composite Flight hour Employment Cost Per ACE ACE Employment Cost in real term / Composite Flight Hours: see Glossary.  Support Cost Per Composite F12 Hour Composite flight hour per ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost]. Composite flight hour: see Glossary.  Composite flight hours per ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost]. Composite flight hour: see Glossary.  ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  ENROUTE ATFM DELAY **  Days with En route delay per flight   Mumber of days where en route ATFM delay per flight > 1 minute En route ATFM delay per flight   CFMU Symbort ACT   Days with delays: Days with En route delay per flight   Days with delays: Days with En route delay per flight   Days with delays: Days with En route delay greater than I minute in the ACC.  Support Cost Per Composite flight with the per covered by the report.  En route ATFM delay   CFMU Symbort Melays   Days with delays: Days with En route delay greater than I minute in the ACC.  **G flights delayed flight   CFMU Symbort Melays (CFMU Symbort Melays (CFMU Symbort Melays) (CFMU Symbort Melay (CFMU Symbort Melays) (CFMU Sym  |   |                     |  |
| ATM/CNS provision costs (million @2004) ATM/CNS provision costs (million @2004) ACE F34 : TOTAL "Controllable ANSP costs" [En-route + Terminal] in real term. F14 - TOTAL "Controllable ANSP costs" [En-route + Terminal] in real term. F34 : TOTAL En route+Terminal CAPEX (see Glossary).  ANSP Annual Report published by the ANSP + other reports.  COST-EFFECTIVENESS ATM/CNS provision Cost Per ATM/CNS provision costs in real term / Composite Flight hours. Composite Flight hour C15: Staff costs for "ATCO in OPS" [En-route + Terminal]. ATCO hour ATCO in OPS" [En-route + Terminal]. ATCO hours: Do2 Sum of "ATCO in OPS" [En-route + Terminal]. ATCO hours: Do2 Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  Support Cost Per Composite Flight Hour Composite Flight hour: see Glossary.  Composite flight hour see Glossary. ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost]. Composite flight hour: see Glossary. ACC composite flight hours: see Glossary. ACC hours: Do2 Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  EN ROUTE ATFM DELAY **  Days with En route delay per flight * I min in the ACC. En route AFM delay per flight * I min in the ACC.  En route AFM delay per flight * I min in the ACC.  ## flights delayed CFMU CFMU Days with delays see Glossary.  CFMU Number of flights delayed due to en-route ATFM regulation divided by the total number of flights.  AIRPORT ATFM DELAY **  ATFM Delay per Arrival CFMU ATFM delay divided by the number of flights landing at these airports. (For all the airports controlled by the ANSP).  ATFM Delay per Arrival GFMU Same as above but with the split between delay due to weather or other delays.  | Total Staff   | ACE 98              | 2 2 2  |
| [ACC+APP+TWR].   | ATCOs in OPS  | ACE                 |  |
| ATM/CNS provision costs (million @004)  Capital Investment (M ⊕)  ACE  F34: TOTAL "Controllable ANSP costs" [En-route + Terminal] in real term.  Epital Investment (M ⊕)  ACE  F34: TOTAL En route+Terminal CAPEX (see Glossary).  SAFETY  ANSP  Annual Report published by the ANSP + other reports.  COST-EFFECTIVENESS  ATM/CNS provision Cost Per composite Flight hour  Employment Cost Per ACE  Employment Cost in real term: (Cliss Staff costs for "ATCOs in OPS" [En-route + Terminal],  ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  Support Cost Per Composite  Flight Hour  Composite flight hours see Glossary.  Composite flight hours per ACE  Composite flight hours see Glossary.  ATCO hours  EN ROUTE ATFM DELAY **  Days with En route delay per flight > 1 min in the ACC.  En-route AFM delay per flight > 1 min the ACC.  En-route AFM delay per flight > 1 min the ACC.  En-route ATFM delay  CFMU  Days with delays: Days with En route day greater than 1 minute in the ACC.  Possible flights delayed due to en-route ATFM regulation divided by the total number of flights.  AIRPORT ATFM DELAY **  ATFM Delay per Arrival flight  ATFM Delay per Arrival flight  ATFM Delay per Arrival flight  CFMU  ATFM Delay per Arrival flight Noure above but with the split between delay due to weather or other delays.  Same as above but with the split between delay due to weather or other delays.  |   |                     |  |
| (million €2004)       F14 - TOTAL "Controllable ANSP costs" [En-route + Terminal] in real term.         Capital Investment (M ⊕)       ACE       F34 : TOTAL En route+Terminal CAPEX (see Glossary).         SAFETY       ANSP       Annual Report published by the ANSP + other reports.         COST-EFFECTIVENESS         ATM/CNS provision Cost Per composite Flight hour       ACE       ATM/CNS provision costs in real term / Composite Flight hours.         Employment Cost Per ATCO hour       ACE       Employment Cost in real term: (C15: Staff costs for "ATCO in OPS" [En-route + Terminal], ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].         Support Cost Per Composite Flight hour       ACE       Support Cost in real term: [ATM/CNS provision costs - Employment Cost]. Composite flight hour: see Glossary.         Composite flight hours see Glossary.       Composite flight hours: see Glossary.         EN ROUTE ATFM DELAY ***       ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].         EN ROUTE ATFM DELAY ***       Number of days where en route ATFM delay per flight > 1 min in the ACC. En-route ATFM delay per flight > 1 min in the ACC.         En route AFM delay per flight       CFMU       Number of days where en route ATFM regulation divided by the total number of flights.         En route ATFM delay       CFMU       Days with delays: Days with En route delay greater than 1 minute in the ACC.         % flights delayed       CFMU       Days with  | A FED 6/GD IG   | A CIE               | ,  |
| Capital Investment (M ⊕)         ACE         F34 : TOTAL En route+Terminal CAPEX (see Glossary).           SAFETY         ANSP         Annual Report published by the ANSP + other reports.           COST-EFFECTIVENESS         ATM/CNS provision Cost Per Composite Flight hour         ACE         ATM/CNS provision costs in real term / Composite Flight hours. See Glossary.           Employment Cost Per Composite Flight Hour         ACE         Employment Cost in real term: In real term: C15: Staff costs for "ATCOs in OPS" [En-route + Terminal]. ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].           Support Cost Per Composite Flight Hour         ACE         Support Cost in real term: [ATM/CNS provision costs - Employment Cost]. Composite flight hours: see Glossary.           Composite flight hour         ACE         Support Cost in real term: [ATM/CNS provision costs - Employment Cost]. Composite flight hour: see Glossary. ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].           EN ROUTE ATFM DELAY ** Days with En route delay per flight > 1 minute En route AFM delay per Glight > 1 minute in the ACC. En-route ATFM delay per flight > 1 minute in the ACC. En-route ATFM delay: see Glossary. The ACC selected is the ACC which as the maximum number of days with en-route delay per flight > 1 minute in the year covered by the report.           En route AFM delay         CFMU         Days with delays: Days with En route delay greater than 1 minute in the ACC. Mumber of flights delayed due to en-route ATFM regulation divided by the total number of flights.           AIRPORT ATFM DELAY ** ATFM Delay per Arrival flight  |   | ACE                 |  |
| COST-EFFECTIVENESS  ATM/CNS provision Cost ACE ATM/CNS provision costs in real term / Composite Flight hours.  Per composite Flight hour Cost Per ACE Employment Cost in real term:  C15: Staff costs for "ATCOs in OPS" [En-route + Terminal].  ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  Support Cost Per Composite Flight hour: see Glossary.  Composite flight hour see Glossary.  Composite flight hour: see Glossary.  ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  EN ROUTE ATFM DELAY POLICY ATCO in OPS" hours on duty [ACC+APP+TWR].  EN ROUTE ATFM DELAY POLICY ATCO in OPS" hours on duty [ACC+APP+TWR].  EN ROUTE ATFM delay per flight > 1 minute  En route AFM delay per flight > 1 minute in the ACC.  En route AFM delay per flight > 1 minute in the year covered by the report.  For route ATFM delay CFMU Days with delays: Days with En route delay greater than 1 minute in the ACC.  % flights delayed CFMU Number of flights delayed due to en-route ATFM regulation divided by the total number of flights.  AIRPORT ATFM Delay per Arrival CFMU ATFM Delay due to airport regulations divided by the number of flights landing at these airports. (For all the airports controlled by the ANSP).  ATFM Delay per Arrival CFMU Same as above but with the split between delay due to weather or other delays.  |   | ACE                 |  |
| ATM/CNS provision Cost ACE ATM/CNS provision costs in real term / Composite Flight hours.  Employment Cost Per ACE Employment Cost in real term:  C15: Staff costs for "ATCO in OPS" [En-route + Terminal],  ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  Support Cost Per Composite Flight hour see Glossary.  Composite flight hour see Glossary.  Composite flight hours per ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  Composite flight hours see Glossary.  Composite flight hours: See Glossary.  Composite flight hours: See Glossary.  ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  EN ROUTE ATFM DELAY PACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  EN ROUTE ATFM DELAY PACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  En route ATFM DELAY PACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  En route ATFM delay PACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  En route ATFM delay PACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  The ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  The ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  The ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  The ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  The ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  The ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  The ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  The ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  The ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  The ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  The ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  The ACE Suppo | SAFETY  | ANSP                | Annual Report published by the ANSP + other reports.   |
| ATM/CNS provision Cost Per composite Flight hour Employment Cost Per ACE ATCO hour Cost Per ATCO hour Cost Per Composite Flight Hours: see Glossary.  Employment Cost Per ATCO hour Cost Per Composite Flight Hours: see Glossary.  Employment Cost Per Composite ATCO hours Cost Per Composite Cost Per Composite Flight Hour Support Cost Per Composite Flight Hour Composite flight hours: see Glossary.  ATCO hours  ACE Support Cost in real term: [ATM/CNS provision costs - Employment Cost]. Composite flight hour: see Glossary.  Composite flight hours: see Glossary.  ATCO hours  ACE Composite flight hours: see Glossary.  ATCO hours  EN ROUTE ATFM DELAY  Days with En route delay per flight > 1 min in the ACC. En-route ATFM delay: see Glossary.  En route AFM delay per GFMU Finght I minute in the year covered by the report.  En route ATFM delay CFMU Days with delays: Days with En route delay greater than 1 minute in the ACC.  % flights delayed CFMU Days with delays: Days with En route delay greater than 1 minute in the ACC.  Number of flights delayed due to en-route ATFM regulation divided by the total number of flights.  AIRPORT ATFM Delay  ATFM Delay per Arrival flight CFMU ATFM Delay due to airport regulations divided by the number of flights landing at these airports. (For all the airports controlled by the ANSP).  ATFM Delay per Arrival flight (Weather – Other)  ACE ACE ACE ACE ACE ACE ACE ACE ACE AC  | COST-EFFECTIVENESS  | •                   |  |
| Employment Cost Per   ACE   Employment Cost in real term:   C15: Staff costs for "ATCO in OPS" [En-route + Terminal].   ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].   |   | ACE                 | ATM/CNS provision costs in real term / Composite Flight hours.   |
| ATCO hour C15: Staff costs for "ATCOs in OPS" [En-route + Terminal]. ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  Support Cost Per Composite Flight Hour Composite flight hours per ACE Composite flight hours: see Glossary. ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  EN ROUTE ATFM DELAY PACE Composite flight hours: see Glossary. ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  EN ROUTE ATFM DELAY PACE CFMU Number of days where en route ATFM delay per flight > 1 min in the ACC. En-route ATFM delay: see Glossary.  En route AFM delay per flight > 1 minute En-route ATFM delay: see Glossary.  En route AFM delay per flight > 1 minute in the year covered by the report.  En route ATFM delay CFMU Days with delays: Days with En route delay greater than 1 minute in the ACC.  % flights delayed CFMU Number of flights delayed due to en-route ATFM regulation divided by the total number of flights.  Delay per delayed flight CFMU En route ATFM delay divided by the number of flights.  AIRPORT ATFM DELAY ATFM DELAY ATFM Delay per Arrival flight CFMU Same as above but with the split between delay due to weather or other delays.  AIFM Delay per Arrival flight CFMU Same as above but with the split between delay due to weather or other delays.   |   |                     |  |
| Support Cost Per Composite Flight Hour Composite flight hours see Glossary.  Composite flight hours see Glossary.  ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  Composite flight hour: see Glossary.  ATCO hours  ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].  EN ROUTE ATFM DELAY **  Days with En route delay per flight > 1 min in the ACC.  En-route AFM delay per flight > 1 minute  En route AFM delay per flight > 1 minute in the year covered by the report.  En route ATFM delay  CFMU Days with delays: Days with En route delay greater than 1 minute in the ACC.  flights delayed  CFMU Number of flights delayed due to en-route ATFM regulation divided by the total number of flights.  Delay per delayed flight  CFMU En route ATFM delay divided by the number of flights.  AIRPORT ATFM DELAY **  ATFM Delay per Arrival flight  CFMU Same as above but with the split between delay due to weather or other delays.  AIRPOR ATFM Delay per Arrival flight (Weather – Other)  Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  Support Cost in real term: [ATM/CNS provision costs - Employment Cost].  ATFM Delay per flight hour: see Glossary.  ATFM Delay per Arrival flight (See Antifolion of the per flight of the pe | 1 0   | ACE                 |  |
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| Days with En route delay per flight > 1 min in the ACC.  En-route AFM delay per flight > 1 min in the ACC.  En-route AFM delay per flight > 1 min in the ACC.  En-route AFM delay per flight > 1 min in the ACC.  En-route AFM delay per flight > 1 min in the ACC selected is the ACC which as the maximum number of days with en-route delay per flight > 1 minute in the year covered by the report.  En route ATFM delay   | ATCO hours  |                     | ATCO hours: D20: Sum of "ATCO in OPS" hours on duty [ACC+APP+TWR].   |
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| flights.  Delay per delayed flight  CFMU  En route ATFM delay divided by the number of flights.  AIRPORT ATFM DELAY  ATFM Delay per Arrival flight  ATFM Delay per Arrival plight  ATFM Delay per Arrival flight  CFMU  ATFM Delay due to airport regulations divided by the number of flights landing at these airports. (For all the airports controlled by the ANSP).  ATFM Delay per Arrival flight (Weather – Other)  Same as above but with the split between delay due to weather or other delays.  | En route AFM delay per flight   |                     | The ACC selected is the ACC which as the maximum number of days with en-route delay per flight > 1 minute in the year covered by the report.   |
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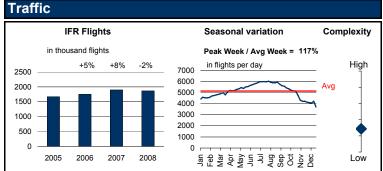
<sup>97</sup> Delay due to group of airports are allocated proportionally to the traffic at these airports.

<sup>98</sup> See "Specification for Information Disclosure, V. 2.6" (DEC '08) document for description of code (e.g.: D10).

