

# PRR 2010

## **Performance Review Report**

An Assessment of Air Traffic Management in Europe  
during the Calendar Year 2010



Performance Review Commission | May 2011

## 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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Printed by EUROCONTROL, 96, rue de la Fusée, B-1130 Brussels, Belgium. The PRC's website address is <http://www.eurocontrol.int/prc>. The PRU's e-mail address is [PRU@eurocontrol.int](mailto:PRU@eurocontrol.int).

# DOCUMENT IDENTIFICATION SHEET

## DOCUMENT DESCRIPTION

### Document Title

Performance Review Commission  
Performance Review Report covering the calendar year 2010 (PRR 2010)

### PROGRAMME REFERENCE INDEX

PRC Performance Review Report

### EDITION:

Final report

### EDITION DATE:

12 May 2011

### SUMMARY

This report of the Performance Review Commission analyses the performance of the European Air Traffic Management System in 2010 under the Key Performance Areas of Safety, Punctuality & Predictability, Capacity & Delays, Flight Efficiency, Environmental impact, and Cost-Effectiveness.

### Keywords

Air Traffic Management

Performance Measurement

Performance Areas

Performance Indicators

ATM

ANS

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<http://www.eurocontrol.int/prc>

## DOCUMENT STATUS AND TYPE

### STATUS

Draft

☐

Proposed Issue

☐

Released Issue

☒

### DISTRIBUTION

General Public

☒

EUROCONTROL Organisation

☐

Restricted

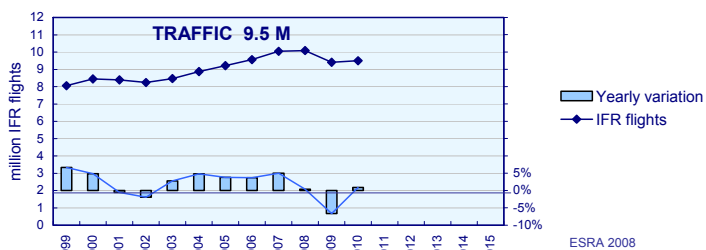
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**INTERNAL REFERENCE NAME:**

PRR 2010

## EUROPEAN LEVEL - AVIATION PERSPECTIVE

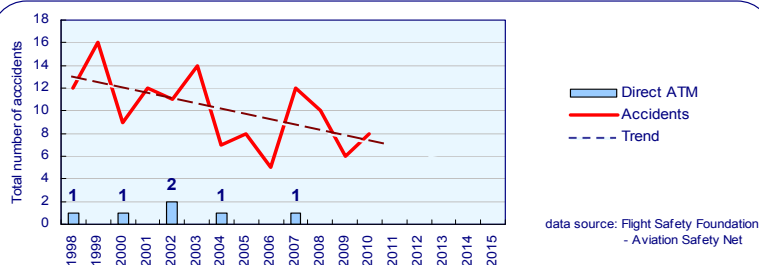
### TRAFFIC



MEASURE	DATA			
	2009	2010	YEARLY VARIATION	YEARLY % VARIATION
FLIGHTS	9.4 M	9.5 M	▲	+0.8%

Following the unprecedented downturn in 2009, traffic growth was modest in 2010. Flight cancellations due to volcanic ash in April reduced traffic growth by 1,2%.

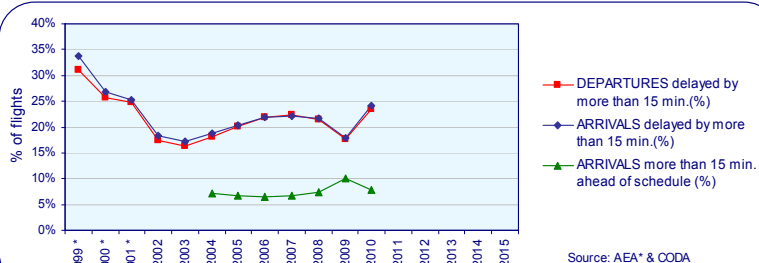
### AVIATION SAFETY



MEASURE	DATA			
	2009	2010	YEARLY VARIATION	
ATM-Induced accidents	0	0	=	

There was no ATM-induced accident in 2010.

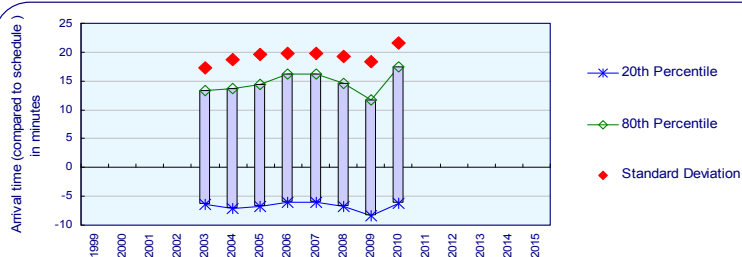
### PUNCTUALITY



MEASURE	DATA			
	2009	2010	YEARLY VARIATION	YEARLY % change
Arrivals > 15 min %	17.9%	24.2%	▲	6.3%pt

Air transport punctuality in 2010 was the worst recorded since 2001 (24.2% of flights delayed more than 15 minutes vs. schedule), although traffic was below 2007 levels and traffic growth was modest.

### PREDICTABILITY



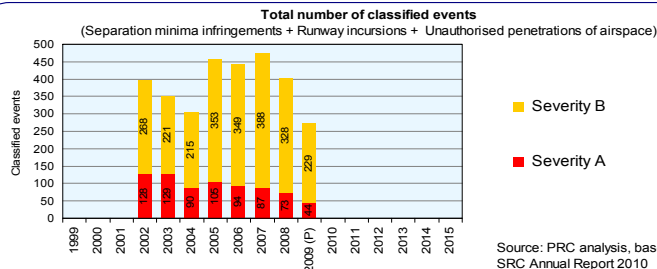
MEASURE	DATA			
	2009	2010	YEARLY VARIATION	YEARLY % VARIATION
Standard Deviation	18.4 min	21.5 min	▲	+17%

In line with on time performance, a significant increase in the level of variability originating from departure delays can be observed in 2010.



## EUROPEAN LEVEL - ANS PERSPECTIVE

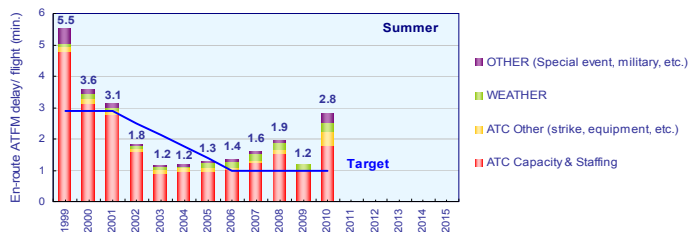
### SAFETY



KPIs	DATA 2009			
	TARGET	ACTUAL	YEARLY VARIATION	TARGET MET
Classified events	None	273	▼	N/A

The apparent improvement on high severity incidents should be taken with caution. The unsatisfactory situation on incident reporting on European-level requires urgent attention; this includes high numbers of unreported incidents, late provision of final data, and a high number of incident reports still remaining under investigation and/or are not severity classified.

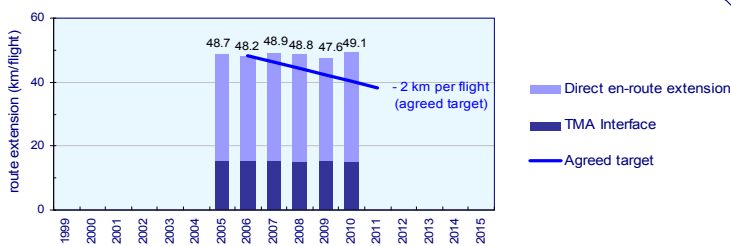
### ATFM DELAYS (EN-ROUTE)



KPIs	DATA			
	TARGET	ACTUAL	Summer VARIATION	TARGET MET
MINUTES/ FLIGHT	1.0	2.8	▲	No

Notwithstanding a modest traffic growth in 2010, en-route ATFM delay more than doubled from 1.2 to 2.8 minutes per flight in summer 2010. This is the highest level since 2001 and almost three times higher than the agreed PC summer delay target. 2010 saw an exceptional level of industrial actions.

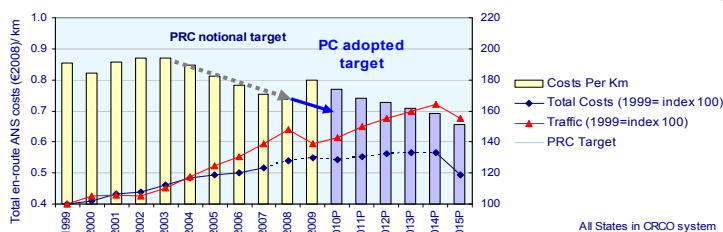
### FLIGHT - EFFICIENCY



KPIs	DATA			
	TARGET	ACTUAL	YEARLY VARIATION	TARGET MET
KM / FLIGHT	40.2	49.1	▲	No

Notwithstanding further en-route design related improvements, the horizontal en-route extension increased in 2010. This was due to a degradation in route utilisation (ash cloud and strikes), less direct routings being provided by ATC and increasing average flight length.

### COST - EFFECTIVENESS

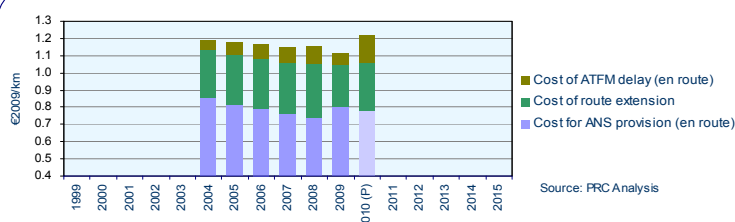


KPIs	DATA 2009			
	TARGET	ACTUAL	YEARLY VARIATION	TARGET MET
REAL UNIT COST/ KM	-3.0%	8.1%	▲	No

After a constant decrease between 2003 and 2008, en-route unit costs significantly increased in 2009, following the unprecedented traffic downturn. They reached €0.80/km (+8.1%), which marks the end of a positive improvement trend.

As a result, the Pan-European target adopted by the PC in Nov. 2007 is no longer achievable.

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



KPIs	DATA			
	TARGET	Projected	YEARLY VARIATION	TARGET MET
TOTAL UNIT COST/ KM	None	1.2 €/km (€2009)	▲	N/A

Total economic en-route unit cost of ANS (charges + delays + flight-inefficiencies) increased significantly in 2010. This was mainly due to higher en-route ATFM delay costs (industrial actions and implementation of new ATM systems) and the cost of route extension (mainly due to higher jet fuel price, circumnavigation of airspace affected by the ash cloud in April and industrial actions).

Figure 1-1: Key performance indicators [2010]

## Introduction

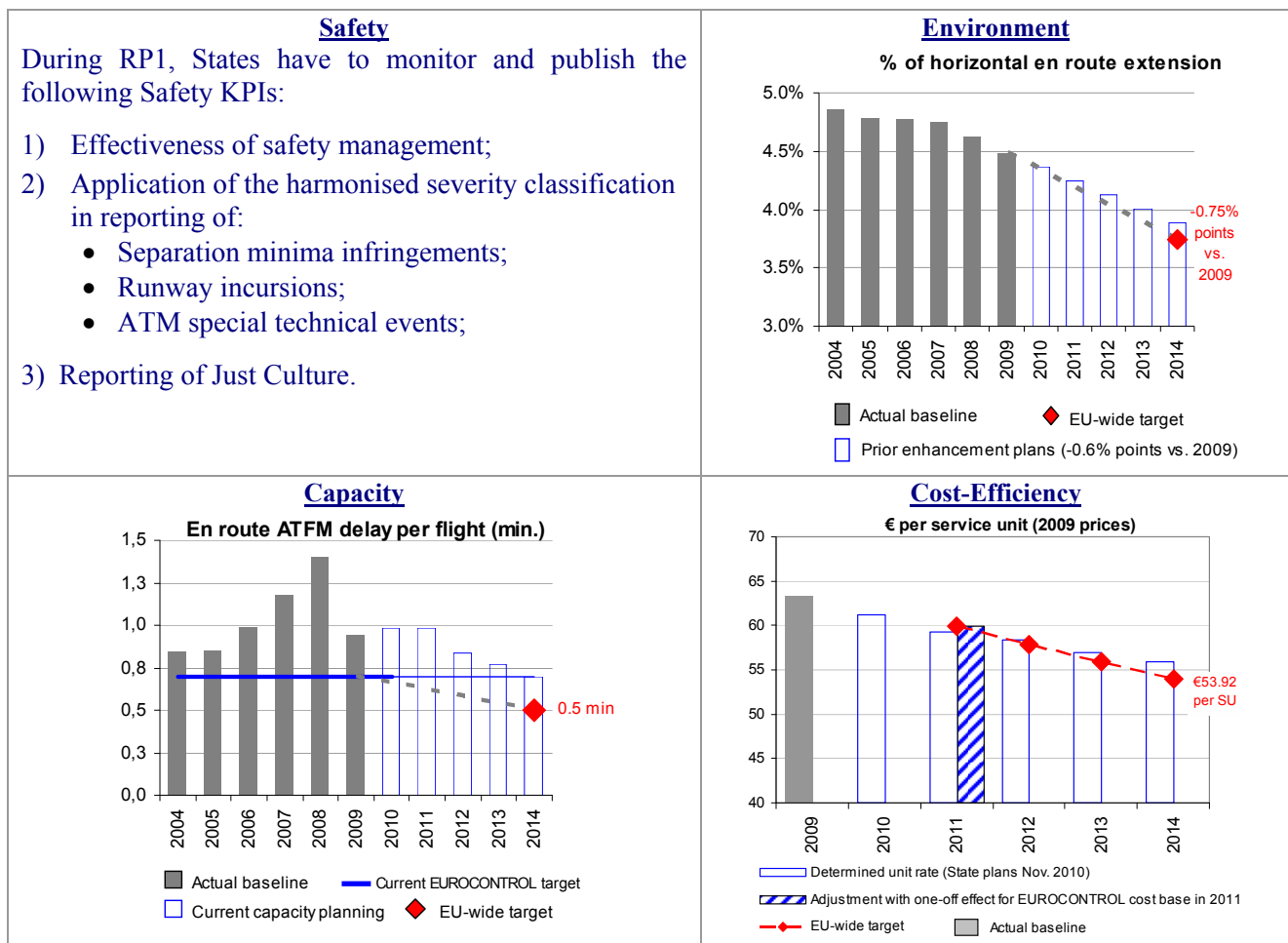
PRR 2010 presents an assessment of the performance of European Air Navigation Services (ANS) for the calendar year 2010 which was marked by a number of exceptional events such as the volcanic ash cloud, industrial actions, and unusually severe weather conditions, each of which had a significant impact on traffic growth, the level of delays and flight efficiency.

## SES Performance Scheme

The year 2010 saw the start of the implementation of the Single European Sky (SES) performance scheme, the designation of EUROCONTROL's PRC supported by the PRU as the SES Performance Review body (PRB) and the setting of EU-wide performance targets for the first reference period (RP1: 2012-2014). All of these aim at driving further improvements in the performance of Air Navigation in Europe.

The designation of EUROCONTROL as the SES PRB creates synergies between the SES and EUROCONTROL performance review systems, which will further promote pan-European performance improvement.

The EU-wide targets apply to the 27 EU States, Norway and Switzerland, and are designed to set a level of ambition for RP1. The realisation of this ambition requires National Supervisory Authorities to develop national/FAB performance plans that are consistent with the EU-wide targets by the end of June 2011.



The different instruments of the SES II package together constitute powerful tools towards performance improvement. The full realisation of the SES objectives will require an alignment of the various elements.

## European Air Traffic

After the unprecedented traffic downturn in 2009 (-6.6%), traffic increased a modest +0.8% to 9.5 million flights in 2010, which is well below 2007 levels. Note that in some parts of the network traffic continued to fall.

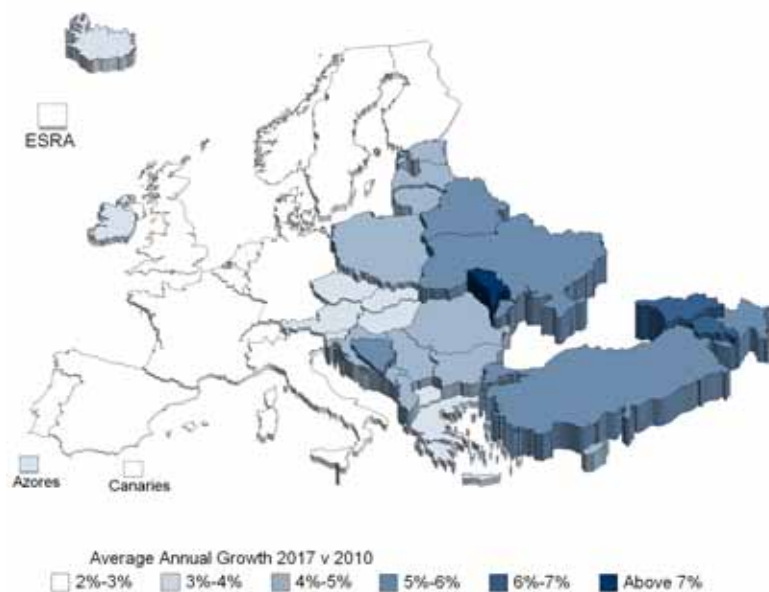
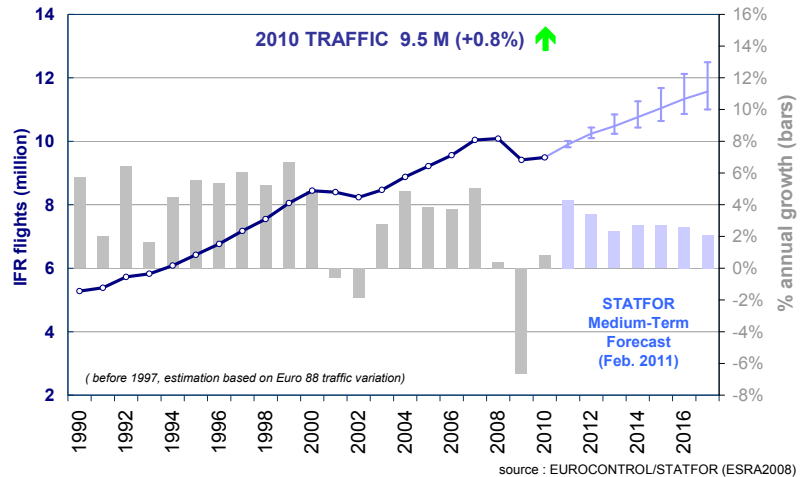
The weak economic growth, compounded by exceptional events (volcanic ash cloud, industrial actions, and unusually severe weather conditions) had a negative impact on traffic growth.

Approximately 111 000 flights were cancelled due to volcanic ash clouds in April, which reduced air traffic by some 48% during 8 days and annual air traffic growth by 1.2% in 2010.

Approximately 26 000 flights were cancelled due to industrial action and some 45 000 flights due to bad weather conditions in 2010.

STATFOR [Feb. 2011] forecasts a rebound of traffic in 2011 (+4.3% vs. 2010), and an annual average growth rate of 3.2% between 2010 and 2014.

However, traffic growth is not evenly spread across Europe. High traffic growth is forecast for the emerging markets in the Eastern European States in the next 5 years, albeit from a smaller base. A small to moderate growth is expected for the more mature markets in Western Europe.



Traditional scheduled traffic declined by -1.1% in 2010 but still accounts for the largest share of total IFR traffic (57.3%). The “low cost” traffic increased by +6.9% reaching a total market share of 22.1% in 2010. After a decline over the past two years, business aviation grew again by +5.5% in 2010 and accounted for 7.2% of total IFR traffic.

Although no statistically significant correlation could be demonstrated thus far, it should be noted that traffic variability and complexity can have an impact on ANS performance. The core area of Europe shows only a moderate level of seasonality but the highest levels of complexity. The situation is reversed in South-East Europe.

## Safety

Incident reporting remains unsatisfactory in some areas of Europe. The Safety Regulation Commission (SRC) estimates that, while some 15 000 incidents are reported, as many as 30 000 incidents remain un-reported. Thirty EUROCONTROL States reported in 2009, one more than in 2008. No or limited progress has been made in the remaining 8 States during the past 6 years.

Aggregated data on incidents remain provisional for up to two years due to the length of investigation and late submission of final data by some States. Moreover, the lack of consistency in reporting and assessing incidents across the EUROCONTROL States and during successive years does not permit trends to be identified confidently.

Regulatory provisions concerning the publication of investigation reports for accidents and serious incidents (Regulation (EU) No 996/2010, Articles 16.6 and 16.7) would need (i) to be reinforced, (ii) to be applied to all EUROCONTROL States and (iii) to be extended to all reported incidents. The ratio between open and closed reports should be published by States annually and implementation of the respective recommendations should be tracked.

There is an urgent need to accelerate the deployment of automatic safety data reporting tools in Europe in order to improve the reporting culture and consequently the level of reporting. Sufficient resources are needed to validate the data properly, analyse the results and draw lessons. A single European database that meets data quality criteria is an essential enabler for effective safety analysis.

NSAs need to be provided with the requisite resources to discharge fully their safety oversight responsibilities. International safety audits, inspections and surveys of NSAs and ANSPs should be rationalised.

## Operational Air Transport Performance

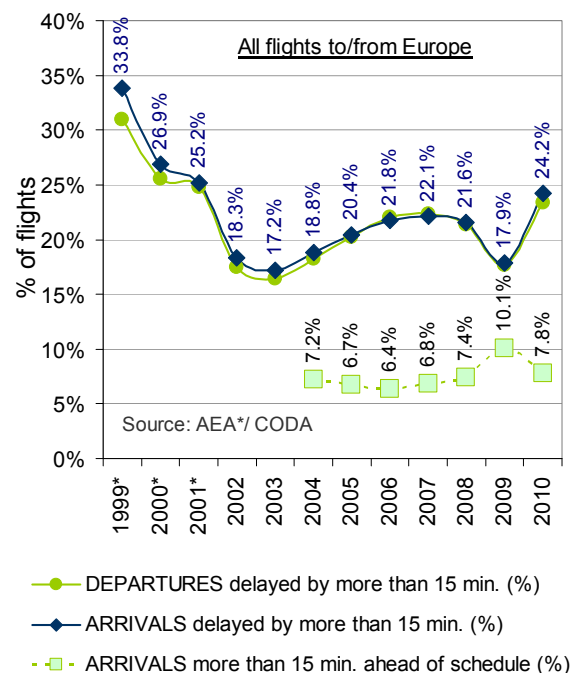
Air transport punctuality in 2010 was the worst recorded since 2001 (24.2% of flights delayed more than 15 minutes vs. schedule) although traffic was below 2007 levels and traffic growth was modest.

The main causes of this poor performance are as follows:

- ANS-related delays (+32.5%) and their share in air transport delays (+7.3% points) increased significantly in 2010, primarily due to industrial actions; and,
- weather-related delays (snow, freezing conditions) were higher than usual during winter 2009 and in December 2010.

The volcanic ash cloud in April/May 2010 had a limited impact on punctuality, as the majority of the flights were cancelled.

Departure delays remained the principal drivers of arrival punctuality and predictability, with relatively small flight time variations in the gate-to-gate phase.



## Network Management

EUROCONTROL already performs essential operational support functions for the European ATM network, which are expected to be reinforced by the “ATM Network functions” being established under the SES.

The Network functions are expected to play an important role in the achievement of operational EU-wide performance targets (i.e. ENV/flight efficiency, Capacity), together with co-ordinated actions of individual stakeholders (FABs, ANSPs, airports, aircraft operators, military organisations).

The Network functions are also expected to give advance warning on changes in traffic trends and in working with ANSPs to ensure that capacity plans and delivery are adapted to match actual demand.

The PRC plans to extend the review and monitoring of the Network function performance specified under the SES to the entire European ATM network.

In view of the complex links between the Network functions, ANSPs, airports and users' performance on the overall network performance, suitable Network Management performance indicators need to be developed and tested before any target can be set for the second reference period (RP2: 2015-2019).