<sup>99</sup> Regulations on traffic volumes EGLL60, EHFIRAM, LEBLFIN, LECMARR1 have been reclassified as airport regulations.

| ANSP name                 | Country               | Page |
|---------------------------|-----------------------|------|
| <b>A</b> ena              | Spain                 | A-1  |
| ANS CR                    | Czech Republic        | A-2  |
| ATSA Bulgaria             | Bulgaria              | A-3  |
| Austro Control            | Austria               | A-4  |
| Avinor                    | Norway                | A-5  |
| <b>B</b> elgocontrol      | Belgium               | A-6  |
| Croatia Control           | Croatia               | A-7  |
| <b>D</b> CAC Cyprus       | Cyprus                | A-8  |
| DFS                       | Germany               | A-9  |
| DHMİ                      | Turkey                | A-10 |
| DSNA                      | France                | A-11 |
| EANS                      | Estonia               | A-12 |
| ENAV                      | Italy                 | A-13 |
| <b>F</b> inavia           | Finland               | A-14 |
| <b>H</b> CAA              | Greece                | A-15 |
| HungaroControl            | Hungary               | A-16 |
| IAA                       | Ireland               | A-17 |
| LFV/ANS Sweden            | Sweden                | A-18 |
| LGS                       | Latvia                | A-19 |
| LPS                       | Slovak Republic       | A-20 |
| LVNL                      | Netherlands           | A-21 |
| <b>M</b> ATS              | Malta                 | A-22 |
| MK CAA                    | FYROM                 | A-23 |
| MoldATSA                  | Moldova               | A-24 |
| MUAC                      |                       | A-25 |
| <b>N</b> ATA Albania      | Albania               | A-26 |
| NATS                      | United Kingdom        | A-27 |
| NAV Portugal (FIR Lisboa) | Portugal              | A-28 |
| NAVIAIR                   | Denmark               | A-29 |
| Oro Navigacija            | Lithuania             | A-30 |
| PANSA                     | Poland                | A-31 |
| ROMATSA                   | Romania               | A-32 |
| Skyguide                  | Switzerland           | A-33 |
| Slovenia Control          | Slovenia              | A-34 |
| SMATA                     | Serbia and Montenegro | A-35 |
| UkSATSE                   | Ukraine               | A-36 |

#### Aena, Spain



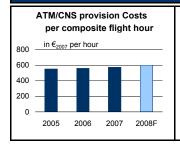
| Key data   | 2006                         | 2007                         | 2008(F)                      |
|--|------------------------------|------------------------------|------------------------------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) En Route ATFM delays ('000 minutes) | 1759<br>1325<br>1979<br>1420 | 1897<br>1420<br>2114<br>1398 | 1864<br>1410<br>2047<br>1063 |
| Airport ATFM delays ('000 minutes)  Total Staff  ATCOs in OPS  | 1157<br>3933<br>1934         | 1413<br>3966<br>1966         | 723<br>1972                  |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)  | 1025<br>130                  | 1129<br>130                  | 1972<br>1163<br>151          |

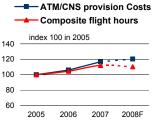
#### Safety

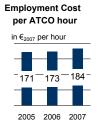
| RESULTADOS DE 2007 / 2007 RESULTS   |                        |                             |  |  |  |  |
|---|------------------------|-----------------------------|--|--|--|--|
| INDICADOR PLAN ANUAL 2007 / ANNUAL INDICATOR PLAN 2007  | META 2007<br>GOAL 2007 | CIERRE 2007<br>CLOSURE 2007 |  |  |  |  |
| Número de accidentes por causas de Navegación Aérea Red de Telecomunica-<br>ciones Aeronáuticas (ATN) / Comunicaciones, Navegación y Vigilancia (CNS) por<br>cada 100.000 movimientos / Number of accidents due to Ali Navigation reasons<br>Aeronautica Telecommunications Network (ATN) / Communications, Navigation<br>and Surveillance (CNS) for each 100,000 movements | 3,88*10-3              | 0                           |  |  |  |  |
| Número de incidentes con severidad A por causas de Navegación Aérea (ATN /<br>CNS) por cada 100.000 movimientos / Number of incidents at severity A level<br>due to Air Navigation reasons (ATN / CNS) for each 100.000 movements   | 1,005842               | 0,9736                      |  |  |  |  |
| Número de No Conformidades del Sistema de Gestión de Seguridad Operativa<br>(SGSO) de auditorias internas y externas / Number of non-conformities of the<br>Operational Security Management System (SGSO) of Internal and external<br>audits:   | <100                   | 14                          |  |  |  |  |

source: Memoria 2007 (ANSP annual report)

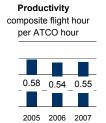
#### **Cost effectiveness**



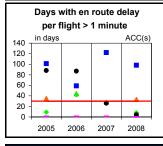








#### **En Route ATFM delay**





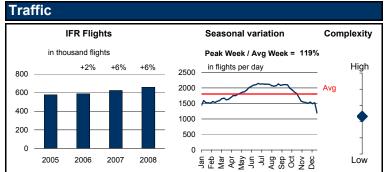
| En route ATF   | *                      | min)                 |                             |                  |
|----------------|------------------------|----------------------|-----------------------------|------------------|
| ACC            | Days with<br>delays>1m | % flights<br>delayed | Delay per<br>delayed flight | Delay ('000 min) |
| Madrid □       | 98                     | 5.1%                 | 15                          | 772              |
| Canarias ∆     | 33                     | 1.6%                 | 21                          | 100              |
| Sevilla ◊      | 8                      | 0.5%                 | 17                          | 36               |
| Barcelona A. o | 4                      | 1%                   | 15                          | 154              |
| Palma -        | 0                      | 0%                   | 18                          | 1                |





| Airports with | Delay per<br>arrival flight MALE | Arrival flights Delay (000) | Delay per<br>arrival flight | Arrival flights<br>('000) |
|---------------|----------------------------------|-----------------------------|-----------------------------|---------------------------|
| Ibiza         | 3.3                              | 27                          | Tenerife Sur. 0.7           | 29                        |
| Palma De Mal. | 1.6                              | 96                          | Barcelona 0.7               | 161                       |
| Madrid/Baraj. | 1.2                              | 235                         | Valencia 0.3                | 42                        |
| Gerona        | 8.0                              | 21                          | Las Palmas 0.2              | 57                        |
| Arrecife Lan. | 0.7                              | 26                          | Alicante 0.2                | 40                        |

#### ANS CR, Czech Republic



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 590  | 623  | 659     |
|  | 202  | 211  | 224     |
|  | 179  | 188  | 195     |
| En Route ATFM delays ('000 minutes)  | 495  | 451  | 291     |
| Airport ATFM delays ('000 minutes)   | 106  | 76   | 38      |
| Total Staff  | 859  | 868  | 188     |
| ATCOs in OPS   | 169  | 179  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> )   | 97   | 108  | 104     |
| Capital Investment (million €2007)   | 19   | 16   | 20      |

#### Safety

"The most important criterion for assessing the performance of ANS CR is the safety of the air navigation services provided. No case was recorded in 2007 in which ANS CR employees were involved in or directly caused an air accident or seriously endangered the safety of air transport.

Incidents in air traffic caused by ANS CR when providing ATS show a long-term stable development of both the number of incidents and the seriousness of their impact on the safety of air traffic. Seven incidents occurred in 2007; in accordance with the ICAO classification, four were assessed as "Major Incident" and two as "Significant Incident" and one as "No Effect". Taking into account the further significant increase of air traffic in the airspace and at the airports in the Czech Republic in 2007, the number of incidents converted to the operation unit constantly declining." (Extract from ANSP's 2007 annual report).

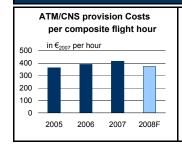
#### A summary of incidents reported in 2007

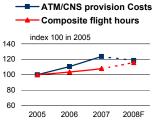
| Aircraft (Maximum<br>Take-Off Mass) | Serious<br>incident | Incident |
|-------------------------------------|---------------------|----------|
| Over 5 700 kg                       | 1                   | 243      |
| 2 250 - 5 700 kg                    | 0                   | 6        |
| 2 250 kg or less                    | 0                   | 33       |

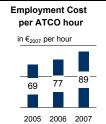
source: Air Accidents Investigation Institute of Czech Republic - annual report 2007

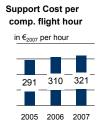
#### **Cost effectiveness**

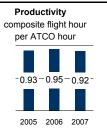
ESSAR 2 compliant severity classification



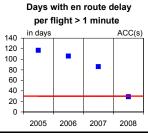


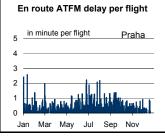


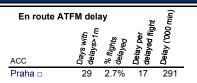




#### **En Route ATFM delay**

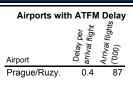




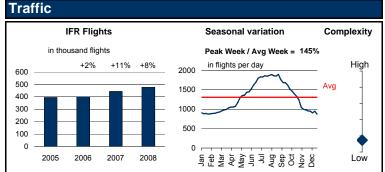








#### ATSA Bulgaria, Bulgaria

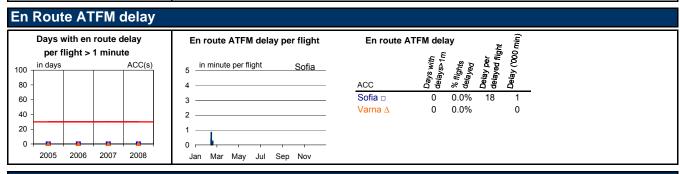


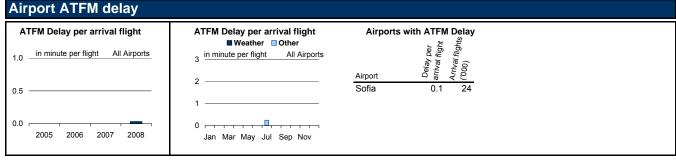
| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 402  | 444  | 478     |
|  | 137  | 152  | 161     |
|  | 69   | 76   | 83      |
| En Route ATFM delays ('000 minutes)  | 0    | 0    | 1       |
| Airport ATFM delays ('000 minutes)   | 0    | 0    | 1       |
| Total Staff  | 1309 | 1278 | 230     |
| ATCOs in OPS   | 239  | 237  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> )   | 76   | 70   | 70      |
| Capital Investment (million €2007)   | 7    | 10   | 7       |

#### Safety

No information found in ANSP's 2007 annual report.

#### **Cost effectiveness ATM/CNS** provision Costs - ATM/CNS provision Costs Support Cost per Productivity **Employment Cost** composite flight hour per composite flight hour -Composite flight hours per ATCO hour comp. flight hour per ATCO hour in €<sub>2007</sub> per hour index 100 in 2005 in €<sub>2007</sub> per hour in €<sub>2007</sub> per hour 600 140 120 400 300 100 0.57 \_0.45\_0.50 200 -395 320 80 100 60 2006 2007 2005 2006 2007 2008F 2005 2006 2007 2005 2006 2007





#### Austro Control, Austria



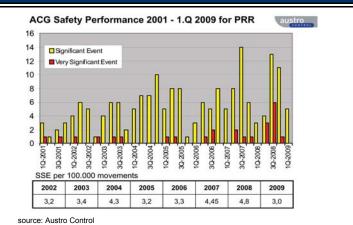
| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 854  | 926  | 955     |
|  | 279  | 305  | 316     |
|  | 366  | 392  | 409     |
| En Route ATFM delays ('000 minutes)  | 201  | 605  | 1047    |
| Airport ATFM delays ('000 minutes)   | 539  | 467  | 565     |
| Total Staff  | 820  | 833  | 269     |
| ATCOs in OPS   | 258  | 268  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> )   | 151  | 155  | 162     |
| Capital Investment (million €2007)   | 22   | 20   | 26      |

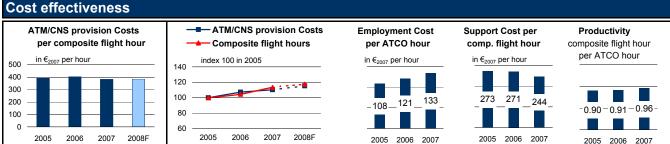
#### Safety

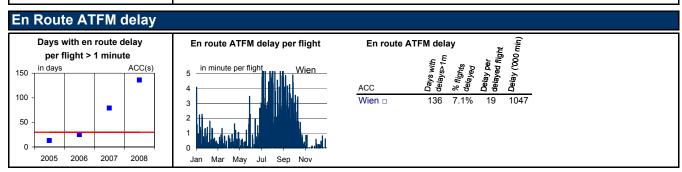
- 1. Although a negative deflection occurred during 2. to 4. quarter of 2008, the national Safety Performance Targets were never breached.
- 2. This temporary deflection is being acted upon with precise safety improvement actions with the focus to prevent reoccurrence of such a deflection in the future. In 1. quarter 2009 the SSE-Indicator shows a value equal to the long-term average over years, which indicates a first effect of the measures taken.
- 3. As required by national safety regulation, the SSE metric indicates the relative risk attribution to ATM of each incident. It does NOT indicate the absolute aviation risk of the incidents.

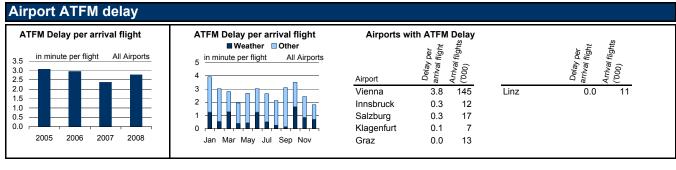
(source : Austro Control)

National severity classification.

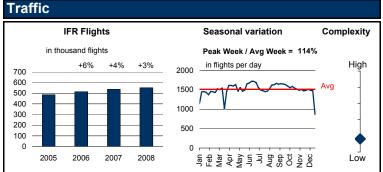








#### **Avinor, Norway**

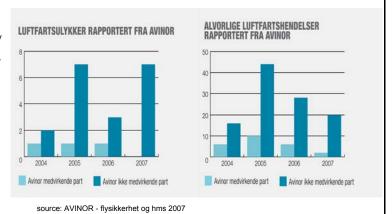


| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 515  | 538  | 552     |
|  | 293  | 306  | 315     |
|  | 722  | 750  | 761     |
| En Route ATFM delays ('000 minutes)  | 123  | 102  | 29      |
| Airport ATFM delays ('000 minutes)   | 28   | 70   | 78      |
| Total Staff  | 985  | 950  | 343     |
| ATCOs in OPS   | 387  | 328  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)                        | 140  | 177  | 175     |
|  | 12   | 19   | 31      |

#### Safety

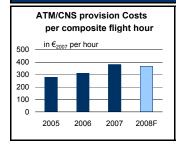
"There were no aviation accidents in Norwegian aviation in 2007 in which Avinor was a contributory party. In Avinor one serious aviation incident was recorded in which Avinor was a contributory party. The Accident Investigation Board's (AIBN) investigations have a broader scope than those undertaken by Avinor, and they may therefore reach different conclusions. The corresponding figures for 2006 were one aviation accident and eight serious aviation incidents.

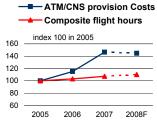
Avinor's aim is for there to be no aviation accidents in which Avinor is a contributory party, and that the number of serious aviation incidents in which it is a contributory party should be reduced." (Extract from ANSP's 2007 annual report).

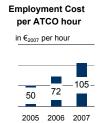


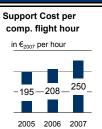
ESSAR 2 compliant severity classification.

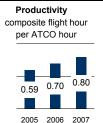
#### **Cost effectiveness**



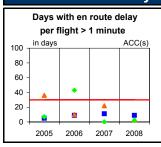


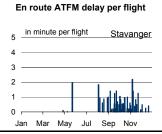


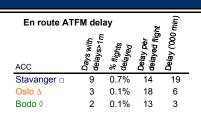




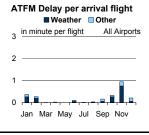
#### En Route ATFM delay



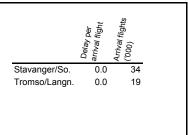




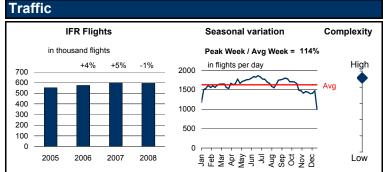




| Airports with | ATFM                        | l Delay                   |
|---------------|-----------------------------|---------------------------|
| Airport       | Delay per<br>arrival flight | Arrival flights<br>('000) |
| Oslo/Garder.  | 0.5                         | 118                       |
| Trondheim/Va. | 0.2                         | 26                        |
| Alesund/Vigr. | 0.2                         | 6                         |
| Bergen/Flesl. | 0.1                         | 46                        |
| Bodo          | 0.1                         | 20                        |
|               |                             |                           |



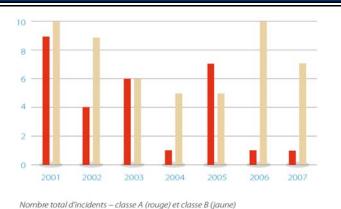
#### Belgocontrol, Belgium



| Key data  | 2006                           | 2007                           | 2008(F)                         |
|---|--------------------------------|--------------------------------|---------------------------------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) En Route ATFM delays ('000 minutes) Airport ATFM delays ('000 minutes) | 574<br>108<br>317<br>58<br>154 | 600<br>114<br>332<br>46<br>140 | 594<br>120<br>332<br>101<br>226 |
| Total Staff ATCOs in OPS ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)  | 979<br>233<br>145<br>19        | 968<br>228<br>139<br>21        | 230<br>150<br>43                |

#### Safety

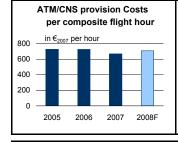
"2007 showed a decrease in the number of Class A and Class B incidents (8 instead of 11). The following incidents have been recorded: 1 Class A (same as in 2006) and 7 Class B (10 in 2006). The number of incidents per 100.000 movements follows the same trend. In 2007, 0.71 Class A and Class B incidents have been recorded per 100.000 movements, which are attributable to Belgocontrol. This result is better than last year (1.02). It is below the company's objective (maximum 1 incident per 100.000 movements) and clearly below what is defined in the management contract (maximum 1.5 incidents for every 100.000 movements)". (Extracted and translated from ANSP's 2007 annual report)

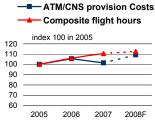


source : 2007 Annual report

ESSAR 2 severity classification.