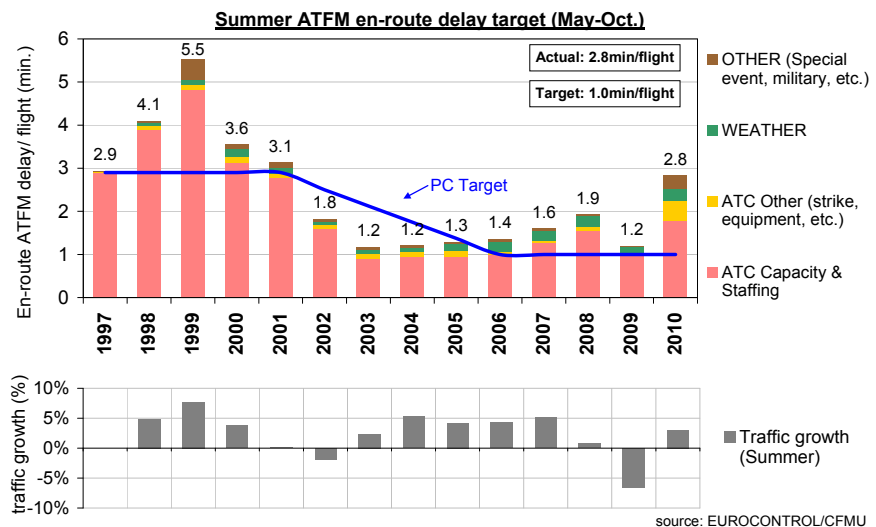
## Operational En-route ANS Performance

### CAPACITY

In summer 2010, en-route ATFM delays more than doubled (from 1.2 to 2.8 minutes per flight) which is the highest level since 2001 and almost three times higher than the agreed PC target (1 minute per flight).

Although traffic grew by 3.1% compared to summer 2009 (+0.8% annually), traffic levels were still below 2007 levels. At the same time, en-route ATFM delays per flight increased by +134% compared to summer 2009.

While the dip in traffic due to the ash cloud in April/May 2010 is clearly visible, the impact in terms of en-route ATFM delay was small because flights were cancelled instead of delayed.



Ninety percent of en-route ATFM delays were concentrated in a comparatively small number of ACCs (17 out of 67), which negatively affected the entire European network. These included:

- specific events such as industrial actions in France and Spain not only resulted in high en-route ATFM delays but also had a negative impact on flight efficiency and cancellations;
- preparations for the implementation of the VAFORIT system in Rhein ACC (which also affected performance in Langen). Performance is expected to improve in 2011;
- the south-east axis (Austria, Croatia, Greece and Cyprus) remains of major concern. Capacity issues are compounded by high traffic growth, particularly in Zagreb and Nicosia.

However, the vast majority of ACCs (e.g. UK, Italy, Czech Republic and Portugal) continued the improvements made in previous years or maintained a good level of performance in 2010.

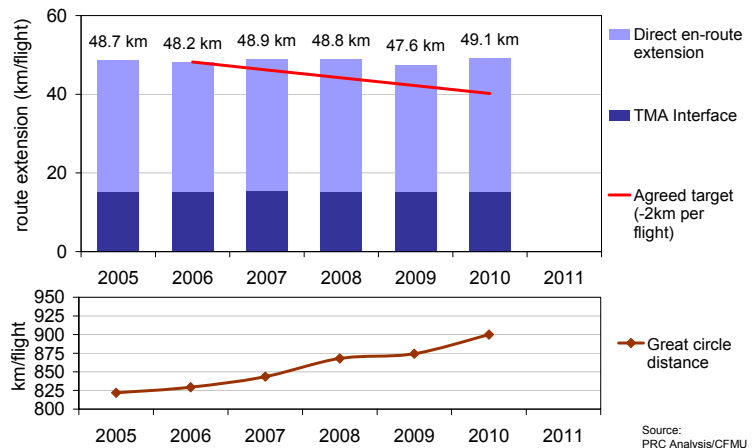
## FLIGHT-EFFICIENCY

Significant improvements were achieved in en-route design (one-third of the improvement to be achieved over 5 years according to the EU-wide target was achieved in one year).

However, aircraft operators had to accept less efficient flight plans to circumnavigate airspace affected by the ash cloud or ATC industrial action.

As a result, the use of the route network worsened, which negated the improvements in en-route design and resulted in increased horizontal en-route extension. Thus, the PC target was not met.

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



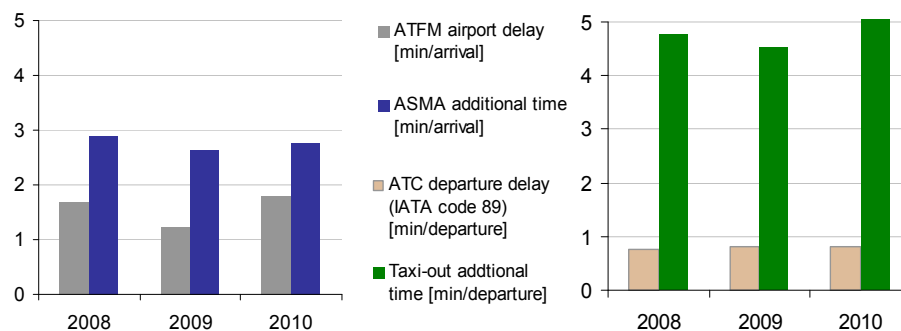
## Operational ANS Performance at Airports

Congestion remains an issue at several major European airports, notwithstanding: (i) the traffic downturn in 2009, and (ii) capping of demand through the airport co-ordination process.

In view of the long lead time required to increase airport capacity (new runways, new terminals, etc.) significant problems can be expected when traffic grows.

The airport arrival ATFM delays increased by +30% compared to 2009 (1.8 minutes per arrival). The terminal area transit time (ASMA) increased by +8% (2.8 additional minutes per arrival).

Departure delays attributable to local ATC constraints remained stable, but taxi-out additional times increased by 0.6 minutes (see graph on right). This is a negative trend.



Istanbul (IST), London Heathrow (LHR) and Gatwick (LGW), Madrid (MAD), and Rome (FCO) generated high taxi-out additional times (+6 to +10 minutes). CDM/DMAN can contribute to a more efficient management of the departure flow, and its implementation should be considered by these airports.

Arrival ATFM delays are monitored by EUROCONTROL, but the other above-mentioned TMA/airport efficiency KPIs are not. Active monitoring and management of those performance indicators, both by the Network functions and local ATC units could bring significant benefits.

Reactionary delays amount to 46% of all air transport delays. The propagation of delays through the network and their potential mitigation by the Network functions and the revision of the current ATFM priority rule would be worth investigating.



Significant improvements in ANS performance could be achieved by enhancing the relationship between the Network functions and airports.

The following measures could be taken to mitigate the impact of adverse weather conditions:

- provision of early information on the capacity of airport/handling infrastructures (e.g. de-icing); status of the airport movement area; and enhanced meteorological forecasts, combined with effective CDM processes, would help ANS to exercise its role of managing traffic at the airport; and,
- improved management of arrivals in strong wind conditions (weather information input in arrival manager tools and introduction of time-based separations).

## Environmental Impact of ANS

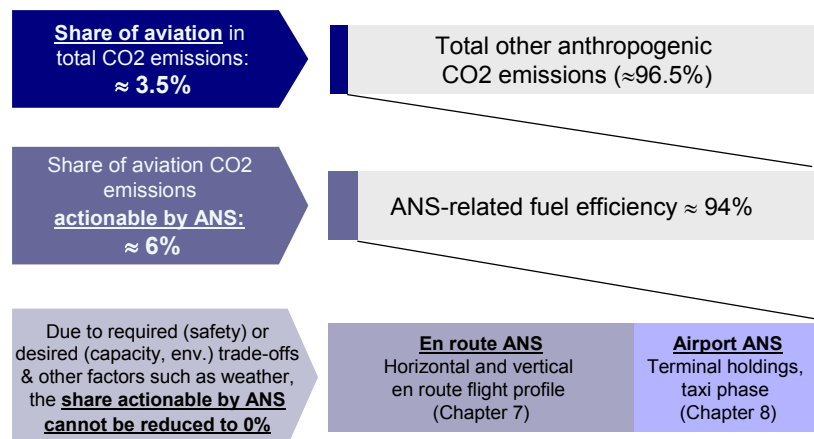
Emissions from aviation account for approximately 3.5% of total CO<sub>2</sub> emissions in Europe.

At its 37th Assembly in October 2010, ICAO achieved the adoption of the first global governmental agreement which commits the aviation sector to reducing its greenhouse emissions (-2% p.a. until 2020).

Although the main contribution to the reduction of aviation CO<sub>2</sub> emissions is expected to come from fleet renewal, technology developments and low carbon fuels, ANS has its role to play as well.

The ANS-related impact on climate change is closely linked to operational performance which is largely driven by inefficiencies in the 4D trajectory and associated fuel burn.

The PRC's estimate of ANS-related fuel efficiency of aviation in Europe is approximately 94%. ANS contribution towards improving aviation CO<sub>2</sub> efficiency is therefore limited to some 6% of the total aviation-related fuel burn and associated CO<sub>2</sub> emissions (≈0.2% of total emissions).



Although limited by safety requirements and additional constraints (noise, capacity, cost, etc.), there is scope for improvements in ANS efficiency (closer to optimal flight profile) and also in optimising the distribution of delays along the trajectory (e.g. ground vs. air, reduced speed vs. holding).

Of the estimated 6% ANS-related fuel inefficiency, the horizontal en-route flight path holds the highest potential for ANS-related improvements (≈3.7%), followed by terminal transit (≈1.2%), and inefficiencies in the taxi phase (≈0.7%).

One of the major challenges for improving ANS-related fuel efficiency will be the improvement of aviation's environmental performance in the face of continuous traffic growth. Maintaining or improving the same level of ANS service quality while absorbing projected demand, which is expected to double over the next 20 years, will be challenging.

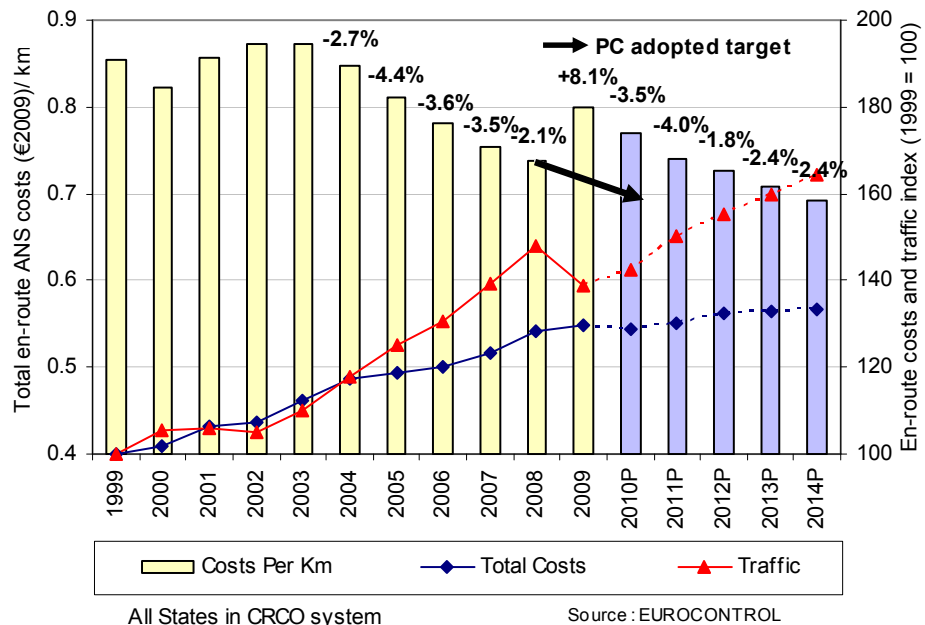
Noise management at airports is an important issue. A well balanced and forward-looking strategy is required for the Airport Operator, ANSP, CAA and the local land use planning authorities to reduce noise exposure and the number of inhabitants affected by noise, while optimising the use of airport capacity.

While the main contribution is expected to come from measures with long lead times (land use planning, reduction of noise at source), ANS has an important role to play in the application of noise abatement operational procedures (NAOPs) which require also a well balanced assessment of resulting trade-offs with other KPAs such as airport capacity and flight efficiency.

## ANS Cost-effectiveness

After a constant decrease between 2003 and 2008, en-route unit costs significantly increased in 2009, following an unprecedented traffic downturn (-6.2% in terms of kilometres controlled). They reached €0.80/km (+8.1%), which marks the end of a positive improvement trend.

As a result, the Pan-European target adopted by the PC in Nov. 2007 (-6% reduction of unit costs between 2008 and 2010) is no longer achievable.



In April 2009, several European ANSPs stated that they would implement cost-containment measures from 2009 onwards. This was explicitly called for by the European Commission. For a majority of States, 2009 actual en-route costs are lower than the plans made in November 2008. This indicates a certain degree of reactivity to the significant traffic shock experienced in 2009, and suggests that some cost-containment measures were implemented in 2009. However, it is disappointing that, notwithstanding the efforts made in 2009 to reduce en-route costs compared to the plans (-2.2% which is equivalent to €130M), the total en-route cost base at system level increased by +1.3% in real terms compared to 2008.