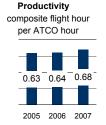
#### **Cost effectiveness**



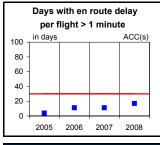


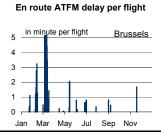


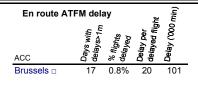




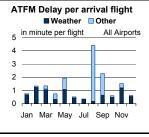
#### **En Route ATFM delay**

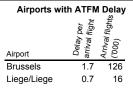




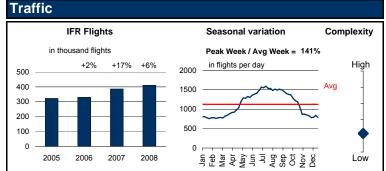








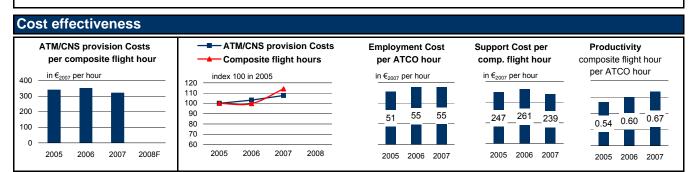
#### Croatia Control, Croatia

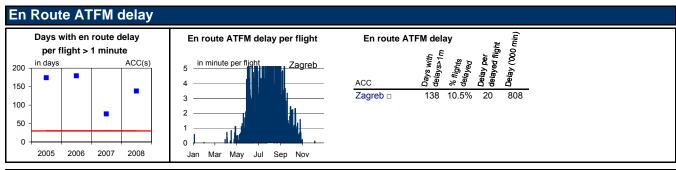


| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 330  | 386  | 411     |
|  | 135  | 156  | 162     |
|  | 79   | 85   | 86      |
| En Route ATFM delays ('000 minutes)  | 472  | 265  | 808     |
| Airport ATFM delays ('000 minutes)   | 3    | 14   | 1       |
| Total Staff  | 735  | 747  | 210     |
| ATCOs in OPS   | 201  | 201  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> )   | 55   | 57   | 58      |
| Capital Investment (million €2007)   | 4    | 5    | 6       |

#### Safety

ANSP's 2007 Annual report not available.







#### **DCAC Cyprus, Cyprus**



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 217  | 242  | 272     |
|  | 100  | 111  | 124     |
|  | 61   | 62   | 64      |
| En Route ATFM delays ('000 minutes)  | 165  | 359  | 720     |
| Airport ATFM delays ('000 minutes)   | 1    | 21   | 19      |
| Total Staff  | 180  | 315  | 73      |
| ATCOs in OPS   | 60   | 66   |         |
| ATM/CNS provision costs (million € <sub>2007</sub> )   | 36   | 37   | 38      |
| Capital Investment (million €2007)   | n/a  | n/a  | n/a     |

#### Safety

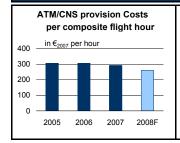
All reported incidents occurred en-route, involved IFR flights and all were classified as being severity C.

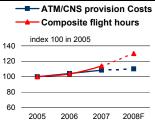
(source : DCAC Cyprus)

| Type of Incident (ATM related)   | TOTAL | Class of<br>Airspace |   |    |
|--|-------|----------------------|---|----|
| and the control of th |       | Α                    | В | С  |
| TOTAL NUMBER OF INCIDENTS  | 454   | 434                  |   | 20 |
| Aircraft deviation from applicable ATM regulation  | 443   | 423                  | 2 | 20 |
| Aircraft deviations from applicable published ATM procedures   | 443   | 423                  |   | 20 |
| Aircraft deviation from ATC clearance  | 32    | 30                   |   | 2  |
| Unauthorised penetration of airspace   | 429   | 409                  |   | 20 |
| Other type of incidents  | 5     | 5                    |   |    |

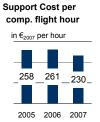
source : DCAC Cyprus

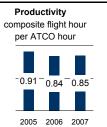
#### **Cost effectiveness**



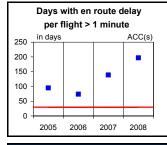


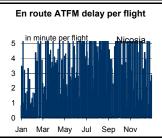


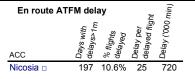




#### **En Route ATFM delay**

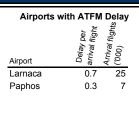




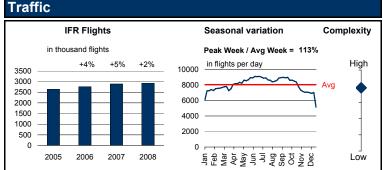








#### **DFS**, Germany



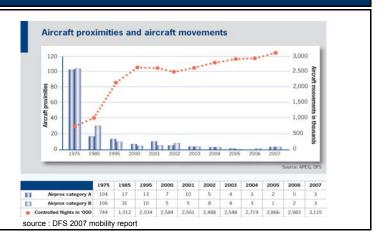
| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 2763 | 2891 | 2935    |
|  | 1342 | 1404 | 1443    |
|  | 2091 | 2154 | 2155    |
| En Route ATFM delays ('000 minutes)  | 602  | 893  | 2132    |
| Airport ATFM delays ('000 minutes)   | 1138 | 1300 | 1604    |
| Total Staff  | 4770 | 4689 | 1721    |
| ATCOs in OPS   | 1705 | 1727 |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)                        | 808  | 817  | 874     |
|  | 74   | 80   | 111     |

#### Safety

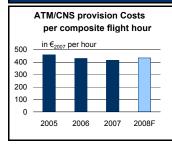
"DFS also successfully managed to maintain its high safety record. Although the number of aircraft proximities rose to six, it must be borne in mind that this number has not exceeded nine over the past five years. In comparison, prior to 2003 there were at least 10 incidents in any given year – in 1999 there were 21." (Extract from ANSP's 2007 annual report).

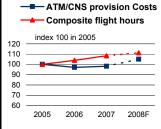
"In 2007, the APEG attributed three aircraft proximities to category B ("safety not assured"). All of them were caused by DFS. Three other airproxes were classified as category A ("risk of collision"). One of these was brought about by the DFS subsidiary The Tower Company, which is responsible for air traffic control at nine regional airports. The other two were caused by the driver of a follow-me car and a free balloon pilot." (Extract from DFS Mobility Report 2007).

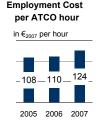
ESSAR 2 compliant severity classification.



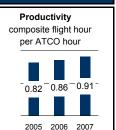
#### **Cost effectiveness**



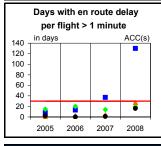




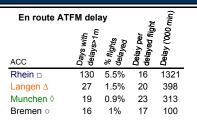




#### En Route ATFM delay







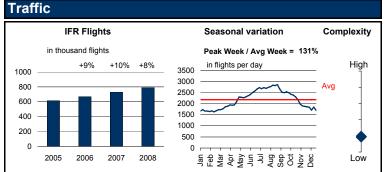




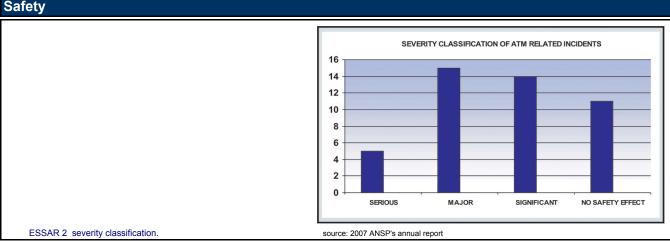
| Airports with | h ATFN                      |                          |
|---------------|-----------------------------|--------------------------|
| Airport       | Delay per<br>arrival flight | Vrrival flights<br>'000) |
| Frankfurt     | 4.3                         | 243                      |
| Munich        | 1.5                         | 215                      |
| Dusseldorf    | 1.3                         | 114                      |
| Hamburg       | 0.6                         | 81                       |
| Stuttgart     | 0.2                         | 73                       |

|               | Delay per<br>arrival fligh <sub>t</sub> | Arrival flights<br>('000) |
|---------------|---|---------------------------|
| Berlin-Tegel  | 0.2                                     | 79                        |
| Tempelhof-Be. | 0.1                                     | 10                        |
| Schoenefeld   | 0.1                                     | 31                        |
| Cologne/Bonn  | 0.1                                     | 70                        |
| Bremen        | 0.0                                     | 20                        |

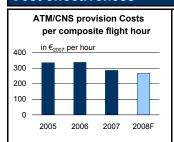
#### **DHMI**, Turkey

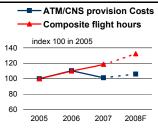


| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 668  | 732  | 792     |
|  | 578  | 622  | 674     |
|  | 518  | 568  | 603     |
| En Route ATFM delays ('000 minutes)  | 9    | 17   | 135     |
| Airport ATFM delays ('000 minutes)   | 245  | 240  | 674     |
| Total Staff  | 4775 | 4870 | 721     |
| ATCOs in OPS   | 597  | 655  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)                        | 240  | 220  | 231     |
|  | 43   | 49   | 56      |

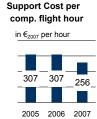


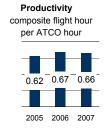
#### **Cost effectiveness**



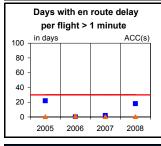


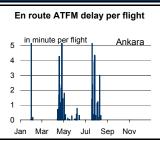


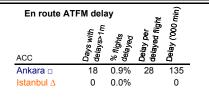




#### **En Route ATFM delay**

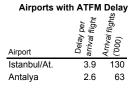












#### **DSNA**, France

#### Traffic Seasonal variation IFR Flights Complexity in thousand flights Peak Week / Avg Week = 118% +4% -0% High in flights per day 10000 3500 3000 8000 Avg 2500 6000 2000 1500 4000 1000 2000 500 ٥ 2005 2006 2007 2008 Jan Feb Mar Apr Jun Jul Sep Oct Nov

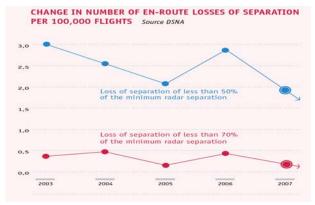
| Key data  | 2006 | 2007 | 2008(F) |
|---|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) En Route ATFM delays ('000 minutes) Airport ATFM delays ('000 minutes) | 2770 | 2935 | 2925    |
|   | 2039 | 2168 | 2178    |
|   | 1882 | 1929 | 1933    |
|   | 1437 | 1466 | 1375    |
|   | 1403 | 1005 | 834     |
| Total Staff   | 8808 | 8870 | 2734    |
| ATCOs in OPS  | 2642 | 2672 |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)   | 999  | 1086 | 1137    |
|   | 153  | 164  | 139     |

#### Safety

"The safety event processing board (ITES) is a new structure that aims to centralize the process of safety events for which air navigation failure is judged significant. In 2007, 42 events were checked and closed. The main selection criterion for these events was the air navigation dysfunction classified as "very important" (a). Furthermore, 8 events classified as "important" (b) were generally studied as they presented a specific interest. The 2007 events examined by ITES can be broken down into three types:

- Runway incursions (aircraft/vehicle andaircraft/aircraft incursions),
- Abnormal loss of separations, of which one near CFIT (controlled flight into terrain).
- technical failures."
   (Extract from ANSP's 2007 annual report).

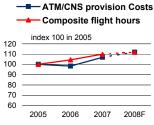
National severity classification.

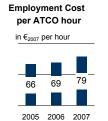


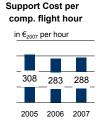
source: ANSP's 2007 annual report

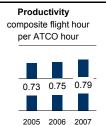
#### **Cost effectiveness**



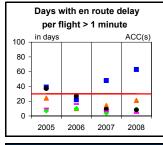




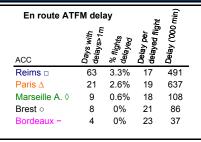




#### En Route ATFM delay







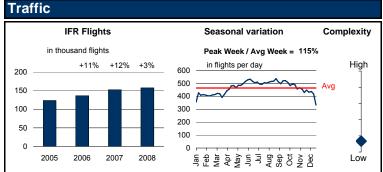




| Airports with ATFM Delay |                             |                           |  |  |  |  |
|--------------------------|-----------------------------|---------------------------|--|--|--|--|
| Airport                  | Delay per<br>arrival flight | Arrival flights<br>('000) |  |  |  |  |
| Cannes Mand.             | 9.3                         | 8                         |  |  |  |  |
| Paris/Le Bou.            | 2.6                         | 31                        |  |  |  |  |
| Paris/Orly               | 1.7                         | 117                       |  |  |  |  |
| Toussus Le N.            | 1.2                         | 6                         |  |  |  |  |
| Paris/Charle.            | 1.0                         | 280                       |  |  |  |  |

|               | Delay per<br>arrival flight | Arrival flights<br>('000) |
|---------------|-----------------------------|---------------------------|
| Lyon/Sartola. | 0.8                         | 65                        |
| Nice          | 0.6                         | 72                        |
| Marseille/Pr. | 0.5                         | 51                        |
| Lille/Lesqui. | 0.5                         | 10                        |
| Ajaccio       | 0.2                         | 7                         |

#### **EANS**, Estonia



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 136  | 153  | 157     |
|  | 48   | 54   | 56      |
|  | 32   | 35   | 37      |
| En Route ATFM delays ('000 minutes) Airport ATFM delays ('000 minutes)   | 0    | 0    | 3<br>0  |
| Total Staff  | 110  | 120  | 37      |
| ATCOs in OPS   | 29   | 34   |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)                        | 9    | 9    | 11      |
|  | 1    | 2    | 4       |

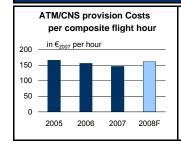
#### Safety

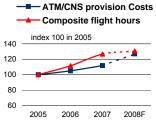
- "EANS quality goals to be achieved in 2007 were as follows: Air Traffic Management:
- 0 flight accidents: no flight accidents took place ACHIEVED;
- Up to 2.79 incidents (inadequate separation minima) per 100 000 operations: 1 incident was registered per 156 000 flight operations – ACHIEVED;
- Up to 2.79 incidents (separation minima infringement) per 100 000 operations: 7 incidents were registered per 156 000 controlled flights, which makes 4.48 incidents per 100 000 operations NOT ACHIEVED;
- Up to 2.79 ATS-related runway incursions at Tallinn airport per 30 000 operations: ACHIEVED: no ATS-related Runway incursions took place caused by EANS (according to the conclusions of internal audit in ATS Department)."

  (Extract from ANSP's 2007 annual report)

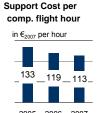
ESSAR 2 compliant severity classification.

#### **Cost effectiveness**



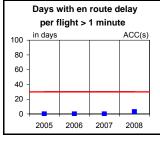




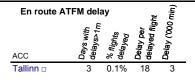




#### **En Route ATFM delay**







#### **ENAV**, Italy



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 1548 | 1675 | 1631    |
|  | 1035 | 1113 | 1111    |
|  | 1368 | 1473 | 1410    |
| En Route ATFM delays ('000 minutes)  | 517  | 331  | 75      |
| Airport ATFM delays ('000 minutes)   | 1267 | 1199 | 744     |
| Total Staff  | 2966 | 2698 | 1253    |
| ATCOs in OPS   | 1201 | 1183 |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)                        | 618  | 628  | 628     |
|  | 177  | 164  | 150     |

#### Safety

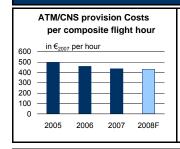
"There were 200 notifications of reduced separation and activation of TCAS in 2006, a higher number than the 138 in 2005, 36 in 2003 and 44 in 2004. The significant difference between the number of events in 2006 and 2005 in comparison with previous years is due, above all, to the application of the new protocol between ANSV and ENAV SpA of 25th January 2005, according to which ANSV will promptly inform about all ATM events within the airspace under its responsibility. [...]" "ANSV was notified in 2006 about 56 runway incursions (of which 3 abroad, involving Italian-registered aircraft). In 3 such cases an investigation for serious incidents was initiated, dealing with incidents classifiable as severity Cat B, where there was a clear reduction in separation with possibility of collision. By analogy of circumstances, 9 other events were investigated as serious incidents, involving landings or tentative landings on busy or closed runways [...]" (translated from the ANSV annual report). ESSAR 2 compliant severity classification.