Given short term rigidities to adjust costs downwards and unavoidable lead times, it is understood that some of the measures that were implemented in 2009 may actually only have an impact on costs in 2010 and onwards. At system level, en-route costs planned for 2010 were revised downwards by some €320M compared to November 2008 plans. It is important that these planned savings materialise so that, in future years, unit costs can return to the levels achieved before the economic downturn. Following the significant traffic reduction in 2009, and the tools provided by SES II, there is an opportunity to better match capacity and demand in the coming years while at the same time improving cost-effectiveness performance.

At system level, en-route unit costs are planned to decrease by -2.8% p.a. between 2009 and 2014, which is well below the performance improvement achieved between 2003 and 2008 (-3.3% p.a.). The planned improvement is rather disappointing given the high expectations that a coordinated implementation of the SES II performance scheme during this period should bring significant performance improvements.

The five largest States plan to decrease en-route unit costs between 2009 and 2014. The initiatives taken in France and in Spain to address performance issues show that cost-effectiveness improvements could be achievable when there is a strong political and managerial commitment.

Available 2009 data show that average European terminal unit costs per IFR airport movement increased by +10.5% over 2008 in real terms. This results from a significant decrease in traffic (-8.3%) coupled with an increase in costs (+1.3%), a pattern rather similar to en-route.



Some States covered by the SES Performance scheme have no airport above the 50,000 IFR airport movements threshold set by the Charging Scheme regulation and therefore do not report Terminal ANS costs and unit rate information. However, all SES States and the PRB will have to monitor Terminal ANS costs and unit rates information during RP1 (2012-2014) to ensure that improvements in en-route ANS cost-efficiency are not achieved at the expense of a deterioration in terminal ANS cost-efficiency performance.

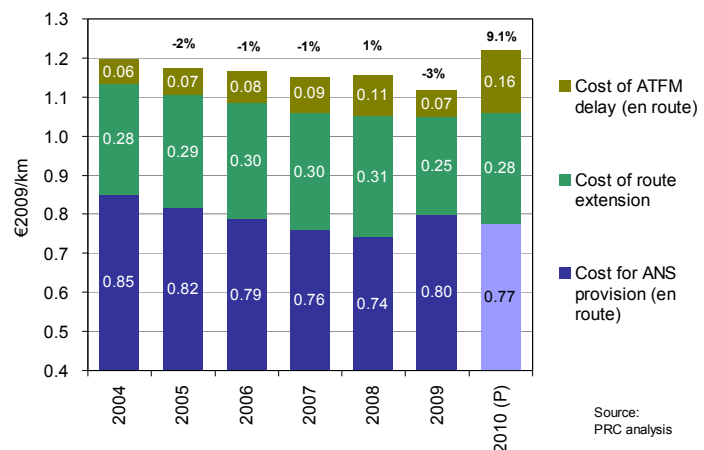
Setting meaningful EU-wide performance targets requires historical information and therefore all States covered by the SES legislation are strongly encouraged to start reporting terminal ANS costs and unit rates information at least in relation to the main airport in their country.

## Economic Assessment of ANS Performance

Besides safety, which is ensured mainly through a prescriptive approach, ANS performance can be translated in economic terms. In Europe, airspace users bear the cost of capacity (charges), of delays associated with insufficient capacity, and of flight inefficiencies (additional fuel burn, flight time). Better understanding the trade-offs between quality of service and cost-effectiveness at both system and State level will become increasingly important in view of target setting and performance management under the SES Performance Scheme.

The total economic en-route unit cost of ANS (charges + delays + flight-inefficiencies) increased significantly in 2010 (+9.1%).

The increase was mainly due to a significant increase in en-route ATFM delay costs (+145%), originating principally from industrial actions and implementation of new ATM systems) and the cost of route extension (mainly caused by increasing jet fuel price, circumnavigation of airspace affected by the ash cloud in April and industrial actions). This was the worst performance since 2004.



A reactive approach to ANS performance, awaiting crises to take action, proved to be inefficient. The cooperative proactive approach in en-route capacity planning led by EUROCONTROL did deliver significant improvements from 2003 to 2008, but is vulnerable to external factors such as industrial actions.

The adoption of binding performance targets and corrective mechanisms under the Single European Sky offers the opportunity to make performance improvements more robust.

There is an opportunity to extend the benefits to the entire EUROCONTROL area through adoption of Pan-European performance targets, and facilitation of performance management by the Network functions.

The PRC acknowledges that the efforts required by the ANS industry to contain costs while ensuring the provision of sufficient capacity to meet present and future performance objectives require a number of genuine changes which can be of different nature (e.g., institutional, organisational, managerial, financial, operational and technical). Among the key success factors for meeting the future challenges, the following deserve special focus:

- Drive sustainable long term change (i.e. short term cost-effectiveness improvements should not jeopardise the provision of future capacity);
- Maximise the use of existing human and capital resources;

- Engage in genuine changes with the different partners:
  - effective social dialogue to drive sustainable changes
  - explore different degrees of cooperative business opportunities among ANSPs (e.g. FABs)
  - drive cost-effective technological changes from SESAR; and,
  - make the most effective use of the Network functions;
- Strengthen the medium term planning process while developing the need for business flexibility; and,
- Incentivize the timely delivery of ATC capacity.

## PRC Recommendations 2010

The Provisional Council is invited to:

- a. **note** the PRC's Performance Review Report for 2010 (PRR 2010) and to **submit** it to the Permanent Commission;
- b. **request** those States and ANSPs with late and/or incomplete safety incident reporting to review their reporting and investigation systems and to resolve urgently any related issues, and to **invite** the Director General to support them as appropriate;
- c. **ensure** that the use of resources is optimised by harmonising, rationalising and integrating all international audits, inspections, surveys to which NSAs/CAAs and ANSPs are subjected, noting that for EU Member States this optimisation should result in a system organised around the EASA standardisation inspections complemented by ICAO Audits and peer reviews (EASA opinion 02/2010);
- d. **request** the Director General to monitor ANS performance at airports, including ANS efficiency indicators such as pre-departure delays due to local ATC constraint, ASMA and Taxi-out additional times on top of ATFM delays, and to bring solutions to identified issues.

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## 1.1 Purpose of the report

- 1.1.1 Air Navigation Services (ANS) are 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 This Performance Review Report (PRR 2010) has been produced by the independent Performance Review Commission (PRC) of EUROCONTROL. The PRC and its supporting Unit the Performance Review Unit (PRU) were established in 1998 and have been conducting performance review, target-setting and cost-effectiveness benchmarking since then.
- 1.1.3 The purpose of this report is to provide policy makers and ANS stakeholders with objective information and independent advice concerning European ANS performance in 2010, based on research, consultation and information provided by relevant parties. The PRC's recommendations can be found in the Executive Summary.
- 1.1.4 The draft final report is made available to stakeholders for consultation and written comment from 25 February - 18 March 2011. The PRC will consider every comment received and will amend the Final Report where warranted.

## 1.2 Structure of the report

- 1.2.1 PRR 2010 is structured as follows:

Executive Summary		
Part I: Background		
Chapter 1:	Introduction	
Chapter 2:	SES Performance Scheme	
Chapter 3:	European Air Traffic	
Part II: Key Performance Areas		
Chapter 4:	Safety	
Chapter 5:	Operations	Air Transport Performance
Chapter 6:		Network Management
Chapter 7:		En-route ANS Performance
Chapter 8:		ANS Performance at Airports
Chapter 9:		Environmental impact of ANS
Chapter 10:	ANS Cost-effectiveness	
Part III: Economic Assessment of ANS Performance		
Chapter 11:	Economic assessment of en-route ANS Performance	

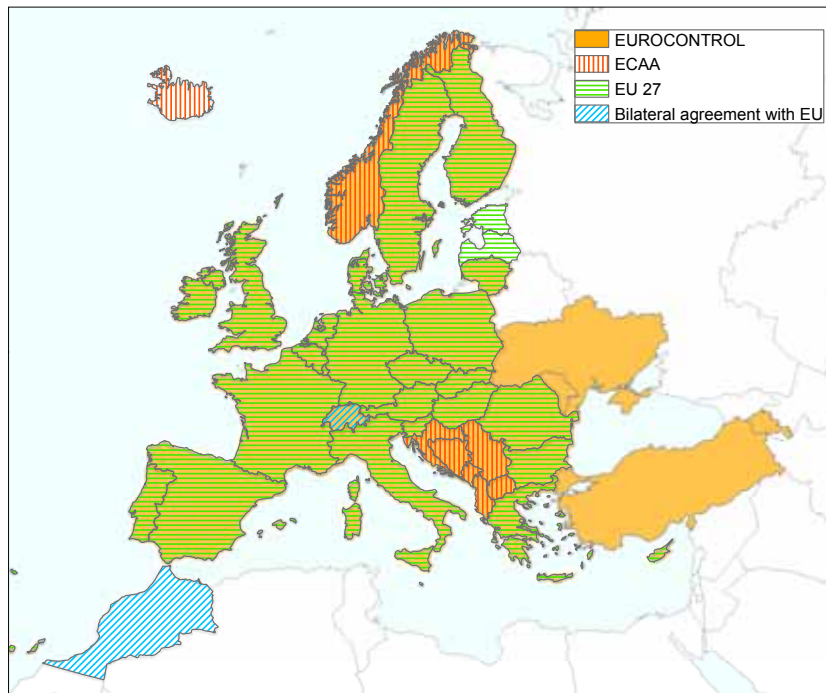
- 1.2.2 New features of the report include:

- The Single European Sky performance scheme within the context of a pan-European Performance Review is outlined in Chapter 2; and
- European network management and its important role in enhancing ANS performance is addressed in Chapter 6.

- 1.2.3 Unless otherwise indicated, PRR 2010 refers to ANS performance in the airspace controlled by the 38 Member States of EUROCONTROL<sup>1</sup> in 2010 (see Figure 1-1), hereinafter referred to as “Europe”, and all data refer to the calendar year 2010. In particular, please note that most of the cost-effectiveness data used in Chapter 10 “Cost-

<sup>1</sup> Latvia became the 39<sup>th</sup> Member State of EUROCONTROL on 1<sup>st</sup> January 2011.

efficiency” are taken from the ACE Benchmarking report 2009 [Ref. 1].



**Figure 1-1: EUROCONTROL and SES States [2010]**

### **1.3 Performance Review in EUROCONTROL and SES States**

- 1.3.1 In 1998, the EUROCONTROL Organisation established performance review in order, “*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 basis for investment analyses...*” [Ref. 2]. This was achieved through the creation of the independent PRC, which has discharged performance review duties as defined in its Terms of Reference [Ref. 3] for the EUROCONTROL States since then.
- 1.3.2 In 2010, EUROCONTROL, acting through its PRC, supported by the Performance Review Unit PRU accepted the designation as the Performance Review Body (PRB) of the SES performance scheme, from the EC. The PRB’s role is, “*to assist the Commission, in co-ordination with the national supervisory authorities, and to assist the national supervisory authorities on request in the implementation of the performance scheme*”. The designation is valid until 15 June 2015. The EC appointed Mr Peter Griffiths as the PRB Chairman.
- 1.3.3 Prior to being designated as PRB, the PRC/PRU has done work for the European Commission, with the prior authorisation of the EUROCONTROL Organisation. This work has included:
  - “Evaluation of the Impact of the Single European Sky Initiative on ATM Performance” (December 2006) [Ref. 4];
  - “Evaluation of Functional Airspace Block (FAB) initiatives and their contribution to performance improvement” (October 2008) [Ref. 5];
  - “Review of local and regional Performance Planning, consultation and management processes” (December 2009) [Ref. 6]; and,
  - “Proposed EU-wide Performance targets for the period 2012-2014” (September 2010) [Ref. 7].
- 1.3.4 All of this work has been funded by the European Commission. These reports can be

consulted on the PRC website ([www.eurocontrol.int/prc](http://www.eurocontrol.int/prc)).

1.3.5 More details on the SES performance scheme are given in Chapter 2.

## 1.4 Implementation status of PC decisions on PRC recommendations

1.4.1 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"*.

1.4.2 The Provisional Council (PC 33, May 2010) adopted, unchanged, the PRC's recommendations arising out of PRR 2009. These recommendations are as follows:

The Provisional Council requested States and ANSPs whose maturity level is below 70% to urgently resolve the related issues and to request the Director General to support them as appropriate;

The Provisional Council requested States and Air Navigation Service Providers to implement "just culture" where this is not already the case;

The Provisional Council encouraged States and ANSPs to use automatic detection and reporting tools and to further improve the transparency of ANS safety;

The Provisional Council noted the importance of a balanced approach to performance: increases in en-route delays over the period 2003-2008 nearly cancelled out the benefits of improvements in cost-effectiveness;

The Provisional Council urged the ANSPs concerned to resolve urgently the issues leading to high delays in the top 30 delay-generating sectors, and to request the Director General to assist them in this respect;

The Provisional Council urged ANSPs, given the severe economic downturn, to effectively implement the planned cost-containment measures so that:

- they materialise into genuine cost-savings for airspace users in the cost bases for 2010 and subsequent years and that;
- they contribute to improving the total economic cost of ANS and do not compromise the provision of future ATC capacity;

The Provisional Council urged:

- States, ANSPs, airspace users and the Agency to further improve the design and use of airspace for both civil and military needs, and
- ANSPs and airlines to make more effective use of airspace released to civil operations;

The Provisional Council encouraged airport stakeholders (Airport operators, coordinators, ANS providers and airlines) to constructively engage in the PRC-led process of development of indicators and targets addressing operational performance at and around airports and in the building of a comprehensive and reliable data base that can adequately support it.

**Figure 1-2: PC action on PRC recommendations contained in PRR 2009**

1.4.3 Since 2005, the PRC has made 33 recommendations requiring action to the Provisional Council. The implementation status of the associated PC decision is shown in Figure 1-3:

KPA/Decision	Imple- mented	Partially implemented	Not implemented	No action needed, or recent decision	Total
Safety		11		1	12
Environment/flight efficiency	4	1		1	6
Capacity	2	5		4	11
Cost-efficiency		3		1	4
<b>Total</b>	<b>6</b>	<b>20</b>		<b>7</b>	<b>33</b>

**Figure 1-3: Implementation status of PC decisions on PRC recommendations**

1.4.4 Details of these recommendations are contained in previous performance review reports.

## KEY POINTS

1. The SES Performance Scheme presents an opportunity to drive significant improvement in ANS performance at the EU level.
2. The designation of EUROCONTROL as the SES PRB creates synergies between the SES and EUROCONTROL performance review systems, which will further promote pan-European performance improvement.
3. It is the PRC's intention to ensure that the synergies between the EUROCONTROL and SES systems are exploited for the benefit of all States.

## 2.1 Introduction

- 2.1.1 Commission Regulation (EU) No 691/2010 laying down a performance scheme entered into force on 23 August 2010 [Ref. 8]. The Single European Sky (SES) Performance scheme was published in the EU Journal on 03 August 2010. This marked the start of the implementation of the performance scheme, and in particular preparation for the first reference period (RP1) that runs for three years from 2012 to 2014.
- 2.1.2 In order to assist in the implementation of the Performance Scheme, the European Commission (EC) designated EUROCONTROL - acting through its Performance Review Commission (PRC) and supported by the Performance Review Unit (PRU) - as the Performance Review Body (PRB) of the Single European Sky [Ref. 9]. The designation was accepted on 15 September by EUROCONTROL and is valid until 30 June 2015. Separately, the PRB Chairman has been appointed by the EC.
- 2.1.3 A key rationale for the EC designating EUROCONTROL is to achieve synergies between the SES performance scheme and the EUROCONTROL performance review system. The PRC's intention is to ensure that common procedures, tools and data feed both systems and hence reduce the overall cost, whilst maximising the benefits to both systems.
- 2.1.4 This chapter sets out how the PRC will ensure that the benefits of a single pan-European performance review are achieved.
- 2.1.5 In order to support the wider requirements of the PRB tasks, the PRU is undergoing a change management process (funded by the EC) and, as part of the wider EUROCONTROL reform, the PRU will also extend the breadth and depth of available expertise. This larger PRU will be in an even stronger position to support the PRC on all performance related issues.
- 2.1.6 The PRC's Performance Review Reports (PRR) will inform the EUROCONTROL Organisation and aviation stakeholders on pan-European performance issues. The PRB will provide separate reports to the EC on issues relating directly to the SES Performance Scheme in line with the relevant legislation.

## 2.2 SES Performance Scheme in Context

- 2.2.1 The performance scheme is one element of the wider SES II package which comprises five pillars: performance, safety, technology, airport capacity and human factors.
- 2.2.2 The performance pillar is a new regulatory approach introduced via amendments to the existing SES legislation [Ref. 10]. In addition to the performance scheme, this includes:
  - Revision of the common charging regulation to introduce a system of determined costs and risk sharing to replace the full cost recovery system [Ref. 11]. The revised charging scheme, notably the replacement of the full cost recovery system by "determined costs" and risk sharing, combined with target setting under the

performance scheme, provides several noteworthy elements:

- (a) incentives for ANSPs to contain their costs;
- (b) additional revenue when traffic is higher than forecast, which provides financial resources for ANSP to increase capacity beyond initial plans and therefore contain delays when traffic is above forecast;
- (c) capped ANSP exposure to traffic risk, which limits financing costs and safeguards their financial viability; and,
- (d) further improved accountability and cost-consciousness of ANSPs, under the oversight of National Supervisory Authorities (NSAs).

In the absence of mandatory financial incentives on capacity/delays, the charging scheme should however be applied in a way that minimises the risk of under-delivery of capacity.

- Enhancements to the Functional Airspace Block (FAB) concept such that it applies to all aspects of ANS service provision rather than just airspace as had previously been the case. States are required to ensure implementation of FABs by 4 December 2012.

The PRC considers that FABs could be key enablers of performance improvement across Europe and that the EU-wide performance targets will further encourage Member States to maximise the potential benefit of FABs, and to support achievement of the SES goals by taking a FAB rather than a national focus.

For the first Reference Period (RP1: 2012-2014) the PRC considers that the establishment of FABs will lead to a number of ‘quick wins’ such as common procurement, integrated training and airspace design leading to improvements in flight-efficiency and capacity whilst institutional and business restructuring to achieve significant cost reductions may take longer<sup>2</sup>.

One of the major benefits from FABs, according to the PRC, would be the rationalisation of support costs (investment, operating, non-ATCO staff), which represent close to 70% of ANSP total costs [Ref. 1], across ANSPs in the FAB. However, as such rationalisation will require time and substantial efforts from States/ANSPs, it is likely that not all benefits already materialise in RP1.

- The introduction of the Network function. On 15 February 2011, the Single Sky Committee agreed the Implementing Rule on Network functions and voted in favour of EUROCONTROL being nominated as Network Manager (NM). The PRC considers the Network functions to be a key enabler to facilitate performance improvements (see Chapter 6).

2.2.3 Together, these elements provide tools for Member States and ANSPs to enhance ANS performance. However, they in themselves are not sufficient - the other pillars provide additional support to ensure that significant improvements can be achieved by ensuring that safety is optimised, that the technology required is available, that airport capacity keeps up with ANS capacity and that social dialogue issues are fully integrated in to proposed solutions.

2.2.4 The pillars relevant to the PRB during the reporting period are:

- the safety pillar, which is the extension of the EASA system to cover ATM/ANS and aerodromes [Ref. 12]. EASA becomes the sole safety regulator for air transport in the EU. The PRB is working closely with EASA to ensure safety issues are fully represented in the performance scheme. This interaction is described in Chapter 4; and,
- the technology pillar, which consists of the Single European Sky ATM Research (SESAR) Programme and the associated European ATM Master Plan. Together, they

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2 The PRC recognises that the short-term benefits of FABs will vary according to the specific issues prevalent within each initiative.

are key to ensuring that technological enablers required to improve ANS performance are available and implemented in a coordinated and timely fashion.

- RP1 corresponds to the first implementation package (IP1) of SESAR as described in the European ATM Master plan [Ref. 13]. IP1 is in essence a continuation of the existing implementing plans with a new prioritisation. The SESAR JU has indicated that, besides new investments, which are considered to be limited, the impact of SESAR implementation on ANS performance during RP1 is not quantified at this time. Therefore, the PRC has assumed that IP1 has been included already in ANSP plans and therefore accounted for in the analysis undertaken in developing this report.
- Performance targets proposed by the PRB for RP2 and beyond will need to reflect improved performance capabilities expected from the implementation of R&D as well as associated costs.

## 2.3 Implementation of the SES Performance Scheme

2.3.1 ANS performance has been improving in recent years [Ref. 14], even before performance scheme mechanisms were applied. With greater focus on planning and accountability for performance, target-setting, monitoring, incentives and corrective actions at both European and national/FAB levels under the SES performance scheme, ANS performance improvements are expected to continue. However, the negative impact from the economic crisis needs to be taken into account.

2.3.2 The SES Performance Scheme is designed as a powerful driver of European ANS performance. The scheme includes EU-wide targets for Safety<sup>3</sup>, Cost-Efficiency, Capacity and Environment which are transposed into binding national/FAB targets (Cost-efficiency and Capacity in RP1) for which clear accountabilities must be assigned within national/FAB performance plans.

2.3.3 The PRB, following extensive public consultation [Ref. 15] proposed to the EC recommendations for EU-wide targets, on 27 September 2010 [Ref. 7].

2.3.4 On 03 December 2010, the SSC gave a positive opinion on the EU-wide performance targets proposed by the EC for RP1 (see Figure 2-1). The targets were adopted by the EC in February 2011, and are as follows:

	Environment	Capacity	Cost-efficiency
Target	A reduction of horizontal en-route flight extension by 0.75% points versus 2009 baseline.	Annual average en-route ATFM delay (all causes) of 0.5 minutes per flight by 2014	Determined unit rate for 2014 is set at €53.92

**Figure 2-1: EU-wide targets for RP1**

2.3.5 The EU-wide targets are designed to set a level of ambition for RP1. The realisation of this ambition requires NSAs to develop national/FAB performance plans that are consistent with the EU-wide targets by the end of June 2011.

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3 For the first reference period (RP1: 2012 to 2014) the legislation does not require EU-wide targets for Safety; this is a recognition of the lack of both agreed safety KPIs and harmonized data on safety related events. However, safety will be monitored.



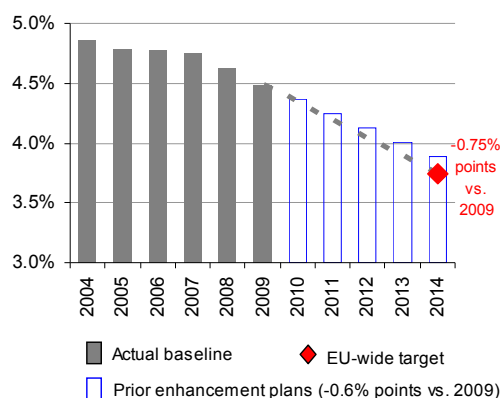
### Safety

During RP1, States have to monitor and publish the following Safety KPIs:

- 1) Effectiveness of safety management;
- 2) Application of the severity classification of the Risk Assessment Tool to allow harmonised reporting of severity assessment of:
  - Separation minima infringements;
  - Runway incursions;
  - ATM special technical events;
- 3) Reporting of Just Culture

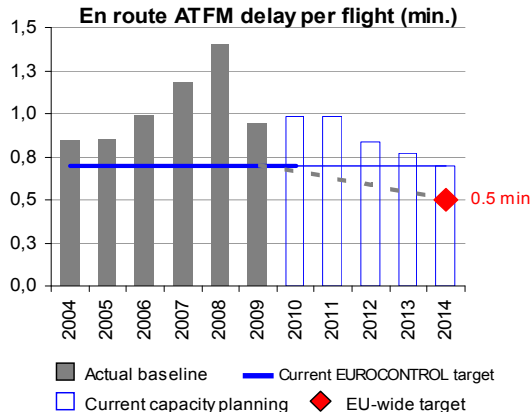
### Environment

#### % of horizontal en route extension



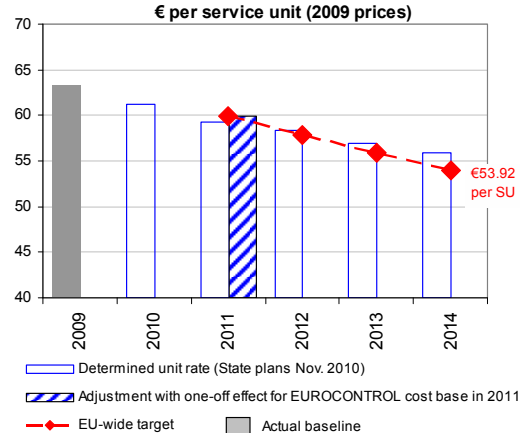
### Capacity

#### En route ATFM delay per flight (min.)



### Cost-Efficiency

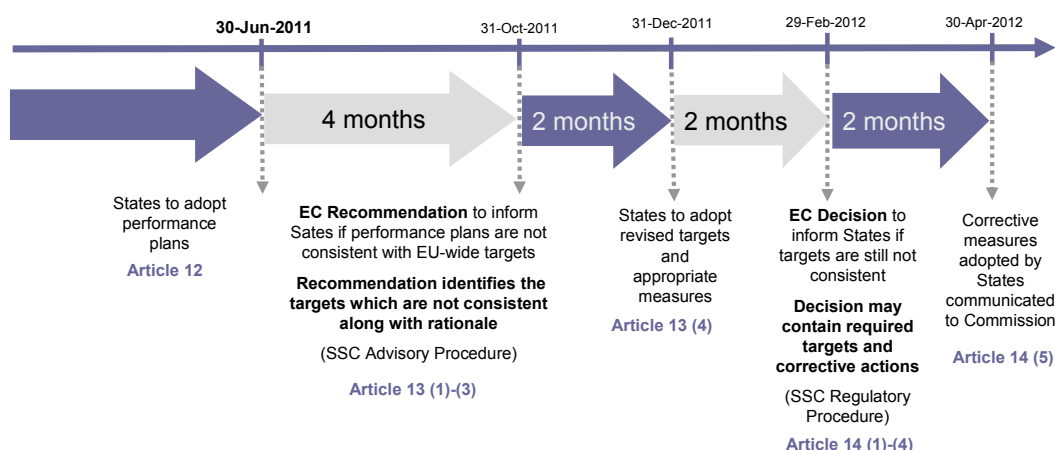
#### € per service unit (2009 prices)