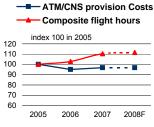
#### ITALIA

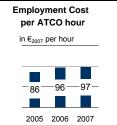
|            | VOLO COMMERCIALE |                  | LAVORO AEREO |                  | AVIAZIONE | GENERALE         |    |
|------------|------------------|------------------|--------------|------------------|-----------|------------------|----|
|            | Incidenti        | Inconv.<br>gravi | Incidenti    | Inconv.<br>gravi | Incidenti | Inconv.<br>gravi |    |
| Velivoli   | 5                | 17               | 4            | 1                | 37 (26)*  | 5 (2)            | 69 |
| Elicotteri | 2                |                  | 5            | 1                | 4 (1)     | 1                | 13 |
| Alianti    |                  |                  |              |                  | 16 (16)   | 1 (1)            | 17 |
|            | 7                | 17               | 9            | 2                | 57 (43)   | 7 (3)            | 99 |

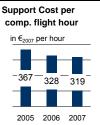
ANSV - Rapporto Informativo sull'Attività Svolta dall'Agenzia Anno 2007

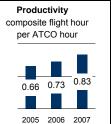
#### Cost effectiveness



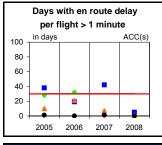




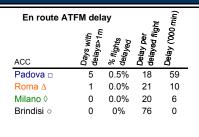


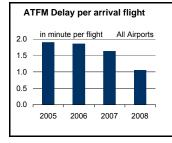


#### **En Route ATFM delay**







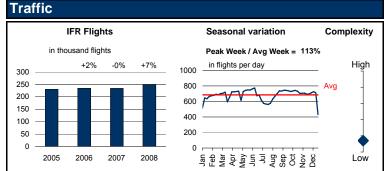




| Airports witl | n ATFN                      |                           |
|---------------|-----------------------------|---------------------------|
| Airport       | Delay per<br>arrival flight | Arrival flights<br>('000) |
| Venice/Tess.  | 3.9                         | 40                        |
| Rome/Fiumici. | 2.6                         | 173                       |
| Brescia/Mont. | 1.8                         | 6                         |
| Milan/Malpen. | 0.6                         | 109                       |
| Torino/Casel. | 0.5                         | 27                        |

|               | <sup>D</sup> elay per<br>arrival flight | Arrival flights<br>('000) |
|---------------|---|---------------------------|
| Milan/Linate  | 0.5                                     | 64                        |
| Bergamo/Orio. | 0.4                                     | 32                        |
| Cagliari Elm. | 0.1                                     | 18                        |
| Bologna       | 0.1                                     | 31                        |
| Olbia Costa . | 0.1                                     | 15                        |

#### Finavia, Finland



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 235  | 234  | 250     |
|  | 112  | 112  | 116     |
|  | 277  | 272  | 279     |
| En Route ATFM delays ('000 minutes)  | 7    | 4    | 1       |
| Airport ATFM delays ('000 minutes)   | 16   | 20   | 22      |
| Total Staff  | 559  | 511  | 194     |
| ATCOs in OPS   | 205  | 193  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)                        | 52   | 53   | 53      |
|  | 15   | 13   | 9       |

#### Safety

Finavia recorded a number of 1210 reports in 2006, 1257 in 2007 and 1627 in 2008 in their COORS system (Confidential Occurrence and Observations Reporting System ). This shows an increasing reporting culture within Finavia.

There were no accidents or serious incidents caused by Finavia in 2008. There were 4 serious incidents where Finavia had a contribution (although not the primary contribution).

The Safety and Quality department has 11 staff.

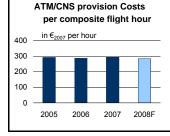
Finavia marked two important steps in 2008: human factors categorisation is included in the analysis of each occurrence now, and the COORS system has been computerised, while the scope of the system has been widened to include all areas of line management (ATS, Airports maintenance and rescue service, ANS technical, Environment, work safety, Security, AIS, MET).

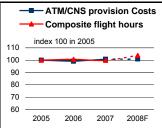
Finavia conducted 36 internal audits in 2008 (35 in 2007) and trained 54 persons to SAM 2008 totalling 103 SAM personnel (59 in 2007).

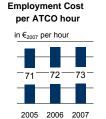
Source (Finavia)

Unknown severity classification

#### **Cost effectiveness**

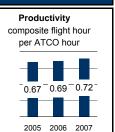




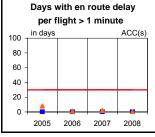


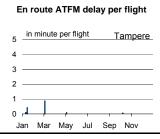


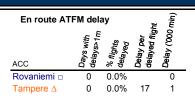
Support Cost per



#### En Route ATFM delay

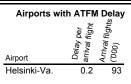












#### **HCAA**, Greece

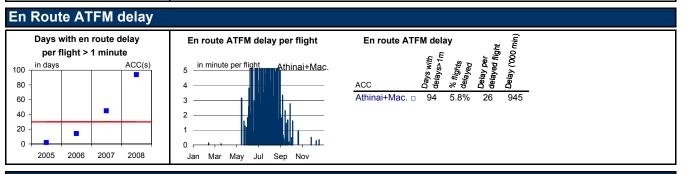


| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 566  | 621  | 643     |
|  | 436  | 467  | 484     |
|  | 426  | 453  | 443     |
| En Route ATFM delays ('000 minutes)  | 88   | 352  | 945     |
| Airport ATFM delays ('000 minutes)   | 284  | 452  | 423     |
| Total Staff  | 1613 | 1613 | 571     |
| ATCOs in OPS   | 508  | 508  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)                        | 210  | 195  | 199     |
|  | n/a  | n/a  | n/a     |

#### Safety

ANSP's 2007 Annual report not available.

#### **Cost effectiveness** ATM/CNS provision Costs -ATM/CNS provision Costs Support Cost per Productivity **Employment Cost** per composite flight hour composite flight hour -Composite flight hours per ATCO hour comp. flight hour per ATCO hour in €<sub>2007</sub> per hour index 100 in 2005 in €<sub>2007</sub> per hour in €<sub>2007</sub> per hour 160 400 140 300 120 276 0.64 0.69 200 100 232 184 100 80 0 60 2006 2007 2008F 2005 2006 2007 2008F 2005 2006 2007 2005 2006 2007 2005 2006 2007





#### HungaroControl, Hungary



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 604  | 615  | 622     |
|  | 198  | 200  | 202     |
|  | 127  | 125  | 119     |
| En Route ATFM delays ('000 minutes)  | 13   | 9    | 0       |
| Airport ATFM delays ('000 minutes)   | 27   | 15   | 10      |
| Total Staff  | 685  | 686  | 190     |
| ATCOs in OPS   | 189  | 189  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> )   | 70   | 67   | 75      |
| Capital Investment (million €2007)   | 19   | 18   | 10      |

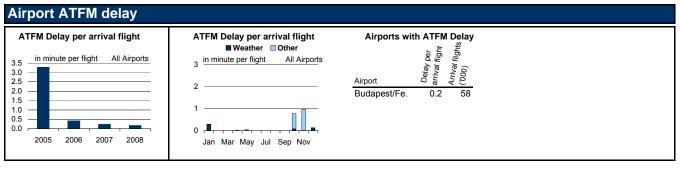
#### Safety

- "• The number of incidents rendered significant in relation to the activities of HungaroControl Pte. Ltd. Co. in 2007 was lower 7 incidents altogether than the value accepted in the safety enhancement planning of HungaroControl Pte. Ltd. Co., which is 12 a year.
- As a result of the measures taken in order to mitigate the severity of incidents the breakdown of ratio of incidents indicates improvement. The most severe incidents of all with HungaroControl Pte. Ltd. Co. contribution were classified as "C" (significant) in the six-grade scale of EUROCONTROL ESARR 2.
- The operation or malfunction of technical devices and software caused no problems in the safe execution of services."
  (Extract from ANSP's 2007 annual report).

Unknown severity classification.

#### Cost effectiveness ATM/CNS provision Costs - ATM/CNS provision Costs **Employment Cost** Support Cost per Productivity per composite flight hour Composite flight hours per ATCO hour comp. flight hour composite flight hour per ATCO hour in €<sub>2007</sub> per hour index 100 in 2005 in €<sub>2007</sub> per hour in €<sub>2007</sub> per hour 140 300 120 200 100 0.83 0.83 58 56 56 198 100 80 0 60 2005 2006 2007 2008F 2005 2006 2007 2008F 2005 2006 2007 2005 2006 2007 2005 2006 2007





#### IAA, Ireland

#### **Traffic** IFR Flights Seasonal variation Complexity in thousand flights Peak Week / Avg Week = 114% +3% High in flights per day 2000 700 600 1500 500 400 1000 300 200 500 100 0 2005 2006 2007 2008 Jan Feb Mar Apr Jun Jul Sep Oct Nov

| Key data   | 2006                   | 2007                   | 2008(F)                  |
|--|------------------------|------------------------|--------------------------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) En Route ATFM delays ('000 minutes) | 561<br>259<br>264<br>8 | 595<br>282<br>282<br>5 | 598<br>285<br>279<br>100 |
| Airport ATFM delays ('000 minutes) Total Staff   | 27<br>444              | 29<br>448              | 254                      |
| ATCOs in OPS  ATM/CNS provision costs (million $\epsilon_{2007}$ )   | 227<br>103             | 230<br>105             | 234<br>116               |
| Capital Investment (million €2007)   | 17                     | 17                     | 81                       |

#### Safety

"Despite the Authority's excellent safety record since it was established, there was one potentially serious airproximity incident involving two aircraft which occurred on 23 September 2007. This was reported by the Authority to the Air Accident Investigation Unit of the Department of Transport which subsequently issued its report early in March 2008."

(Extract from ANSP's 2007 annual report).

The air prox statistics, as classified by the air prox panel for 2003 - 2007 are;

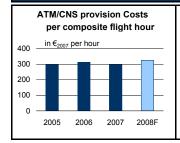
|                |      | 17   |      |      |       |   |
|----------------|------|------|------|------|-------|---|
| Classification | 2003 | 2004 | 2005 | 2006 | 2007* |   |
| A              | 0    | 0    | 0    | 0    |       | 1 |
| Ð              | 2    | 0    | 2    | 0    |       | 1 |
| С              | 6    | 8    | 2    | 2    |       | 1 |
| D              | 1    | 0    | 0    | 1    |       | 0 |

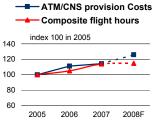
<sup>\*</sup> provisional statstics for 2007.

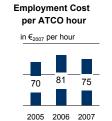
ESSAR 2 compliant severity classification.

source: IAA - Air Proximity Occurrences

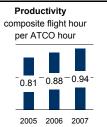
#### **Cost effectiveness**



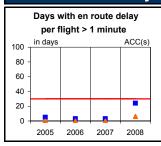




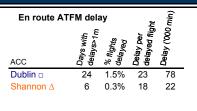




#### En Route ATFM delay

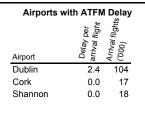












#### LFV/ANS Sweden, Sweden



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 687  | 707  | 732     |
|  | 421  | 430  | 444     |
|  | 540  | 529  | 538     |
| En Route ATFM delays ('000 minutes)  | 16   | 25   | 78      |
| Airport ATFM delays ('000 minutes)   | 18   | 213  | 48      |
| Total Staff  | 964  | 974  | 503     |
| ATCOs in OPS   | 513  | 502  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> )   | 146  | 154  | 175     |
| Capital Investment (million €2007)   | 17   | 22   | 33      |

#### Safety

"No accidents were caused by the operations of ANS during 2007." (Extract from LFV 2007 annual report).

"There were 25 Swedish aviation accidents in 2007, excluding sport-related activity. In comparison with 2006, this was an increase of eight accidents. In spite of this, the trend shows that the risk of being killed or seriously injured in aviation is decreasing. In 2007, one person died within Swedish aviation. There was one accident in scheduled and charter travel. This accident occurred at Arlanda, when an aircraft collided with a vehicle... The safety goal for scheduled and charter travel specifies a halving of the accident frequency during the period 1998 to 2007. To achieve this goal, an accident frequency that is less than 0.235 per 100,000 flying hours is required. The forecast indicates 0.265 accidents per 100,000 flying hours." (Extract from SIKA Lutfart 2007)

Tabell 6.1 Luftfartsolyckor med motordrivna luftfartyg efter flygsituation i Sverige oavsett luftfartygets nationalitet 2006-2007

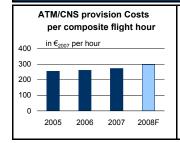
Accidents to powered aircraft by flight phase in Sweden irrespective of the nationality of the aircraft 2006-2007

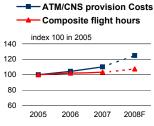
| Art av flygning<br>Type of operation  | Totalt antal Hygsituation Iuffartsolyckor Flight phase Total number of accidents stationart Taxing/ Start Flygning of accidents stationart Take-off En route Taxing/ Stationary |      |                                    |      |      |      |      |      |      |      |
|---|---|------|------------------------------------|------|------|------|------|------|------|------|
|   |   |      | Inflygning/<br>Landning<br>Landing |      |      |      |      |      |      |      |
|   | 2006  | 2007 | 2006                               | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 |
| Linjefart och chartertrafik<br>Scheduled and non-scheduled traffic            | 2   | 2    | 0                                  | 2    | 0    | 0    | 0    | 0    | 2    | 0    |
| Bruksflyg <sup>1</sup><br>Miscellaneous commercial<br>operations <sup>1</sup> | 7   | 6    | 1                                  | 0    | 0    | 2    | 2    | 2    | 4    | 2    |
| Skolflyg<br>Instructional operations  | 0   | 3    | 0                                  | 0    | 0    | 1    | 0    | 0    | 0    | 2    |
| Privatflyg<br>Private operations  | 11  | 17   | 0                                  | 3    | 3    | 4    | 2    | 6    | 6    | 6    |
| Summa Total   | 20  | 28   | 1                                  | 3    | 3    | 7    | 4    | 8    | 12   | 10   |

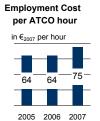
<sup>1</sup> Taxiffyg och aerial work

#### **Cost effectiveness**

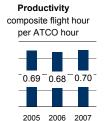
ESSAR 2 compliant severity classification.



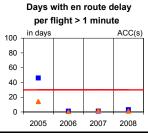


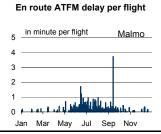


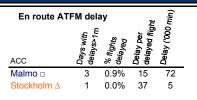


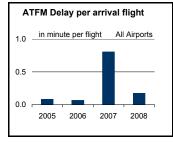


#### En Route ATFM delay

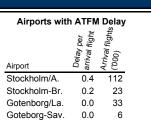












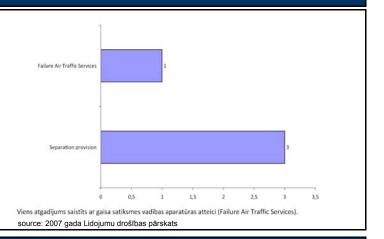
#### LGS, Latvia



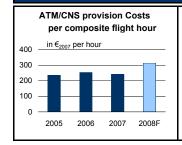
| Key data  | 2006                 | 2007                 | 2008(F)              |
|---|----------------------|----------------------|----------------------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) En Route ATFM delays ('000 minutes) Airport ATFM delays ('000 minutes) | 167<br>58<br>34<br>0 | 192<br>64<br>41<br>0 | 215<br>66<br>44<br>0 |
| Total Staff ATCOs in OPS ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)  | 266<br>54<br>17<br>4 | 293<br>60<br>18<br>9 | 67<br>24<br>17       |

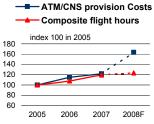
#### Safety

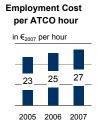
"2007. gadā LGS galvenais mērķis gaisa satiksmes drošuma nodrošināšanā visā Rīgas lidojumu informācijas rajonā bija nodrošināt, ka ATM pakalpojumu iespaidā netiek pārsniegta gaisa kuģu nelaimes gadījumu pieļaujamā varbūtība 1,55 X 10 -8 uz vienu lidojumu stundu. Šis rādītājs 2007. gadā tika izpildīts uzturot ATM pakalpojumu drošumu noteiktajā līmenī un veicot aeronavigācijas drošuma vadības sistēmas darbības pilnveidošanu." (Extract from 2007 gada pārskats) "CAA datubāzē dati par problēmām aeronavigācijas pakalpojumos Latvijā norāda, ka visbiežāk ir bijušas problēmas ar gaisa kuģu distancēšanas (Separation provision) nodrošināšanu. Starp šiem atgadījumiem ir viens nopietns incidents, kurš norisinājās 20.08.2007 Rīgas LIR." (Extract from 2007. gada Lidojumu drošības pārskats)

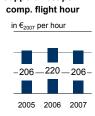


**Cost effectiveness** 

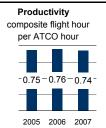








Support Cost per



**En Route ATFM delay** 

| Δir | port | ΔΤ       | FΜ | del | lav |
|-----|------|----------|----|-----|-----|
|     | POIL | $\sim$ 1 |    | uc  |     |

#### LPS, Slovak Republic



| Key data  | 2006 | 2007 | 2008(F) |
|---|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) En Route ATFM delays ('000 minutes) Airport ATFM delays ('000 minutes) | 329  | 323  | 344     |
|   | 73   | 72   | 79      |
|   | 39   | 42   | 46      |
|   | 43   | 154  | 54      |
|   | 0    | 0    | 0       |
| Total Staff   | 451  | 459  | 107     |
| ATCOs in OPS  | 113  | 111  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)   | 38   | 35   | 43      |
|   | 4    | 7    | 5       |

#### Safety

"211 aviation incidents (including accidents) occurred in the Slovak Republic in 2007, what represents an increase by 7% when compared with 197 incidents for the same period in 2006. Out of the number, 41 reports were about full or partial overflight over FIR Bratislava without radio contact with the air traffic control units (PLC)"

(Extract from ANSP's 2007 annual report).

| Incident          | Total | Relation<br>to ATM |        | Share of LPS SR on occurrence |       |  |
|-------------------|-------|--------------------|--------|-------------------------------|-------|--|
|                   |       |                    | Direct | Indirect                      | Total |  |
| Aircraft accident | 21    | 2                  | 0      | 0                             | 0     |  |
| Serious incident  | 3     | 2                  | 1      | 0                             | 1     |  |
| Incident          | 149   | 116                | 8      | 5                             | 13    |  |
| SATM              | 28    | 28                 | 3      | 0                             | 3     |  |
| Various incidents | 10    | 10                 | 1      | 0                             | 1     |  |

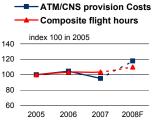
Note: the overview includes incidents that related in any way with provision of ATM services although circumstances of their origin was not connected with the eservices provider.

ESSAR 2 severity classification.

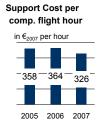
source: ANSP's 2007 annual report

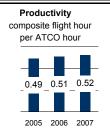
#### **Cost effectiveness**



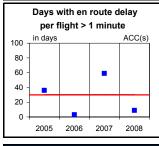




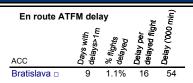




#### **En Route ATFM delay**







#### LVNL, Netherlands

#### **Traffic** IFR Flights Seasonal variation Complexity in thousand flights Peak Week / Avg Week = 112% +4% -3% High in flights per day 2000 700 600 1500 500 400 1000 300 200 500 100 0 2005 2006 2007 2008 Low Jan Feb Mar Apr Jun Jul Sep Oct Nov

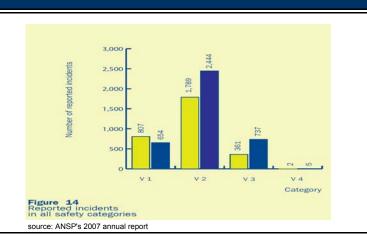
| Key data  | 2006 | 2007 | 2008(F) |
|---|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) En Route ATFM delays ('000 minutes) Airport ATFM delays ('000 minutes) | 564  | 588  | 573     |
|   | 150  | 152  | 152     |
|   | 487  | 504  | 496     |
|   | 39   | 43   | 26      |
|   | 152  | 415  | 545     |
| Total Staff   | 1034 | 1047 | 203     |
| ATCOs in OPS  | 187  | 195  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> )  | 155  | 155  | 165     |
| Capital Investment (million €2007)  | 5    | 9    | 12      |

#### Safety

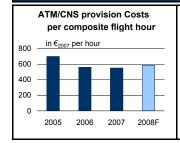
"In 2007 LVNL registered a total of 3,840 reports of occurrences with relevance for safety, against 2,959 in 2006. The substantial rise with regard to 2006 is the consequence of the legal obligation having taken effect in the year under review, to report all incidents, minor ones included. This act also requires a more detailed description of reported incidents than before. Moreover, LVNL's permanent thought for safety has grown into an even greater safety consciousness, which also caused an increase in incident reporting. In the year under review, LVNL had no indications that the rise in the number of reports is related to a decline in safety. The greater part of the incidents reported in 2007 involved a V1 or V2 report, which obviously did not lead to a dangerous situation.

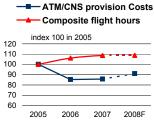
In 2007 five V4 incidents occurred, four of which at or in the airspace of Schiphol and one in the airspace of Beek." (Extract from 2007 ANSP's annual report)

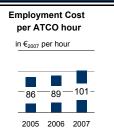
ESSAR 2 compliant severity classification.

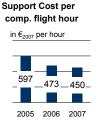


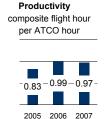
#### **Cost effectiveness**











#### **En Route ATFM delay**











| Airports wit | Delay per ALT U | Arrival flights Delay ('000) |
|--------------|-----------------|------------------------------|
| Airport      | D               | 4 S                          |
| Amsterdam    | 2.5             | 221                          |
| Maastricht   | 0.2             | 5                            |
| Rotterdam    | 0.0             | 13                           |
|              |                 |                              |
|              |                 |                              |

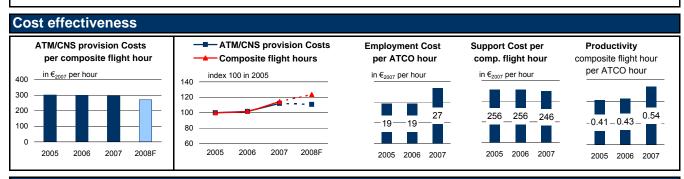
#### MATS, Malta



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 76   | 82   | 85      |
|  | 33   | 38   | 41      |
|  | 28   | 30   | 30      |
| En Route ATFM delays ('000 minutes)  | 0    | 0    | 0       |
| Airport ATFM delays ('000 minutes)   |      | 0    | 0       |
| Total Staff  | 176  | 176  | 47      |
| ATCOs in OPS   | 55   | 48   |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)                        | 12   | 13   | 13      |
|  | 2    | 1    | 1       |

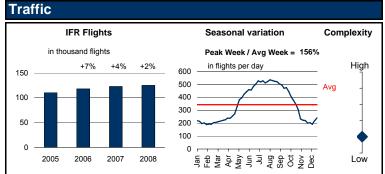
#### Safety

No information found in ANSP's 2007 annual report.



#### **En Route ATFM delay**

# MK CAA, FYROM



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 118  | 123  | 125     |
|  | 21   | 21   | 21      |
|  | 13   | 13   | 14      |
| En Route ATFM delays ('000 minutes)  | 0    | 0    | 0       |
| Airport ATFM delays ('000 minutes)   | 0    | 0    | 0       |
| Total Staff  | 300  | 291  | 71      |
| ATCOs in OPS   | 60   | 57   |         |
| ATM/CNS provision costs (million € <sub>2007</sub> )   | 11   | 10   | 10      |
| Capital Investment (million €2007)   | 3    | 0.3  | 0.3     |

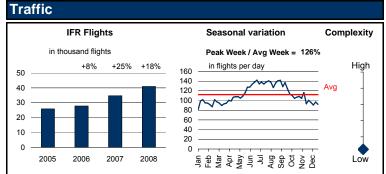
#### Safety

No information found in ANSP's 2007 annual report.

#### **Cost effectiveness ATM/CNS** provision Costs - ATM/CNS provision Costs Support Cost per Productivity **Employment Cost** per composite flight hour -Composite flight hours per ATCO hour comp. flight hour composite flight hour per ATCO hour in €<sub>2007</sub> per hour index 100 in 2005 in $\in_{2007}$ per hour in €<sub>2007</sub> per hour 110 400 100 300 90 368 363 346 200 80 0.30 0.31 -20 100 70 0 60 2006 2007 2005 2006 2007 2008F 2005 2006 2007 2005 2006 2007 2005 2006 2007

## **En Route ATFM delay**

## MoldATSA, Moldova



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 28   | 35   | 41      |
|  | 7    | 9    | 10      |
|  | 10   | 12   | 13      |
| En Route ATFM delays ('000 minutes)  | 0    | 0    | 0       |
| Airport ATFM delays ('000 minutes)   |      | 0    | 0       |
| Total Staff  | 308  | 321  | 58      |
| ATCOs in OPS   | 51   | 59   |         |
| ATM/CNS provision costs (million € <sub>2007</sub> )   | 4    | 4    | 5       |
| Capital Investment (million €2007)   | 1    | 1    | 1       |

#### Safety

ANSP's 2007 Annual report not available.

Unknown severity classification.

#### **Cost effectiveness ATM/CNS** provision Costs - ATM/CNS provision Costs **Employment Cost** Support Cost per Productivity per composite flight hour Composite flight hours per ATCO hour composite flight hour comp. flight hour per ATCO hour in €<sub>2007</sub> per hour index 100 in 2005 in €<sub>2007</sub> per hour in €<sub>2007</sub> per hour 140 300 120 200 0.14 0.14 317 100 80 0 60 2006 2007 2005 2006 2007 2008F 2005 2006 2007 2005 2006 2007 2005 2006 2007

## **En Route ATFM delay**

#### **MUAC**



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 1536 | 1610 | 1608    |
|  | 546  | 575  | 581     |
| En Route ATFM delays ('000 minutes)  | 447  | 969  | 778     |
| Airport ATFM delays ('000 minutes)   | 0    | 0    | 0       |
| Total Staff  | 576  | 588  | 228     |
| ATCOs in OPS   | 215  | 223  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> )   | 119  | 121  | 129     |
| Capital Investment (million €2007)   | 18   | 13   | 13      |

#### Safety

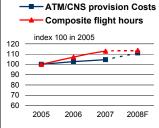
"There was a marked improvement in safety trends in 2007 and, for the fourth consecutive year, not a single serious incident (Category A) was recorded. Furthermore, the number of Category B incidents (major incidents) decreased, from 8 in 2006 to 3 in 2007. This significant improvement is mainly due to the implementation of an enhanced short-term conflict alert system, and improvements in the process for incorporating recommendations resulting from operational incident investigations. It should however, be seen in the context of the continuous year-on-year increases to our traffic levels." (Extract from ANSP's 2007 annual report).

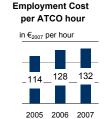
|                          | 2004 | 2005 | 2006 | 2007 | Trend<br>2006/<br>2007 | Main targets<br>set for 2007 |
|--------------------------|------|------|------|------|------------------------|------------------------------|
| SAFETY INDICATORS        |      |      |      |      |                        |                              |
| Category A infringements |      |      |      |      |                        | A limit of 1 occurrence for  |
| Category B infringements |      |      |      |      |                        | each 100,000<br>movements    |

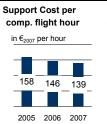
ESSAR 2 severity classification.

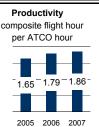
#### **Cost effectiveness**



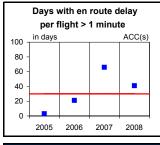




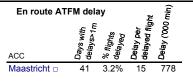




# En Route ATFM delay







#### NATA Albania, Albania



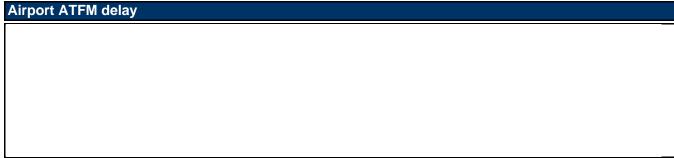
| Key data  | 2006                  | 2007                 | 2008(F)               |
|---|-----------------------|----------------------|-----------------------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) En Route ATFM delays ('000 minutes) Airport ATFM delays ('000 minutes) | 119<br>26<br>17<br>0  | 142<br>31<br>19<br>0 | 148<br>32<br>20<br>12 |
| Total Staff ATCOs in OPS ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)  | 185<br>32<br>12<br>15 | 200<br>40<br>13<br>4 | 50<br>15<br>3         |

#### Safety

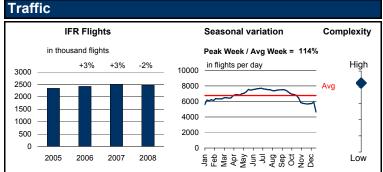
ANSP's 2007 Annual report not available.

#### **Cost effectiveness ATM/CNS** provision Costs - ATM/CNS provision Costs **Employment Cost** Support Cost per Productivity per composite flight hour per ATCO hour composite flight hour -Composite flight hours comp. flight hour per ATCO hour in €<sub>2007</sub> per hour index 100 in 2005 in €<sub>2007</sub> per hour in €<sub>2007</sub> per hour 500 140 400 120 300 100 0.56 200 0.40 - 0.45-387 -379 344 80 100 0 60 2006 2007 2005 2006 2007 2008F 2005 2006 2007 2005 2006 2007 2005 2006 2007





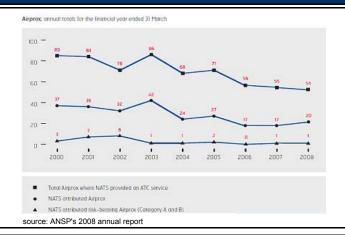
#### NATS, United Kingdom



| Key data  | 2006                                 | 2007                                 | 2008(F)                              |
|---|--------------------------------------|--------------------------------------|--------------------------------------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) En Route ATFM delays ('000 minutes) Airport ATFM delays ('000 minutes) | 2422<br>1398<br>2001<br>1564<br>1074 | 2505<br>1449<br>2026<br>1683<br>1293 | 2466<br>1471<br>1975<br>1359<br>1415 |
| Total Staff ATCOs in OPS ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)  | 5057<br>1392<br>781<br>202           | 5186<br>1443<br>838<br>192           | n/a<br>656<br>176                    |

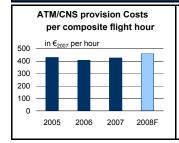
## Safety

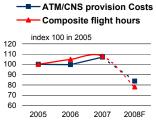
"In safety, NATS continues to maintain its performance against a background of rising traffic – up three per cent to nearly 2.5m flights for another record year. While the number of airproxes attributable to NATS rose slightly from 17 to 20, there was one risk-bearing airprox – the same as last year." (Extract from ANSP's 2008 annual report)

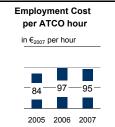


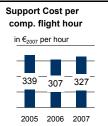
ESSAR 2 compliant severity classification.

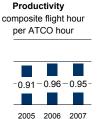
#### **Cost effectiveness**



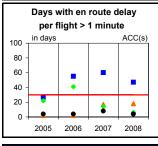








# En Route ATFM delay





| En route ATF | <b>*</b>               | min)                 |                             |                  |
|--------------|------------------------|----------------------|-----------------------------|------------------|
| ACC          | Days with<br>delays>1m | % flights<br>delayed | Delay per<br>delayed flight | Delay ('000 min) |
| London AC □  | 47                     | 2.8%                 | 19                          | 1094             |
| Scottish A   | 18                     | 0.9%                 | 18                          | 104              |
| Manchester ◊ | 6                      | 0.6%                 | 16                          | 55               |
| London TC o  | 4                      | 0%                   | 24                          | 106              |
|              |                        |                      |                             |                  |

#### **Airport ATFM delay**



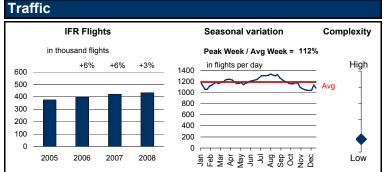


| Airport       | Delay per<br>arrival flight | Arrival flights<br>('000) |
|---------------|-----------------------------|---------------------------|
| London/City   | 6.0                         | 47                        |
| London/Heath. | 4.2                         | 240                       |
| London/Gatwi. | 0.4                         | 132                       |
| Manchester    | 0.3                         | 101                       |
| Edinburgh     | 0.2                         | 62                        |

Airports with ATFM Delay

|               | Delay per<br>arrival flight | Arrival flights<br>('000) |
|---------------|-----------------------------|---------------------------|
| Southampton   | 0.2                         | 25                        |
| London/Stans. | 0.1                         | 96                        |
| London/Luton  | 0.1                         | 58                        |
| Bristol/Luls. | 0.1                         | 33                        |
| Farnborough . | 0.1                         | 12                        |

#### NAV Portugal (FIR Lisboa), Portugal



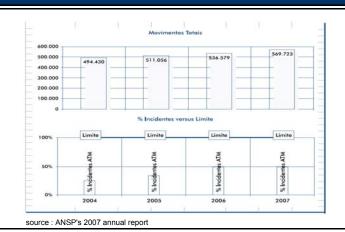
| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) En Route ATFM delays ('000 minutes) | 397  | 421  | 433     |
|  | 252  | 268  | 276     |
|  | 251  | 268  | 274     |
| Airport ATFM delays ('000 minutes)   | 4    | 106  | 82      |
|  | 17   | 45   | 100     |
| Total Staff  | 726  | 712  | 199     |
| ATCOs in OPS   | 197  | 195  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)  | 131  | 135  | 138     |
|  | 6    | 8    | 9       |

#### Safety

In 2007 NAV Portugal received and processed around 800 notifications of safety occurrences, which corresponds to an increase of 33% over the number of reports received in the previous year.

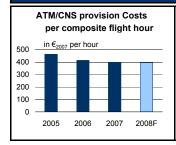
Amongst the notifications received, five of them were directly linked to ATM responsibilities, which in terms of operating risk according to severity classification of ICAO were classified as "A" (Serious Incident) or B (Major Incident). They represented only about 0.75% of the total amount of event / occurrences analysed by competent Services.

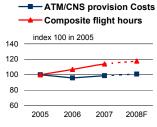
(Extracted and translated from ANSP's 2007 annual report)

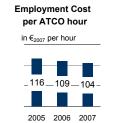


ESSAR 2 compliant severity classification.