**Figure 2-2: Adopted EU-wide targets versus existing plans [2009-2014]**

- 2.3.6 The package is designed to deliver further safety improvements, fewer delays, lower costs and reduced CO<sub>2</sub> emissions. For example, in RP1 it is estimated that airspace users will save €340 million per year in service provision costs or, including indirect costs, more than €1 billion over the whole period of RP1, while at the same time CO<sub>2</sub> emissions are estimated to be reduced by 500 000 tons a year.
- 2.3.7 The national/FAB performance plans are important documents. They “register the commitment of Member States, for the duration of the reference period, to achieve the objectives of the single European sky and the balance between the needs of all airspace users and supply of services provided by air navigation service providers” (Recital 7 of [Ref 8]).
- 2.3.8 Performance plans are drawn up by the NSAs and are adopted by the Member States at either national or FAB level. In addition to containing national/FAB targets, the performance plans also define the contribution of each accountable entity to achieving the target and the incentive schemes and appropriate measures (corrective actions) designed to ensure that the targets are met.
- 2.3.9 Assessment of the performance plans against the EU-wide targets is one of the tasks entrusted to the PRB, along with monitoring achievement of the performance plans during the reference period. The assessment of performance plans for RP1 will occur during the summer of 2011.
- 2.3.10 The legislation defines two phases of assessment (see Figure 2-3) to ensure that performance plans are fit for purpose and adequately contribute to the achievement of the EU-wide targets. The legislation also provides the possibility that the EU-wide targets

themselves may be revised at the end of 2011 to ensure that they reflect the latest situation and are consistent with the full set of adopted National/FAB plans.



**Figure 2-3: Process for elaboration and assessment of national/FAB performance plans**

- 2.3.11 The PRC recognises that RP1 represents a transition from the previous scheme and that current activity represents a steep learning curve for all actors. In particular, the performance scheme and elaboration of performance plans represent significant new tasks for the NSAs. The PRC, in its capacity as the PRB, is working with the NSAs through their NSA Co-ordination Platform to ensure the requisite guidance material is available.

## 2.4 Convergence of EUROCONTROL and SES Schemes

- 2.4.1 The SES performance scheme and the PRC's role as PRB leads to significant opportunity to improve pan-European ANS performance review – particularly in terms of new data flows leading to improved monitoring and target setting.

- 2.4.2 The PRB is required to use the data to report on the KPIs and PIs specified in the legislation (see Figure 2-4).

- 2.4.3 The performance scheme Regulation formalises the flow of data for performance monitoring in the EU. Requirements are established for Member States, ANSPs, Airport Operators, Airport Slot Coordinators and Airlines to provide data in a harmonised manner.

- 2.4.4 Much of this data is already provided and available through existing systems such as eCODA and the CFMU.

KPA	Monitoring of EU-wide KPI/PI during RP1
Safety	Effectiveness of safety management ('maturity')
	Application of severity classification scheme
	Separation infringements
	Runway incursions
	ATM special technical events
Environment	Application of Just Culture
	Average horizontal flight efficiency
Capacity	Effective use of civil/military airspace structures
	Minutes of en-route ATFM delay per flight
	ATFM airport delays,
	Additional time in taxi-out phase
Cost Efficiency	Additional time in arrival sequencing and metering area (ASMA)
	Determined Unit Rate for en-route-ANS
	Monitoring of terminal costs and unit rates

**Figure 2-4: RP1 performance indicators**

- 2.4.5 However, the flow of airport and safety related data will be improved by the implementation of the regulation.

- 2.4.6 One of the key areas of improvement expected from the implementation of the performance scheme is the enhanced availability of harmonised safety data. The SES performance scheme proposes measures to address this.

- 2.4.7 The PRB is working closely with EASA and the European Commission to complete the definitions of the Safety KPIs. It is understood that the necessary amendments to the



regulation will be adopted by a Commission Regulation in late 2011. The implementation of a common risk classification scheme will lead to harmonised reports of key safety events. The performance plans (in association with the ICAO mandated State Safety Plans and the EASA Safety Programme) should ensure progress in both safety culture and application of Just Culture (see also Chapter 4).

- 2.4.8 A second area of improvement will be in the monitoring of ANS performance at airports. The PRR currently focuses on European airports with more than 150 000 annual IFR aircraft movements. In addition, the PRC's ATMAP project with 20 European Airports is developing a framework to measure ANS performance at airports and surrounding airspace. The SES performance scheme will enable ANS performance review at 80 of the largest European airports, including at least one airport in each of the States concerned (see also Chapter 8).
- 2.4.9 The PRC will work with the EUROCONTROL States not subject to EC regulation to determine the suitability of extending the data requirements to the EUROCONTROL area in order to harmonise the data and monitoring activities.
- 2.4.10 There are EUROCONTROL-wide targets for Cost-Efficiency, Capacity and en-route flight extension. They are similar to the SES EU-wide targets but do not use the same definitions and scope (i.e. different number of Member States). Accordingly, in December 2010, the Provisional Council (PC) agreed in principle to the adoption of pan-European targets valid until 2014. The PRC is developing proposals for targets which will be submitted for approval to the PC Session in May 2011.

## **2.5 Conclusions**

- 2.5.1 The year 2010 saw the start of the implementation of the Single European Sky (SES) performance scheme, the designation of EUROCONTROL through its Performance Review Commission supported by the Performance Review Unit the SES Performance Review body (PRB) and the setting of EU-wide performance targets for the first reference period (RP1: 2012-2014). All of these aim at driving further improvements in the performance of Air Navigation in Europe.
- 2.5.2 The designation of EUROCONTROL as the SES PRB [Ref. 9] creates synergies between the SES and EUROCONTROL performance review systems, which will further promote pan-European performance improvement.
- 2.5.3 The EU-wide targets apply to the 27 EU States, Norway and Switzerland, and are designed to set a level of ambition for RP1. The realisation of this ambition requires National Supervisory Authorities to develop national/FAB performance plans that are consistent with the EU-wide targets by the end of June 2011.
- 2.5.4 The different instruments of the SES II package together constitute powerful tools towards performance improvement. The full realisation of the SES objectives will require an alignment of the various elements.

KEY POINTS	KEY DATA 2010		
<ol style="list-style-type: none"> <li>Despite a moderate recovery of +0.8% in 2010, overall traffic remained below 2007 levels. Approximately 4 years of traffic growth were lost due to the economic crisis, which started in 2008.</li> <li>Traffic growth in 2010 was slowed down by a number of exceptional events such as the volcanic ash cloud, industrial actions, and unusually severe weather conditions. The negative impact of the ash cloud on annual traffic growth is estimated at 1.2%.</li> <li>STATFOR forecasts a rebound of traffic in 2011 (+4.3% vs. 2010), and an average annual growth of +3.2% between 2010 and 2014.</li> <li>Traffic growth is not evenly spread across Europe. Continuously high traffic growth is forecast for Eastern European States while only a small to moderate growth is expected for the more mature markets in Western Europe.</li> </ol>	IFR Flights controlled <sup>4</sup>	9.5 M	+0.8%
	Flight hours controlled <sup>4</sup>	13.8 M	+2.5%
	Distance charged (km) <sup>5</sup>	8 538 M	+2.8%
	Service units <sup>5</sup>	113.1 M	+3.4%
<b>Forecast growth (STATFOR Feb. 2011)</b>			
	Forecast growth in 2011		+4.3%
	Average annual growth 2010-17		+2.9%

## 3.1 Introduction

- 3.1.1 This chapter provides some key characteristics on General Air Traffic (GAT) operating under instrument flight rules (IFR) in Europe. The purpose of the chapter is to provide background information for the review of ANS performance in this report.

## 3.2 European air traffic growth

- 3.2.1 Despite a moderate recovery of +0.8% in the ESRA 2008 area<sup>4</sup> in 2010, European air traffic is still below 2007 levels and approximately 4 years of traffic growth were lost due to the economic crisis that started in 2008 (Figure 3-1). Traffic growth in 2010 was slowed down by a number of exceptional events such as the volcanic ash cloud, industrial actions, and unusually severe weather conditions.

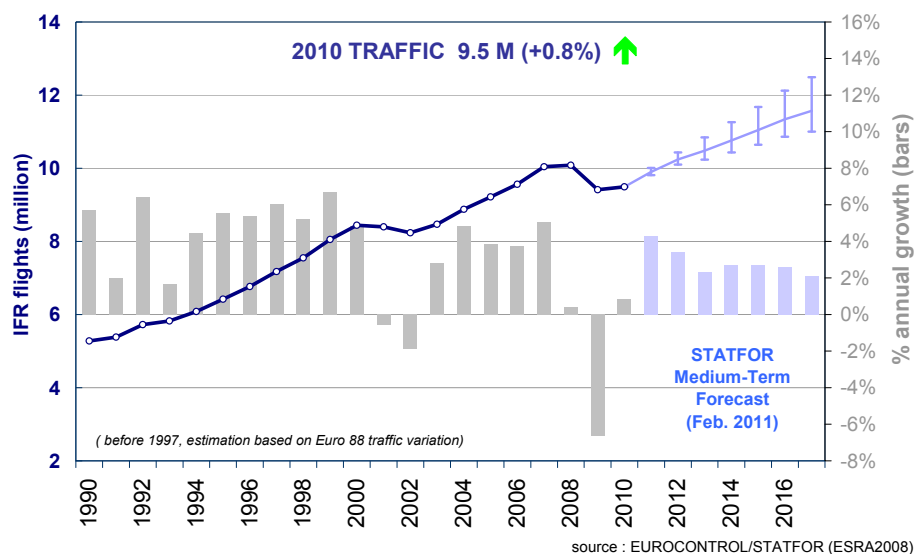
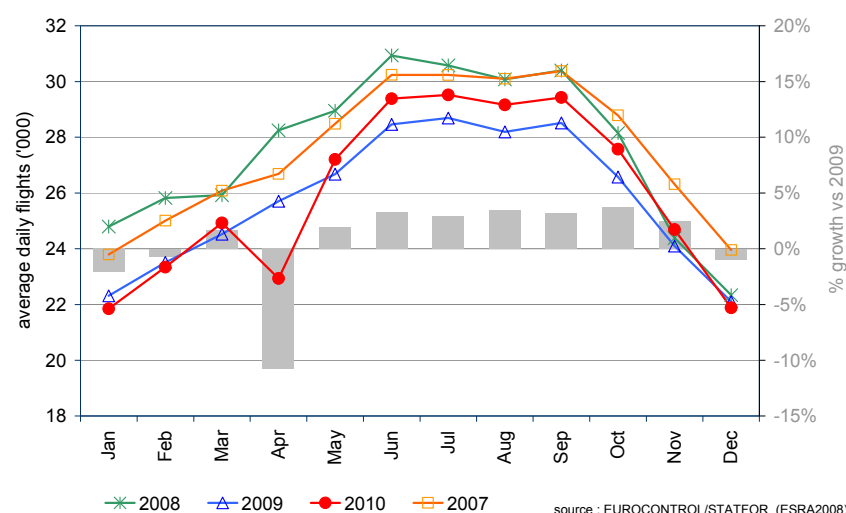


Figure 3-1: Evolution of European air traffic

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

<sup>5</sup> States in EUROCONTROL Route Charges System in 2010, excluding Santa Maria (see Glossary).

- 3.2.2 For 2011, the EUROCONTROL Statistics and Forecast Service (STATFOR), Medium-Term forecast [Ref. 16] predicts a further recovery (+4.3%), followed by an average annual growth of +3.2% between 2010 and 2014. European traffic is expected to return to 2007 traffic levels around 2011/12.



**Figure 3-2: Monthly evolution of IFR traffic**

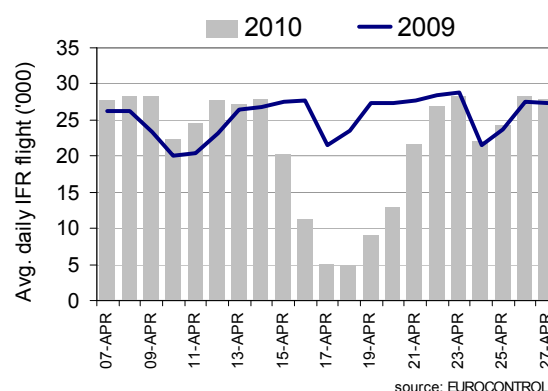
- 3.2.3 Figure 3-2 shows the monthly evolution of IFR traffic. Although annual traffic increased compared to 2009, the weak economic growth, compounded by exceptional events (volcanic ash cloud, industrial actions, and unusually severe weather conditions) had a negative impact on traffic growth and service quality in 2010 (see Chapters 5 to 8 for the impact of exceptional events on service quality). There are some interesting points to note:

- approximately 111 000 flights<sup>6</sup> were cancelled as a result of the volcanic ash cloud in April/May 2010, with a notable negative impact on traffic growth;
- the number of cancellations due to ATC strikes (particularly in France) and social tensions between ATC staff and management in Spain (leading to a closure of Spanish airspace on 3-4 December 2010) is estimated to be around 26 000 flights;
- some 45 000 flights were cancelled due to the bad weather conditions in 2010.

#### IMPACT OF EYJAFJALLAJOKULL ASH CLOUD

- 3.2.4 The eruption of Eyjafjallajokull volcano in Iceland on 14 April, 2010 had a major impact on European civil aviation, mainly through cancelled flights. The main period of the crisis was 15-22 April, though the effects continued also in May<sup>7</sup>.

- 3.2.5 An estimated 48% of the European traffic was cancelled during the 8 days in April, peaking at 80% on 18th April 2010 (see Figure 3-3).



**Figure 3-3: Impact of the ash cloud on traffic**

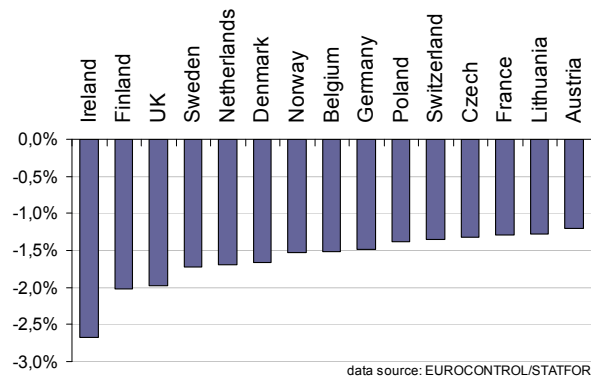
6 An estimated 5 000 extra flights took place (repositioning of aircraft and crew, repatriation of stranded passengers etc.), resulting in a net reduction of 106 000 flights.

7 More detailed information on the impact of the volcanic ash cloud on air traffic can be found in a dedicated report from STATFOR ([www.eurocontrol.int/statfor](http://www.eurocontrol.int/statfor)).

3.2.6 Overall, the negative impact of the ash cloud on European traffic growth is estimated at 1.2%. Hence, without the disruption from the ash cloud, annual European traffic growth would have been in the region of  $\approx 2.0\%$  compared to 2009.

3.2.7 Figure 3-4 shows that States were affected differently by the ash cloud in April/May 2010. The impact was most notable in Ireland, Finland, the United Kingdom and Sweden.

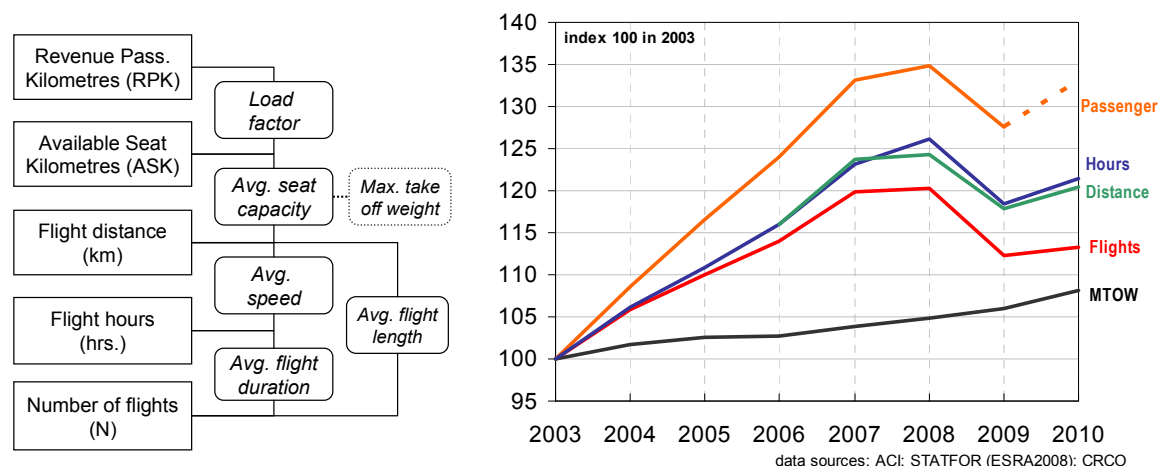
Estimated effect of the ash cloud on annual traffic growth in 2010



**Figure 3-4: Estimated effect of the ash cloud on traffic growth for the most affected States**

### KEY EUROPEAN AIR TRAFFIC INDICATORS

3.2.8 Figure 3-5 shows the relationship between the principal air traffic indicators (left side) and their evolution between 2003 and 2010 in Europe (right side). The societal output of air transport is usually measured in Revenue Passenger Kilometres (RPKs) which is influenced by a number of factors (number of flights, distance, average aircraft size, etc.).

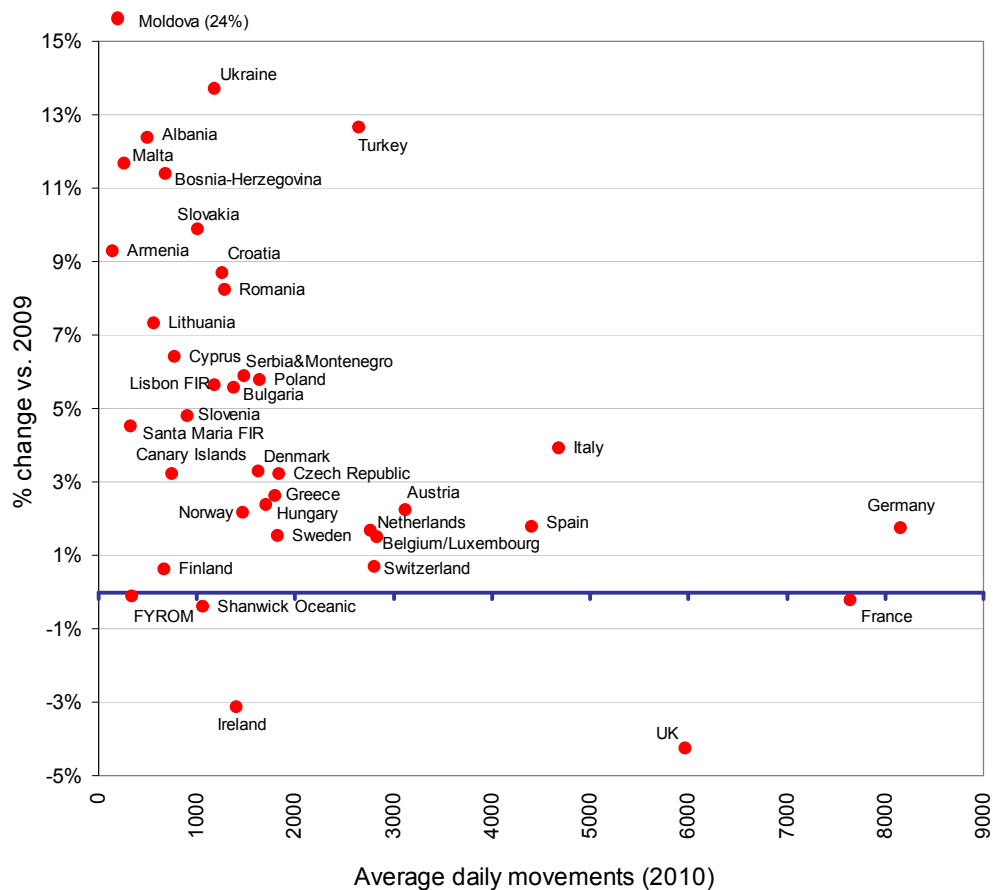


**Figure 3-5: Key European traffic indicators and indices**

3.2.9 There are some interesting points to note from Figure 3-5:

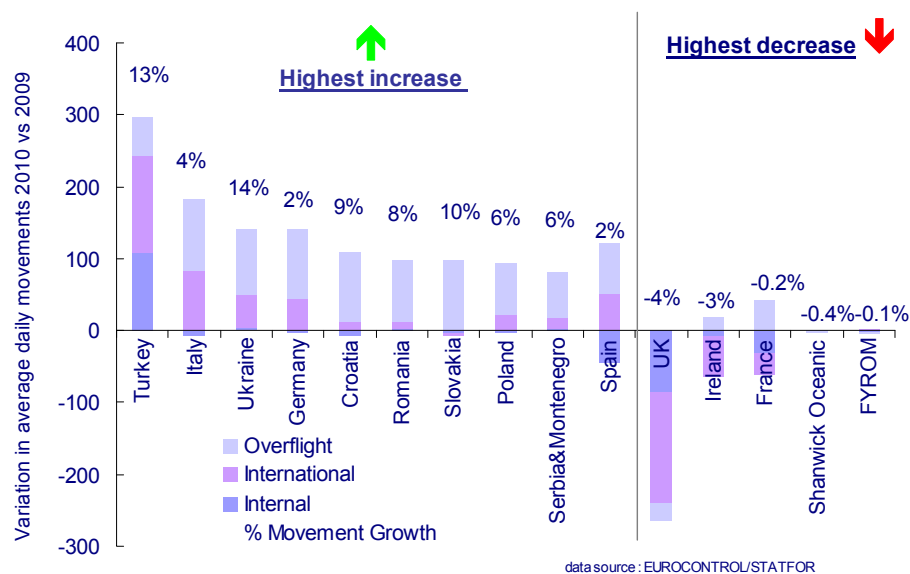
- the average aircraft weight (MTOW) continued to increase throughout the economic crisis while the number of flights dropped significantly in 2009 which indicates a lower number of services but with larger aircraft;
- the average flight distance and the flight hours evolve slightly different than the number of flights leading to an overall increase in the average flight length in Europe. The increase in average flight length is to some extent due to an increase in the number of overflights and of flights to/from Europe, and;
- the available capacity (i.e. number of flights & aircraft size) increased less than the number of passengers leading to a higher overall load factor in 2010.





**Figure 3-8: Traffic growth and traffic volume by charging area [2010]**

3.2.15 Although Moldova shows the highest relative growth (+24%) followed by Ukraine (+14%) in absolute terms Turkey shows by far the highest increase in traffic in 2010 (see Figure 3-9). The growth in Turkey is largely driven by additional international traffic and also by substantial growth in the domestic segment.