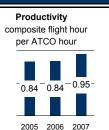
#### **Cost effectiveness**



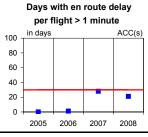


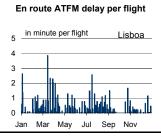


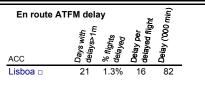




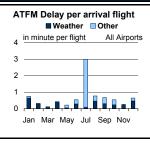
# En Route ATFM delay





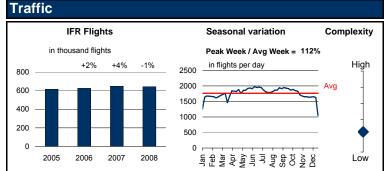






| Airports with ATFM Delay |                              |                        |  |
|--------------------------|------------------------------|------------------------|--|
|                          | / per<br><sup>I</sup> flight | rrival flights<br>300) |  |
| Airport                  | Delay per<br>arrival flight  | Arrival<br>('000)      |  |
| Faro                     | 1.7                          | 21                     |  |
| Porto                    | 1.0                          | 29                     |  |
| Lisbon                   | 0.5                          | 72                     |  |
|                          |                              |                        |  |
|                          |                              |                        |  |

#### NAVIAIR, Denmark



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 624  | 648  | 644     |
|  | 207  | 215  | 216     |
|  | 357  | 362  | 373     |
| En Route ATFM delays ('000 minutes)  | 176  | 61   | 1231    |
| Airport ATFM delays ('000 minutes)   | 124  | 96   | 177     |
| Total Staff  | 656  | 656  | 239     |
| ATCOs in OPS   | 220  | 234  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)                        | 85   | 96   | 99      |
|  | 36   | 26   | 32      |

#### Safety

"Number of incidents

The number of incidents in category A, B and C, attributable to Naviair, shall in 2007 be less than 2,49 pr 100.000 operations

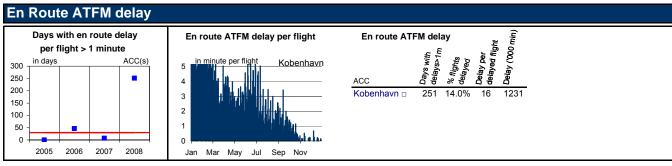
Status for 2007; The requirement is achieved.

The number of incidents in category A, B and C, attributable to Naviair, has for 2007 been 1,55 pr 100.000 operations."

(Extracted and translated from ANSPs 2007 annual report).

ESSAR 2 severity classification.

#### Cost effectiveness ATM/CNS provision Costs - ATM/CNS provision Costs **Employment Cost** Support Cost per Productivity per composite flight hour Composite flight hours per ATCO hour comp. flight hour composite flight hour per ATCO hour in €<sub>2007</sub> per hour index 100 in 2005 in €<sub>2007</sub> per hour in €<sub>2007</sub> per hour 120 110 300 100 200 90 0.85 0.82 65 66 0.83 80 100 70 0 60 2006 2007 2008F 2005 2006 2007 2008F 2005 2006 2007 2005 2006 2007 2005 2006 2007





# Oro Navigacija, Lithuania

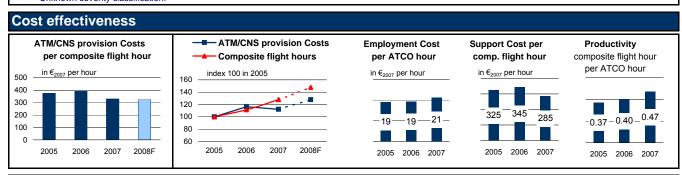


| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 134  | 157  | 181     |
|  | 36   | 42   | 49      |
|  | 38   | 42   | 48      |
| En Route ATFM delays ('000 minutes)<br>Airport ATFM delays ('000 minutes)                                      | 0    | 0    | 0<br>0  |
| Total Staff  | 332  | 335  | 78      |
| ATCOs in OPS   | 77   | 77   |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)                        | 18   | 17   | 20      |
|  | 5    | 4    | 7       |

#### Safety

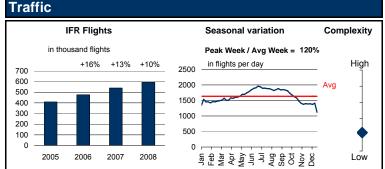
"No accidents or dangerous incidents related with the work of air traffic controllers and other safety-related staff occurred in 2007." (Extract from ANSP's 2007 annual report).

Unknown severity classification.



# En Route ATFM delay

#### PANSA, Poland



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 477  | 541  | 596     |
|  | 286  | 320  | 348     |
|  | 273  | 300  | 314     |
| En Route ATFM delays ('000 minutes) Airport ATFM delays ('000 minutes)   | 468  | 989  | 1190    |
|  | 196  | 171  | 50      |
| Total Staff  | 1175 | 1534 | 383     |
| ATCOs in OPS   | 350  | 365  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> )   | 91   | 100  | 151     |
| Capital Investment (million €2007)   | 10   | 2    | 43      |

#### Safety

PANSA has reached the safety objective - do not have accidents with direct or indirect ATM contribution and to reduce the number of serious incidents irrespective of air traffic rise. The number of Category A incidents (serious incidents) decreased from 5 in 2007 to 3 in

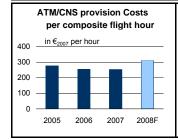
2008, Category B (major incidents) decreased from 9 to 2, Category C (significant incidents) increased from 11 to14. In 2008, 0.502 Class A incidents per 100.000 movements have been recorded almost 2 times better then in 2007 (0.919). For Class B the indicator decreased almost 5 times from 1.665 to 0,334 incidents per 100.000 movements.

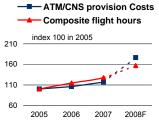
The Safety Management is well structured, with separate SMS Office, independent from the line management. Risk assessment and mitigation of air traffic operations methodology is continuously improving.

(source: PANSA)

Unknown severity classification.

#### **Cost effectiveness**

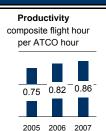




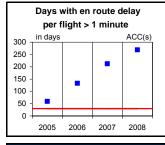


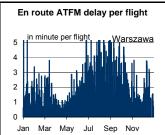


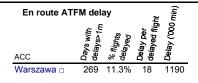
Support Cost per



#### **En Route ATFM delay**

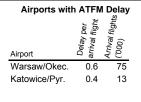




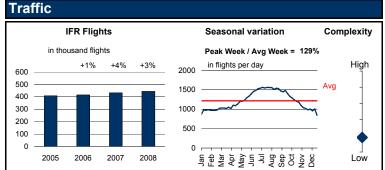








#### ROMATSA, Romania



| Key data  | 2006        | 2007        | 2008(F) |
|---|-------------|-------------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) En Route ATFM delays ('000 minutes) Airport ATFM delays ('000 minutes) | 416         | 432         | 444     |
|   | 257         | 261         | 271     |
|   | 122         | 144         | 159     |
|   | 0           | 0           | 0       |
|   | 0           | 0           | 1       |
| Total Staff ATCOs in OPS  | 1877<br>534 | 1859<br>530 | 529     |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)   | 164         | 136         | 135     |
|   | 8           | 24          | 13      |

#### Safety

"During 2007, special attention has been paid both to the functioning of the system for reporting the safety events, and to the informational content circulated by this system. We mention the fact that the number the events reported in 2007 vas double compared to 2006.

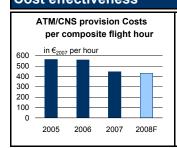
Under these circumstances, we would like to mention that the result of the safety the monitoring was the registration of 467 civil aviation events, out of which only 362 safety events, interesting for the ATM community (175 operational and 187 technical)". (Extract from ANSP's 2007 annual report).

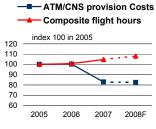
Full list of events available on the internet (Romanian language only).

The analysis of the operational events gravity and the contribution of Romatsa to their occurrence : ->

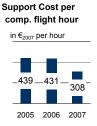
| GRAVI<br>OF TH | TY<br>E EVENT    | NR. | DIRECT<br>CONTRIBUTION | INDIRECT<br>CONTRIBUTION | NO<br>CONTRIBUTION |
|----------------|------------------|-----|------------------------|--------------------------|--------------------|
| AA             | <b>ACCIDENTS</b> | 6   | 1*                     | 0                        | 5                  |
| A              | SERIOUS          |     |                        |                          |                    |
|                | <b>INCIDENTS</b> | 6   | 0                      | 0                        | 6                  |
| В              | MAJOR            |     |                        |                          |                    |
|                | <b>INCIDENTS</b> | 5   | 0                      | 0                        | 5                  |
| C              | SIGNIFICAN       | T   |                        |                          |                    |
|                | <b>INCIDENTS</b> | 36  | 9                      | 3                        | 24                 |
| E              | NO EFFECT        | 122 | 2                      | 1                        | 119                |
| TOT            | AL EVENTS        | 175 | 12                     | 4                        | 159                |

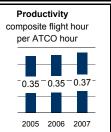
#### **Cost effectiveness**







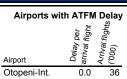




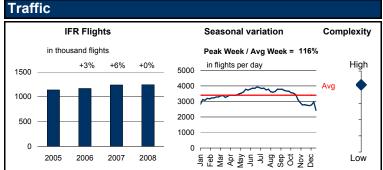
#### **En Route ATFM delay**







#### Skyguide, Switzerland



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 1168 | 1239 | 1244    |
|  | 325  | 350  | 354     |
|  | 436  | 459  | 469     |
| En Route ATFM delays ('000 minutes)  | 1314 | 1382 | 941     |
| Airport ATFM delays ('000 minutes)   | 335  | 646  | 430     |
| Total Staff  | 1222 | 1229 | 326     |
| ATCOs in OPS   | 284  | 311  |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)                        | 185  | 206  | 201     |
|  | 48   | 38   | 41      |

#### Safety

"All air traffic incidents are investigated by the Swiss Federal Aircraft Accident Investigation Bureau (BFU). In 2006, the BFU analysed seven incidents in which the air navigation services were involved.1 As the investigation process can last several months, only one outcome was available at the time of publication on the involvement of the air navigation service and the risk assessment. The BFU categorised the incident as risk category A and determined that a foreign air navigation service provider was involved. Skyguide was not involved." All reports are published on the BFU website.

1. The figures for 2007 should be available in summer 2008." (Extract from the ANSP's 2007 annual report).

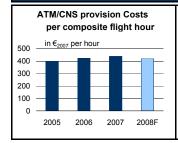
3.2.1 Accidents and serious incidents involving Swiss-registered aircraft in Switzerland and abroad, and foreign-registered aircraft in Switzerland according to their category, including and excluding injuries to persons

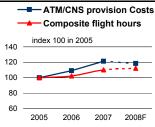
|   | Accidents and serious incidents involving Swiss-registered aircraft |      |       |      | Accidents and serious incidents involving Swiss-registered aircraft |      |       |      | Accidents and serious incidents<br>involving foreign-registered aircraft |      |                |      |       |      |       |      |       |      |       |  |       |  |       |  |  |                    |         |  |    |       |  |                    |                        |       |  |                    |  |                        |  |
|---|---|------|-------|------|---|------|-------|------|--|------|----------------|------|-------|------|-------|------|-------|------|-------|--|-------|--|-------|--|--|--------------------|---------|--|----|-------|--|--------------------|------------------------|-------|--|--------------------|--|------------------------|--|
|   | in Switzerland  |      |       |      |   |      | abe   | oad  | _  |      | in Switzerland |      |       |      |       |      |       |      |       |  |       |  |       |  |  |                    |         |  |    |       |  |                    |                        |       |  |                    |  |                        |  |
|   | Total   |      | Total |      | Total   |      | Total |      | Total  |      | Total          |      | Total |      | Total |      | Total |      | Total |  | Total |  | Total |  |  | Persons<br>injured | Persons |  | Te | Total |  | Persons<br>injured | Persons not<br>injured | Total |  | Persons<br>injured |  | Persons not<br>injured |  |
|   | 2007  | 2006 | 2007  | 2006 | 2007  | 2006 | 2007  | 2006 | 2007   | 2006 | 2007           | 2006 | 2007  | 2006 | 2007  | 2006 | 2007  | 2006 |       |  |       |  |       |  |  |                    |         |  |    |       |  |                    |                        |       |  |                    |  |                        |  |
| Total                                     | 42  | 63   |       | 13   | 33  | SE   | 10    |      | 1  |      | 9              |      | 22    | 7    | 0     | 3    | 11    | 4    |       |  |       |  |       |  |  |                    |         |  |    |       |  |                    |                        |       |  |                    |  |                        |  |
| Aircraft with<br>MTOM 5 2'250 kg          | 20  | 33   | 3     |      | 17  | 29   |       |      |  | 1    |                | 8    | 4     | 5    | 0     | 2    |       | 3    |       |  |       |  |       |  |  |                    |         |  |    |       |  |                    |                        |       |  |                    |  |                        |  |
| Aircraft with<br>MTOM 2'250 -<br>5'700 kg | 3   | 0    | 3     | 0    | 1   |      | 2     | 0    |  | 0    | 2              | 0    | 4     | 1    | o     | 0    |       | 1    |       |  |       |  |       |  |  |                    |         |  |    |       |  |                    |                        |       |  |                    |  |                        |  |
| Aircraft with<br>MTOM > 5'700 kg          | 6   | 12   |       |      | 6   | 12   | 1.    | 1    |  | 0    | 1              | 1    | 2     |      | 0     | 0    | 2     |      |       |  |       |  |       |  |  |                    |         |  |    |       |  |                    |                        |       |  |                    |  |                        |  |
| Helicopter                                | 7   | 11   | 3     | 2    | 8   |      | 3     | 1    | 1  | 0    | 2              | 1    |       | 0    |       | 0    | 0     |      |       |  |       |  |       |  |  |                    |         |  |    |       |  |                    |                        |       |  |                    |  |                        |  |
| Motor gliders and<br>gliders              | 6   | 6    | 2     |      | 4   | 2    | 0     | 1    | 0  | 0    | 0              | ı    | 1     | 1    | 0     | 1    | 1     | 0    |       |  |       |  |       |  |  |                    |         |  |    |       |  |                    |                        |       |  |                    |  |                        |  |
| Balloons and<br>airships                  | 0   | 1    |       |      | 0   | 1    | 0     | 0    |  | 0    |                | 0    |       |      |       | 6    | 0     | 0    |       |  |       |  |       |  |  |                    |         |  |    |       |  |                    |                        |       |  |                    |  |                        |  |

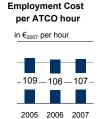
source : BFU - 2007, Statistics

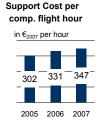
ESSAR 2 compliant severity classification.

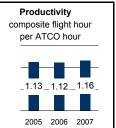
#### **Cost effectiveness**



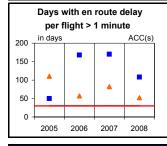




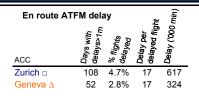




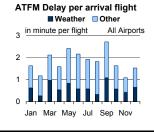
#### En Route ATFM delay

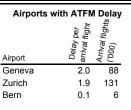












#### Slovenia Control, Slovenia



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 199  | 231  | 249     |
|  | 34   | 38   | 41      |
|  | 36   | 42   | 45      |
| En Route ATFM delays ('000 minutes)  | 10   | 67   | 8       |
| Airport ATFM delays ('000 minutes)   | 0    | 2    | 2       |
| Total Staff  | 178  | 199  | 85      |
| ATCOs in OPS   | 65   | 76   |         |
| ATM/CNS provision costs (million € <sub>2007</sub> )   | 16   | 19   | 23      |
| Capital Investment (million €2007)   | 5    | 3    | 7       |

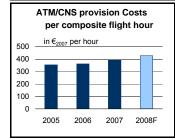
#### Safety

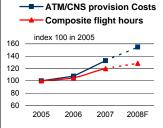
- "In the context of air traffic safety, two operational objectives were defined and thus:
- no extraordinary flight safety event type A, which according to ICAO classification means that an aircraft crash is possible and would be caused by public company staff members
- minimum number of extraordinary flight safety events type B, which according to ICAO classification means reducing the current minimal separation and would be caused by public company staff members

One (1) extraordinary flight safety event type A was recorded in the air traffic control sector, whereby it is necessary to emphasise that the incident happened without any direct contribution from the public company staff. One (1) extraordinary flight safety event type B was recorded and the incident happened without any direct contribution from public company staff."

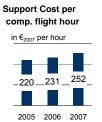
(Extract from 2007 ANSP's annual report)

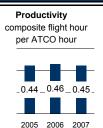
# Cost effectiveness



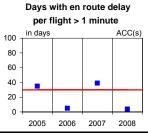




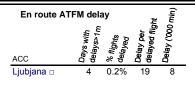




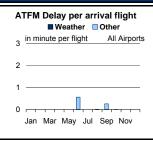
# En Route ATFM delay

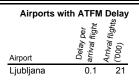




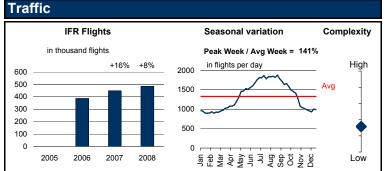








#### SMATSA, Serbia and Montenegro



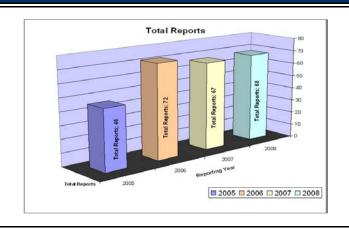
| Key data   | 2006            | 2007            | 2008(F) |
|--|-----------------|-----------------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) En Route ATFM delays ('000 minutes) | 387             | 449             | 486     |
|  | 165             | 188             | 205     |
|  | 59              | 64              | 68      |
|  | 3               | 1               | 3       |
| Airport ATFM delays ('000 minutes)  Total Staff  ATCOs in OPS  | 0<br>831<br>243 | 0<br>822<br>242 | 213     |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)  | 60              | 68              | 69      |
|  | 18              | 6               | 26      |

## Safety

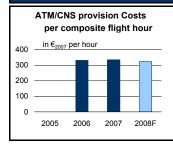
SMATSA safety department was established on November 2004. Among other duties, Safety department is responsible for collecting, analysing, sharing and archiving all safety occurrences datas. No accident was induced by ATM. (source: SMATSA)

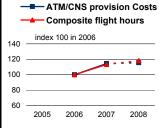
| Year                              | 2005 | 2006 | 2007 | 2008 |
|-----------------------------------|------|------|------|------|
| Number of<br>Accidents            | 2    | 3    | 3    | 6    |
| Number of<br>Serious<br>Incidents | 2    | 1    | 1    | 2    |
| Number of<br>Major<br>Incidents   | 3    | 0    | 5    | 4    |
| RWY<br>Incursion                  | 3    | 2    | 1    | 2    |
| Various<br>Incidents              | 36   | 66   | 57   | 42   |
| Total<br>Reports                  | 46   | 72   | 67   | 68   |

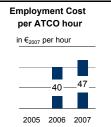


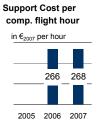


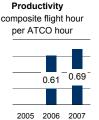
#### **Cost effectiveness**



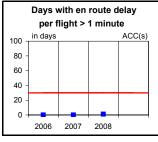




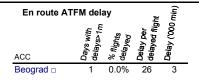




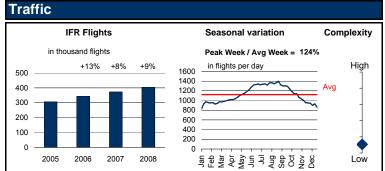
# En Route ATFM delay







## **UkSATSE**, Ukraine



| Key data   | 2006 | 2007 | 2008(F) |
|--|------|------|---------|
| Total IFR flights controlled ('000) IFR flight-hours controlled ('000) IFR airport movements controlled ('000) | 345  | 373  | 406     |
|  | 274  | 304  | 333     |
|  | 165  | 181  | 192     |
| En Route ATFM delays ('000 minutes)  | 0    | 0    | 0       |
| Airport ATFM delays ('000 minutes)   | 0    | 0    | 0       |
| Total Staff  | 5339 | 5467 | 1045    |
| ATCOs in OPS   | 1129 | 1045 |         |
| ATM/CNS provision costs (million € <sub>2007</sub> ) Capital Investment (million €2007)                        | 135  | 137  | 154     |
|  | 19   | 18   | n/a     |

#### Safety

ANSP's 2007 Annual report not available.

#### **Cost effectiveness ATM/CNS** provision Costs - ATM/CNS provision Costs **Employment Cost** Support Cost per Productivity per composite flight hour -Composite flight hours per ATCO hour comp. flight hour composite flight hour per ATCO hour i<u>n €<sub>2007</sub> pe</u>r hour in €<sub>2007</sub> per hour index 100 in 2005 in €<sub>2007</sub> per hour 160 400 140 300 120 0.28 200 349 100 314 0.22 -0.19 100 80 0 60 2006 2007 2005 2006 2007 2008F 2005 2006 2007 2005 2006 2007 2005 2006 2007

# En Route ATFM delay

# **ANNEX X - GLOSSARY**

| ACARE           | Advisory Council for Aeronautics Research in Europe  |
|-----------------|--|
| ACC             | Area Control Centre. That part of ATC that is concerned with en-route traffic coming   |
|                 | from or going to adjacent centres or APP. It is a unit established to provide air traffic control service to controlled flights in control areas under its jurisdiction.   |
| Accident        | An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disamberled in which  |
| (ICAO Annex 13) | such persons have disembarked, in which:  a) a person is fatally or seriously injured as a result of:  |
|                 | Being in the aircraft, or  |
|                 | Direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or   |
|                 | Direct exposure to jet blast,  |
|                 | except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or   |
|                 | b) the aircraft sustains damage or structural failure which:   |
|                 | <ul> <li>Adversely affects the structural strength, performance or flight characteristics<br/>of the aircraft, and</li> </ul>  |
|                 | <ul> <li>Would normally require major repair or replacement of the affected<br/>component, except for engine failure or damage, when the damage is limited<br/>to the engine, its cowlings or accessories, or for damage limited to propellers,<br/>wing tips, antennas, tyres, brakes, fairings, small dents or puncture holes in<br/>the aircraft skin;</li> </ul> |
|                 | c) the aircraft is missing or completely inaccessible.   |
| ACE Reports     | Air Traffic Management Cost-Effectiveness (ACE) Benchmarking Reports   |
| ACI             | Airports Council International (http://www.aci-europe.org/)  |
| AEA             | Association of European Airlines (http://www.aea.be)   |
| Aena            | Aeropuertos Españoles y Navegación Aérea, ANS Provider - Spain   |
| AGA             | Aerodromes Air Routes and Ground Aids  |
| Agency          | The EUROCONTROL Agency   |
| AIG             | Accident and Incident Investigation (ICAO)   |
| Airside         | The aircraft movement area (stands, apron, taxiway system, runways etc.) to which access is controlled.  |
| AIS             | Aeronautical Information Service   |
| ANS             | Air Navigation Service. A generic term describing the totality of services provided in order to ensure the safety, regularity and efficiency of air navigation and the appropriate functioning of the air navigation system.   |
| ANSB            | Air Navigation Services Board  |
| ANS CR          | Air Navigation Services of the Czech Republic. ANS Provider - Czech Republic.  |
| ANS Sweden      | The LFV Group – that is the ANS Provider in Sweden.  |
| ANSP            | Air Navigation Services Provider   |
| APP             | Approach Control Unit  |
| ASM             | Airspace Management  |
| ASMA            | Arrival Sequencing and Metering Area   |
| AST             | Annual Summary Templates   |

| ATC                  | Air Traffic Control. A service operated by the appropriate authority to promote the safe, orderly and expeditious flow of air traffic.  |
|----------------------|---|
| ATCO                 | Air Traffic Control Officer   |
| ATFCM                | Air Traffic Flow and Capacity Management.   |
| ATFM                 | Air Traffic Flow Management. ATFM is established to support ATC in ensuring an optimum flow of traffic to, from, through or within defined areas during times when demand exceeds, or is expected to exceed, the available capacity of the ATC system, including relevant aerodromes.   |
| ATFM delay<br>(CFMU) | The duration between the last Take-Off time requested by the aircraft operator and the Take-Off slot given by the CFMU.   |
| ATFM Regulation      | When traffic demand is anticipated to exceed the declared capacity in en-route control centres or at the departure/arrival airport, ATC units may call for "ATFM regulations".  |
| ATM                  | Air Traffic Management. A system consisting of a ground part and an air part, both of which are needed to ensure the safe and efficient movement of aircraft during all phases of operation. The airborne part of ATM consists of the functional capability which interacts with the ground part to attain the general objectives of ATM. The ground part of ATM comprises the functions of Air Traffic Services (ATS), Airspace Management (ASM) and Air Traffic Flow Management (ATFM). Air traffic services are the primary components of ATM. |
| ATMAP                | ATM Performance at Airports   |
| ATS                  | Air Traffic Service. A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service.   |
| ATSA Bulgaria        | Air Traffic Services Authority of Bulgaria. ANS Provider - Bulgaria.  |
| Austro Control       | Austro Control: Österreichische Gesellschaft für Zivilluftfahrt mbH,  |
|                      | ANS Provider - Austria  |
| AVINOR               | Avinor, ANS Provider - Norway   |
| Bad weather          | For the purpose of this report, "bad weather" is defined as any weather condition (e.g. strong wind, low visibility, snow) which causes a significant drop in the available airport capacity.   |
| Belgocontrol         | ANS Provider - Belgium  |
| CAA                  | Civil Aviation Authority  |
| CANSO                | Civil Air Navigation Services Organisation (http://www.canso.org)   |
| CAEP                 | ICAO Committee for Aviation Environmental Protection  |
| CAP                  | Corrective Action Plan  |
| CDA                  | Continuous Descent Approach   |
| CDM                  | Collaborative Decision Making   |
| CDR                  | Conditional Routes  |
| CE                   | Critical Elements (of a State's safety oversight system)  |
| CEANS                | ICAO Conference on the Economics of Airports and Air Navigation Services  |
| CEATS                | Central European Air Traffic System. The CEATS Programme is created to meet the needs of eight States - Austria, Bosnia-Herzegovina, Croatia, the Czech Republic, Hungry, Italy, the Slovak Republic and Slovenia – to co-operate in the provision of air traffic services within their airspace.   |
| CFMU                 | EUROCONTROL Central Flow Management Unit  |
| CFMU Area            | EUROCONTROL Member States in 2005 + Estonia, Latvia and Lithuania.  |
| CNS                  | Communications, Navigation, Surveillance.   |
| CO <sub>2</sub>      |   |
| -                    | Carbon dioxide  |

| Composite flight hour | En-route flight hours plus IFR airport movements weighted by a factor that reflected the relative importance of terminal and en-route costs in the cost base (see ACE reports)  |
|-----------------------|---|
| COP15                 | 15 <sup>th</sup> Conference of the Parties, Copenhagen 2009   |
| CRCO                  | EUROCONTROL Central Route Charges Office  |
| Croatia Control       | Hrvatska kontrola zračne plovidbe d.o.o. ANS Provider - Croatia,  |
| СТОТ                  | Calculated Take-Off Time  |
| DCAC Cyprus           | Department of Civil Aviation of Cyprus. ANS Provider - Cyprus.  |
| DFS                   | DFS Deutsche Flugsicherung GmbH, ANS Provider - Germany   |
| DHMi                  | Devlet Hava Meydanlari Isletmesi Genel Müdürlügü (DHMi),  |
|                       | General Directorate of State Airports Authority, Turkey. ANS Provider – Turkey.   |
| DMEAN                 | Dynamic Management of the European Airspace Network   |
| DSNA                  | Direction des Services de la Navigation Aérienne. ANS Provider - France   |
| EAD                   | European AIS Database   |
| EANS                  | Estonian Air Navigation Services. ANS Provider – Estonia.   |
| EATM                  | European Air Traffic Management (EUROCONTROL)   |
| EC                    | European Commission   |
| ECAC                  | European Civil Aviation Conference.   |
| ECCAIRS               | European accident and incident database   |
| E-CODA                | Enhanced Central Office for Delay Analysis (EUROCONTROL)  |
| EDCT                  | Estimate Departure Clearance Time   |
| EEA                   | European Economic Area (EU Member States + Iceland, Norway and Lichtenstein)  |
| EEC                   | EUROCONTROL Experimental Centre, Brétigny   |
| Effective capacity    | The traffic level that can be handled with optimum delay (cf. PRR 5 Annex 6)  |
| ELFAA                 | European Low Fares Airline Association (http://www.elfaa.com)   |
| ENAV                  | Ente Nazionale di Assistenza al Volo (ENAV). ANS Provider - Italy   |
| ERA                   | European Regions Airline Association (http://www.eraa.org)  |
| ESARR                 | EUROCONTROL Safety Regulatory Requirement   |
| ESARR 1               | "Safety Oversight in ATM"   |
| ESARR 2               | "Reporting and Analysis of Safety Occurrences in ATM"   |
| ESARR 3               | "Use of Safety Management Systems by ATM Service Providers"   |
| ESARR 4               | "Risk Assessment and Mitigation in ATM"   |
| ESARR 5               | "Safety Regulatory Requirement for ATM Services' Personnel"   |
| ESARR 6               | "Safety Regulatory Requirement for Software in ATM Systems"   |
| ESIMS                 | ESARR Support Implementation & Monitoring Programme   |
| ESRA (2002)           | European Statistical Reference Area (see STATFOR Reports)   |
|                       | Austria, Belgium, Bulgaria, Canary Islands, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, FYROM, Germany, Greece, Hungary, Ireland, Italy, Lisbon FIR, Luxembourg, Malta, Moldova, Netherlands, Norway, Romania, Santa Maria FIR, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom |
| ESRA 2008             | As above plus Albania, Bosnia-Herzegovina, Poland, Serbia & Montenegro, Ukraine   |
| ETS                   | Emissions Trading Scheme. The objective of the EU ETS is to reduce greenhouse gas emissions in a cost-effective way and contribute to meeting the EU's Kyoto Protocol targets.  |
| EU                    | European Union [Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia,  |

|                                     | Slovenia, Spain, Sweden, United Kingdom]  |
|-------------------------------------|---|
| EUROCONTROL                         | The European Organisation for the Safety of Air Navigation. It comprises Member States and the Agency.  |
| EUROCONTROL<br>Member States        | Thirty-eight Member States (31.12.2008): Albania, Armenia, Austria, Belgium, Bosnia & Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Malta, Moldova, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, The former Yugoslav Republic of Macedonia; Turkey, Ukraine and United Kingdom. |
| EUROCONTROL<br>Route Charges System | 1988 (11 States): Belgium, Luxembourg, Germany, France, United Kingdom, Netherlands, Ireland, Switzerland, Portugal, Austria, Spain.  |
|                                     | 1997 (23 States): idem + Greece, Turkey, Malta, Cyprus, Hungary, Norway, Denmark, Slovenia, Czech Republic, Sweden, Italy, Slovak Republic.   |
|                                     | 2000 (28 States): idem + Romania, Croatia, Bulgaria, Monaco, FYROM.   |
|                                     | 2001 (29 States): idem + Moldova.   |
|                                     | 2002 (30 States): idem + Finland.   |
|                                     | 2003 (31 States): idem + Albania  |
|                                     | 2004 (31 States): idem  |
|                                     | 2005 (32 States): idem + Bosnia & Herzegovina   |
|                                     | 2006 (32 States): idem.   |
|                                     | 2007 (32 States) idem   |
|                                     | 2008 (36 States) idem + Serbia, Montenegro, Poland and Lithuania  |
|                                     | 2009 (38 States) ) idem + Armenia and Ukraine   |
| EUROSTAT                            | The Statistical Office of the European Community  |
| EVAIR                               | EUROCONTROL Voluntary ATM Incident Reporting system   |
| FAB                                 | Functional Airspace Blocks  |
| FINAVIA                             | ANS provider – Finland  |
| FIR                                 | Flight Information Region. An airspace of defined dimensions within which flight information service and alerting service are provided.   |
| FL                                  | Flight Level. Altitude above sea level in 100 feet units measured according to a standard atmosphere. Strictly speaking a flight level is an indication of pressure, not of altitude. Only above the transition level (which depends on the local QNH but is typically 4000 feet above sea level) flight levels are used to indicate altitude, below the transition level feet are used.  |
| FMP                                 | Flow Management Position  |
| FUA                                 | Flexible Use of Airspace  |
| Level 1                             | Strategic Airspace Management   |
| Level 2                             | Pre-tactical Airspace Management  |
| Level 3                             | Tactical Airspace Management  |
| FYROM                               | Former Yugoslav Republic of Macedonia   |
| FYROM CAA                           | Civil Aviation Authority of the Former Yugoslav Republic of Macedonia. ANS Provider – FYROM.  |
| GAT                                 | General Air Traffic. Encompasses all flights conducted in accordance with the rules and procedures of ICAO.   |
|                                     | PRR 2008 uses the same classification of GAT IFR traffic as STATFOR:  |
|                                     | 1. Business aviation: All IFR movements by aircraft types in the list of business aircraft types (see STATFOR Business Aviation Report, May 2006, for the list);  |
|                                     | 2. Military IFR: ICAO Flight type= 'M', plus all flights by operators or aircraft types for which 70%+ of 2003 flights were 'M';  |
|                                     | 3. Cargo: All movements by operators with fleets consisting of 65% or more all-freight  |

|  | airframes;   |
|--|--|
|  | 4. Low-cost: See STATFOR Document 150 for list.  |
|  | 5. Traditional Scheduled: ICAO Flight Type = 'S', e.g. flag carriers.  |
|  | 6. Charter: ICAO Flight Type = 'N', e.g. charter plus air taxi not included in (1)   |
| GDP                                    | Gross Domestic Product   |
| General Aviation                       | All civil aviation operations other than scheduled air services and non-scheduled air transport operations for remuneration or hire.   |
| GHG                                    | Greenhouse gases.  |
|  | GHGs include $CO_2$ - Carbon dioxide, $CH_4$ - Methane, $N_2O$ - Nitrous oxide, PFCs - Perfluorocarbons, HFCs - Hydrofluorocarbons, SF <sub>6</sub> - Sulphur hexafluoride.  |
| GIACC                                  | ICAO High-level Group International Aviation and Climate Change  |
| HCAA                                   | Hellenic Civil Aviation Authority. ANS Provider - Greece   |
| HungaroControl                         | ANS Provider - Hungary   |
| IAA                                    | Irish Aviation Authority. ANS Provider - Ireland   |
| IANS                                   | EUROCONTROL Institute for Air Navigation Services, Luxembourg  |
| IAS                                    | International Accounting Standards   |
| IATA                                   | International Air Transport Association (www.iata.org)   |
| ICAO                                   | International Civil Aviation Organization  |
| IFR                                    | Instrument Flight Rules. Properly equipped aircraft are allowed to fly under badweather conditions following instrument flight rules.  |
| ILOAT                                  | International Labour Office Administrative Tribunal  |
| IMC                                    | Instrument Meteorological Conditions   |
| Incident                               | An occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation.   |
| Incident Category A<br>(ICAO Doc 4444) | A serious incident: AIRPROX - Risk Of Collision: "The risk classification of an aircraft proximity in which serious risk of collision has existed".  |
| Incident Category B (ICAO Doc 4444)    | A major incident. AIRPROX - Safety Not Assured: "The risk classification of an aircraft proximity in which the safety of the aircraft may have been compromised".  |
| Interested parties                     | Government regulatory bodies, Air Navigation Service Providers, airport authorities, airspace users, international civil aviation organisations, EUROCONTROL Agency, the advisory bodies to the Permanent Commission, representatives of airspace users, airports and staff organisations and other agencies or international organisations which may contribute to the work of the PRC. |
| JU                                     | Joint Undertaking  |
| Just culture                           | The EUROCONTROL definition of "just culture", also adopted by other European aviation stakeholders, is a culture in which "front line operators or others are not punished for actions, omissions or decisions taken by them that are commensurate with their experience and training, but where gross negligence, wilful violations and destructive acts are not tolerated."            |
| KPA                                    | Key Performance Area   |
| KPI                                    | Key Performance Indicator  |
| Lagging indicators                     | These measure events that have happened (e.g. safety occurrences), effectiveness of safety improvement activities, outcome of service delivery. These focus on results and characterise historical performance.  |
| LAQ                                    | Local Air Quality  |
| LCIP                                   | Local Convergence and Implementation Plan  |
| Leading indicators                     | Leading indicators give advance information relevant to safety in the future. They are developed through comprehensive analyses of organisations (ANSPs, States) and are designed to help identify whether the actions taken or processes in place are effective   |

|                                 | in lowering the risk  |
|---------------------------------|---|
| LGS                             | SJSC Latvijas Gaisa Satiksme (LGS). ANS Provider - Latvia   |
| LHR                             | London Heathrow (UK)  |
|                                 |   |
| LP/LD                           | Low power/Low drag  |
| LPS                             | Letové Prevádzkové Služby. ANS Provider - Slovak Republic   |
| LVNL                            | Luchtverkeersleiding Nederland. ANS Provider - Netherlands  |
| M                               | Million   |
| Maastricht UAC                  | The EUROCONTROL Upper Area Centre (UAC) Maastricht. It provides ATS in the upper airspace of Belgium, Luxembourg, the Netherlands and Northern Germany.   |
| MATS                            | Malta Air Traffic Services Ltd. ANS Provider - Malta  |
| MET                             | Meteorological Services for Air Navigation  |
| MIL                             | Military flights  |
| MIT                             | Miles in Trail  |
| MoldATSA                        | Moldavian Air Traffic Services Authority. ANS Provider - Moldova  |
| MTOW                            | Maximum Take-off Weight   |
| MUAC                            | Maastricht Upper Area Control Centre, EUROCONTROL   |
| MUIC                            | EUROSTAT Monetary Union Index of Consumer Price   |
| NATA Albania                    | National Air Traffic Agency. ANS Provider - Albania   |
| NATO                            | North Atlantic Treaty Organisation  |
| NATO ACCS                       | NATO Air Command and Control System   |
| NATS                            | National Air Traffic Services. ANS Provider - United Kingdom  |
| NAV Portugal                    | Navegação Aérea de Portugal – NAV Portugal, E.P.E.  |
| NAVIAIR                         | Air Navigation Services – Flyvesikringstjenesten. ANS Provider - Denmark  |
| NM                              | Nautical mile (1.852 km)  |
| NMD                             | Network Management and Design   |
| $NO_2$                          | Nitrogen dioxide  |
| NOx                             | Oxides of Nitrogen  |
| NSA                             | National supervisory Authorities  |
| Occurrence<br>(Source: ESARR 2) | Accidents, serious incidents and incidents as well as other defects or malfunctioning of an aircraft, its equipment and any element of the Air Navigation System which is used or intended to be used for the purpose or in connection with the operation of an aircraft or with the provision of an air traffic management service or navigational aid to an aircraft. |
| OEP                             | Operational Evolution Partnership (a list of 35 US airports that was compiled in 2000, based on lists from the FAA and Congress and a study that identified the most congested airports in the US).   |
| OPS                             | Operational Services  |
| Organisation                    | See "EUROCONTROL".  |
| Oro Navigacija                  | State Enterprise Oro Navigacija. ANS Provider - Lithuania   |
| PATA                            | Polish Air Traffic Agency. ANS Provider - Poland  |
| PC                              | Provisional Council of EUROCONTROL  |
| Permanent<br>Commission         | The governing body of EUROCONTROL. It is responsible for formulating the Organisation's general policy.   |
| PM10                            | Particulate Matter, with an aerodynamic diameter of less than 10 micrometers  |
| PRC                             | Performance Review Commission   |
| Primary Delay                   | A delay other than reactionary  |
|                                 | <u> </u>  |

| Productivity                   | Hourly productivity is measured as Flight-hours per ATCO-hour (see ACE reports)  |
|--------------------------------|--|
| PRB                            | Performance Review Body  |
| PRR                            | Performance Review Report  |
| PRR 2006                       | covering the calendar year 2006  |
| PRR 2007                       | covering the calendar year 2007  |
| PRR 2008                       | covering the calendar year 2008  |
| PRU                            | Performance Review Unit  |
| Punctuality                    | On-time performance with respect to published departure and arrival times  |
| R&D                            | Research & Development   |
| RAD                            | Route availability document  |
| Reactionary delay              | Delay caused by late arrival of aircraft or crew from previous journeys  |
| Revised Convention             | Revised EUROCONTROL International Convention relating to co-operation for the Safety of Air Navigation of 13 December 1960, as amended, which was opened for signature on 27 June 1997.  |
| ROMATSA                        | Romanian Air Traffic Services Administration. ANS Provider - Romania   |
| RPK                            | Revenue Passenger Kilometre  |
| RTA                            | Requested Time of Arrival  |
| Runway incursion               | European definition: Any unauthorised presence on a runway of aircraft, vehicle, person or object where an avoiding action was required to prevent a collision with an aircraft. Source: ESARR 2.  |
|                                | US definition: Any occurrence at an airport involving an aircraft, vehicle, person, or object on the ground, that creates a collision hazard or results in a loss of separation with an aircraft taking-off, intending to take off, landing or intending to land. Source: US (FAA order 8020.11A).   |
| RVSM                           | Reduced Vertical Separation Minima   |
| SAFREP                         | EUROCONTROL Director General's Safety Reporting Taskforce  |
| SAR                            | Search & Rescue  |
| SARPs                          | Standards and Recommended Practices (ICAO)   |
| Separation minima              | Separation Minima is the minimum required distance between aircraft. Vertically usually 1000 ft below flight level 290, 2000 ft above flight level 290. Horizontally, depending on the radar, 3 NM or more. In the absence of radar, horizontal separation is achieved through time-separation (e.g. 15 minutes between passing a certain navigation point). |
| Separation minima infringement | A situation in which prescribed separation minima were not maintained between aircraft.  |
| Serious incident               | An incident involving circumstances indicating that an accident nearly occurred.   |
| (ICAO Annex 13)                |  |
| SES                            | Single European Sky (EU)   |
|                                | http://europa.eu.int/comm/transport/air/single_sky/index_en.htm  |
| SESAR                          | The Single European Sky implementation programme   |
| Severity                       | The severity of an accident is expressed according to:   |
|                                | <ul> <li>the level of damage to the aircraft (ICAO Annex 13 identifies four levels:<br/>destroyed: substantially destroyed, slightly damaged and no damage);</li> </ul>  |
|                                | • the <i>type and number of injuries</i> (ICAO Annex 13 identifies three levels of injuries: fatal, serious and minor/none).   |
|                                | PRRs focus on Severity A (Serious Incident) and Severity B (Major Incident).   |
| Skyguide                       | ANS Provider - Switzerland   |
| Slot (ATFM)                    | A take-off time window assigned to an IFR flight for ATFM purposes   |

| Slovenia Control | ANS Provider - Slovenia   |
|------------------|---|
| SMI              | Separation minima infringement.   |
| SO <sub>x</sub>  | Sulphur oxide gases   |
| SRC              | Safety Regulation Commission  |
| SRU              | Safety Regulation Unit  |
| STATFOR          | EUROCONTROL Statistics & Forecasts Service  |
| SUA              | Special Use Airspace  |
| Summer period    | May to October inclusive  |
| Taxi- in         | The time from touch-down to arrival block time.   |
| Taxi- out        | The time from off-block to take-off, including eventual holding before take-off.  |
| TMA              | Terminal manoeuvring area   |
| TMS              | Traffic Management System   |
| UAC              | Upper Airspace Area Control Centre  |
| UK CAA           | United Kingdom Civil Aviation Authority   |
| UK NATS          | United Kingdom National Air Traffic Services  |
| UkSATSE          | Ukrainian State Air Traffic Service Enterprise. ANS Provider - Ukraine  |
| UNFCCC           | United Nations Framework Convention on Climate Change   |
| UR               | Unit Rate   |
| US               | United States of America  |
| US CONUS         | The 48 contiguous States located on the North American continent south of the border with Canada, plus the District of Columbia, excluding Alaska, Hawaii and oceanic areas |
| USD              | US dollar   |
| USOAP            | ICAO Universal Safety Oversight Audit Programme   |
| VFR              | Visual Flight Rules   |
| VLJ              | Very Light Jets   |
| VMC              | Visual metrological conditions  |

#### PRC documentation can be consulted and downloaded from the PRC website http://www.EUROCONTROL.int/prc

1 ECAC Institutional Strategy for Air Traffic Management in Europe, adopted by ECAC Ministers of Transport on 14 February 1997. 2 Regulation (EC) No 549/2004 of the European Parliament and of the Council laying down the framework for the creation of the Single European Sky ("Framework Regulation"). 3 Regulation (EC) No 550/2004 of the European Parliament and of the Council on the provision of air navigation services in the Single European Sky ("Service provision Regulation"). 4 Regulation (EC) No 551/2004 of the European Parliament and of the Council on the organisation and use of the airspace in the Single European Sky ("Airspace Regulation"). 5 Regulation (EC) No 552/2004 of the European Parliament and of the Council on the interoperability of the European Air Traffic Management Network ("Interoperability Regulation"). 6 Proposal for a Regulation of the European Parliament and of the Council amending Regulations (EC) No 549/2004, (EC) No 550/2004, (EC) No 551/2004 and (EC) No 552/2004 in order to improve the performance and sustainability of the European aviation system, (European Commission, 2008/0127 (COD)). 7 Performance Review Commission "Evaluation of Functional Airspace Block (FAB) initiatives and their contribution to performance improvement", October 2008. 8 Performance Review Commission, Implementation status of PRC recommendations, November 2007, http://www.eurocontrol.int/prc/index.html 9 Challenges of Growth 2008, EUROCONTROL, http://www.eurocontrol.int/statfor/gallery/content/ public/documents/Challenges%20of%20Growth%2008%20Summary%20Report%20v1.pdf 10 Economic briefing, IATA, December 2008, http://www.iata.org/NR/rdonlyres/7E25AD13-E0AD-4166-ABD8-CFA192D51AB4/0/IATA\_Economics\_Briefing\_Impact\_of\_Recession\_Dec08.pdf 11 Complexity Metrics for ANSP Benchmarking Analysis, Report by the ACE Working Group on complexity, 2006, Report commissioned by the PRC, http://www.eurocontrol.int/prc/gallery/content/public/Docs/Complexity\_%20report.pdf. 12 ICAO Convention on International Civil Aviation, signed at Chicago on 7 December 1944 13 EUROCONTROL, ATM Strategy for 2000+ (November 1998) 14 Safety Regulation Commission, Annual Safety Report 2008 (http://www.eurocontrol.int/src/public/subsite\_homepage/homepage.html) 15 ESARR 2: EUROCONTROL Safety Regulatory Requirement "Reporting and Analysis of Safety Occurrences in ATM" (2000). http://www.eurocontrol.int/src/gallery/content/public/documents/deliverables/esarr2\_awareness\_package/esar 16 République française, Contrôle et exploitations aériens, Budget annexe, Projets annuels de performances, Annexe au projet de loi de finances pour 2009 (29/09/2008) 17 Performance Review Commission, Performance Review Report 2007 (PRR 2007). An Assessment of Air Traffic Management in Europe during the Calendar Year 2007 (May 2008) 18 EUROCONTROL Central Flow Management Unit, "IFPS Users Manual" Edition 12.3 (November 2008)- $\underline{http://www.cfmu.eurocontrol.int/cfmu/gallery/content/public/userdocs/docs/ifps\_users\_manual.pdf}$ 19 Evaluation of Functional Airspace Block (FAB) Initiatives and their contribution to Performance Improvement, Performance Review Commission, October 2008. 20 Evaluation of Civil/Military Airspace Utilisation, Report commissioned by the Performance Review

Performance Review Commission, Report on ATM Performance at Airports (ATMAP), 2009.

US/ Europe comparison of ATM-related operational performance - An initial harmonized assessment by phase of flight, Report jointly produced by the Federal Aviation Administration (FAA/ATO) and the PRC

Commission, (November 2007).

(June 2009)

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- A comparison of performance in selected US and European En-route Centres, Performance Review Commission, (May 2003)
- 24 ICAO Manual on Air Navigation Services Economics, Document 9161 Fourth Edition 2007.
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- Directive 2002/30/EC of the European Parliament and of the Council of 26 March 2002 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Community airports <a href="http://eur-lex.europa.eu/smartapi/cgi/sga\_doc?smartapi!celexplus!prod!DocNumber&lg=en&type\_doc=Directive&an\_doc=2002&nu\_doc=30">http://eur-lex.europa.eu/smartapi/cgi/sga\_doc?smartapi!celexplus!prod!DocNumber&lg=en&type\_doc=Directive&an\_doc=2002&nu\_doc=30</a>
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#### About the Performance Review Commission

The Performance Review Commission (PRC) provides independent advice on European Air Traffic Management (ATM) Performance to the EUROCONTROL Commission through the Provisional Council.

The PRC was established in 1998, following the adoption of the European Civil Aviation Conference (ECAC) Institutional Strategy the previous year. A key feature of this Strategy is that "an independent Performance Review System covering all aspects of ATM in the ECAC area will be established to put greater emphasis on performance and improved cost-effectiveness, in response to objectives set at a political level".

The PRC reviews the performance of the European ATM System under various Key Performance Areas. It proposes performance targets, assesses to what extent agreed targets and high-level objectives are met and seeks to ensure that they are achieved. The PRC/PRU analyses and benchmarks the cost-effectiveness and productivity of Air Navigation Service Providers in its annual ATM cost-effectiveness (ACE) Benchmarking reports. It also produces ad hoc reports on specific subjects.

Through its reports, the PRC seeks to assist stakeholders in understanding from a global perspective why, where, when, and possibly how, ATM performance should be improved, in knowing which areas deserve special attention, and in learning from past successes and mistakes. The spirit of these reports is neither to praise nor to criticise, but to help everyone involved in effectively improving performance in the future.

The PRC meets typically 15 days a year. It consists of 12 Members, including the Chairman and Vice-Chairman:

Mr. John Arscott **Vice-Chairman**Mr. lacovos Papadopoulos
Mr. Ralf Berghof
Mr. Juan Revuelta Lapique
Mr. Carlo Bernasconi
Mr. Jaime Rodriques Valadares

Dr. Harry Bush Mr. Lauri Vänskä

Mr. Jean-Yves Delhaye Mr. Jean-François Vivier **Chairman** 

Mr. Helmut Erkinger Mrs. Aysin Zeren

PRC Members must have professional experience of air traffic management (planning, technical, operational or economic aspects) and/or safety or economic regulation in one or more of the following areas: government regulatory bodies, air navigation services, airports, aircraft operations, military, research and development.

Once appointed, PRC Members must act completely independently of States, national and international organisations.

The Performance Review Unit (PRU) supports the PRC and operates administratively under, but independently of, the EUROCONTROL Agency. The PRU's e-mail address is *PRU@eurocontrol.int*.

The PRC can be contacted via the PRU or through its website <a href="http://www.eurocontrol.int/prc">http://www.eurocontrol.int/prc</a>.

#### PRC PROCESSES

The PRC reviews ATM performance issues on its own initiative, at the request of the deliberating bodies of EUROCONTROL or of third parties. As already stated, it produces annual Performance Review Reports, ACE reports and ad hoc reports.

The PRC gathers relevant information, consults concerned parties, draws conclusions, and submits its reports and recommendations for decision to the Permanent Commission, through the Provisional Council. PRC publications can be found at <a href="https://www.eurocontrol.int/prc">www.eurocontrol.int/prc</a> where copies can also be ordered.



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