**Figure 3-9: Largest traffic variation per charging area in terms of movements**

3.2.16 In absolute terms, the United Kingdom, Ireland and France show the highest reduction of flights in 2010.

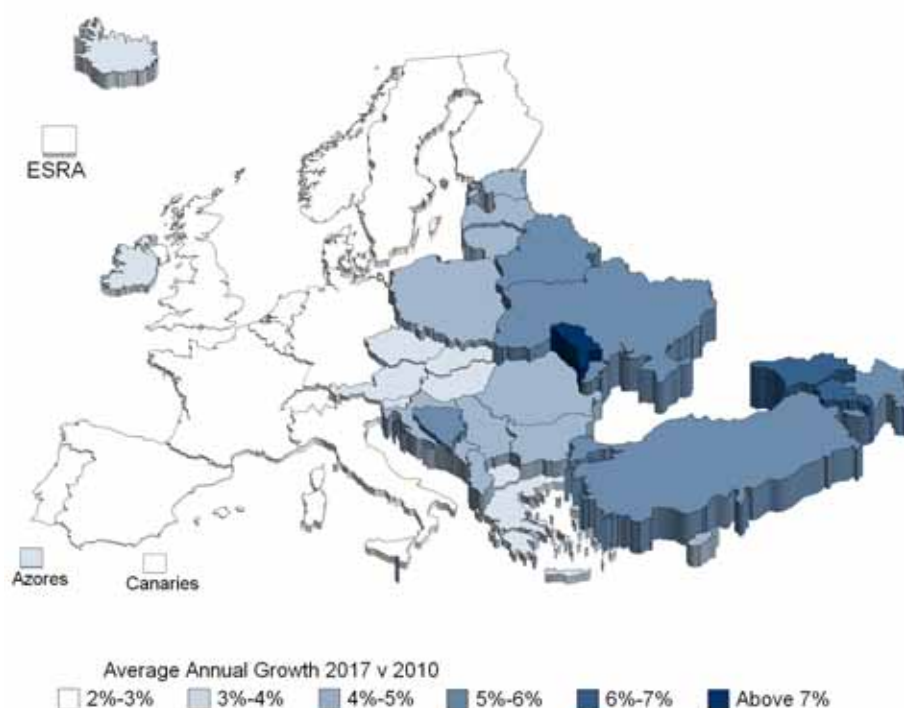
3.2.17 Apart from the impact of the ash cloud (see also Figure 3-4) the traffic reduction in the

UK and Ireland was also due to a combination of factors (aftermath of the economic crisis, industrial actions at British Airways in March, May and June, increase in UK Air Passenger Duty). Traffic growth in France and Spain was also negatively affected by ATC industrial actions.

- 3.2.18 Much of the overall growth in 2010 was driven by the growth in Eastern and South Eastern Europe and growth stimulated by low cost carriers.

#### FORECAST TRAFFIC GROWTH

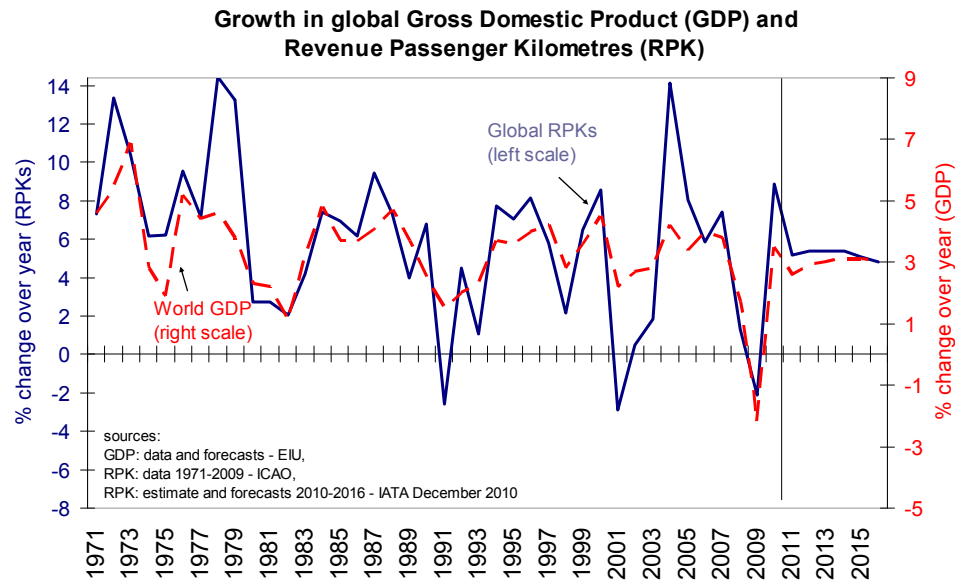
- 3.2.19 European air traffic is expected to grow by 4.3% in 2011, followed by an annual average growth of +3.2% between 2010 and 2014. However, as illustrated in Figure 3-10, the forecast growth rates are quite contrasted across Europe [Ref. 16].



**Figure 3-10: STATFOR Medium-term forecast [Feb. 2011]**

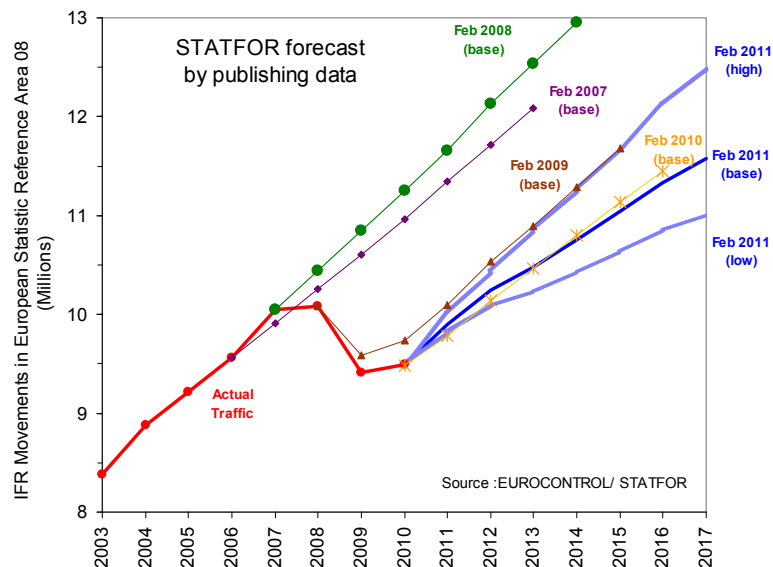
- 3.2.20 High traffic growth is forecast for the emerging markets in the Eastern European States in the next 5 years, albeit from a smaller base. A small to moderate growth is expected for the more mature markets in Western Europe.
- 3.2.21 Reliable traffic forecasts are of particular relevance for the development of business plans and the STATFOR forecast is expected to continue to play an important role in the European context (see also Chapter 6) and also the Single European Sky Performance Scheme (see also Chapter 2).
- 3.2.22 The methodology used for the STATFOR Medium Term Forecasts is based on flight statistics, economic indicators (GDP, oil price, etc.), and other industry drivers (passengers, load factors, aircraft size, etc.) and is continuously being refined as additional data sources become available.
- 3.2.23 Gross Domestic Product (GDP) is understood to be one of the main drivers of aviation growth. Figure 3-11 illustrates the correlation between passenger kilometres flown (solid blue line) and real GDP growth rates (dotted red line). The yellow areas correspond to crisis periods.





**Figure 3-11: World real GDP and RPK**

3.2.24 Figure 3-12 compares actual observed traffic levels to the published STATFOR Medium Term Forecasts. At European level, the STATFOR forecast is currently the most comprehensive forecast available with a satisfactory level of accuracy under normal circumstances (i.e. exceptional events such as the 2001 terrorist attacks or the economic crisis of 2008/09 cannot be predicted in a forecast).



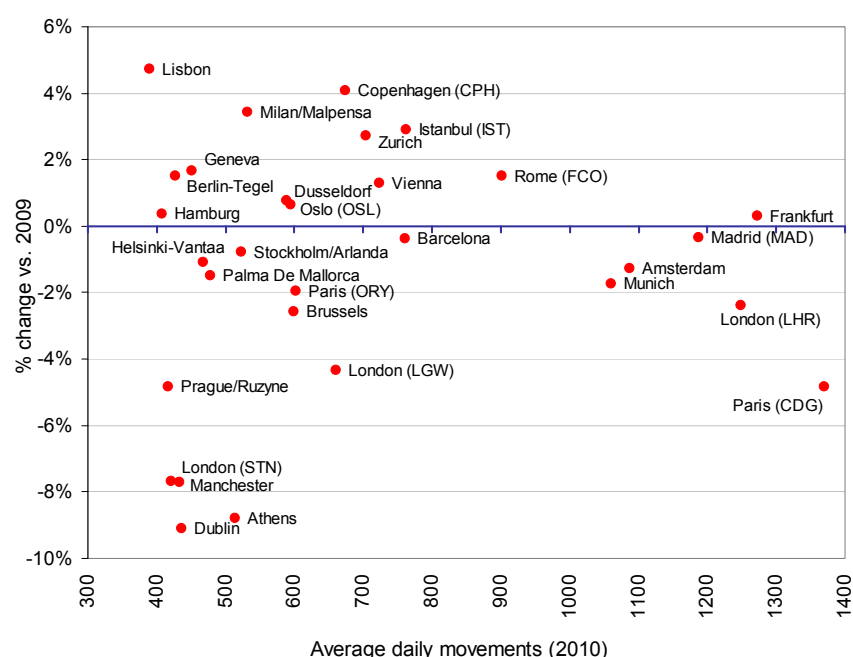
**Figure 3-12: STATFOR Medium-term forecasts with publication dates**

3.2.25 As is the case with any forecast, a certain element of uncertainty is unavoidable. The accuracy - especially at State level - depends to a large extent on data availability, market size and volatility. This is even more so when recovering from an unprecedented economic downturn, as observed in 2008/9. In view of the higher level of economic uncertainty, the forecast range (low to high) provides an indication of the risk and it is important for ANS service providers to allow for a certain level of flexibility in their capacity planning.



## TRAFFIC GROWTH AT THE MAIN EUROPEAN AIRPORTS

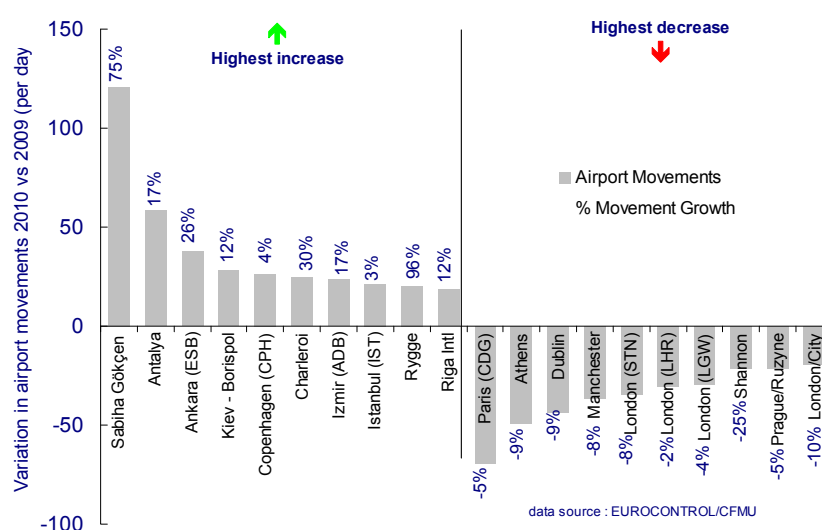
3.2.26 Figure 3-13 shows traffic evolution at the top 30 European airports<sup>9</sup>. Together they accounted for 44% of all European departures in 2010.



**Figure 3-13: Traffic evolution at the top 30 European airports [2010]**

3.2.27 Traffic decreased in 2010 at 17 of the top 30 European airports, notwithstanding the positive overall growth at European level. Overall, traffic growth at airports was quite contrasted by size of the airport. On average, traffic at smaller airports with less than 300 daily movements (51% of traffic) increased by +2.7% in 2010, while traffic at airports with more than 300 daily movements (49% of traffic) decreased by -2.2%.

3.2.28 Complementary to Figure 3-13, Figure 3-14 shows the 10 European airports with highest positive (left side) and negative (right side) year on year variation in absolute terms.



**Figure 3-14: Airports with largest variation in average daily movements**

<sup>9</sup> Three year average of IFR movements (arrivals and departures) between 2008 and 2010.

- 3.2.29 Five of the airports with the highest absolute growth in 2010 are located in Turkey. The airports with the highest decline in terms of average daily movements in 2010 are Paris (CDG), Athens (ATH), Dublin (DUB) and Manchester (MAN).
- 3.2.30 The estimated effect of the ash cloud in April/May 2010 on annual traffic growth at the most affected airports ranges between 1-2%. The effect was most notable at the Nordic airports (Helsinki, Oslo, Copenhagen and Stockholm).

### 3.3 European traffic characteristics

#### TRAFFIC SEGMENTS

3.3.1 The distribution of IFR traffic by flight type between 2005 and 2010 is shown in Figure 3-15, using the STATFOR classification.

3.3.2 Traditional scheduled traffic declined by -1.1% in 2010 but still accounts for the largest share of total IFR traffic (57.3%). The “low cost” traffic increased by +6.9% reaching a total market share of 22.1% in 2010.

3.3.3 After a decline over the past two years, business aviation grew again by +5.5% in 2010 and accounted for 7.2% of total IFR traffic.

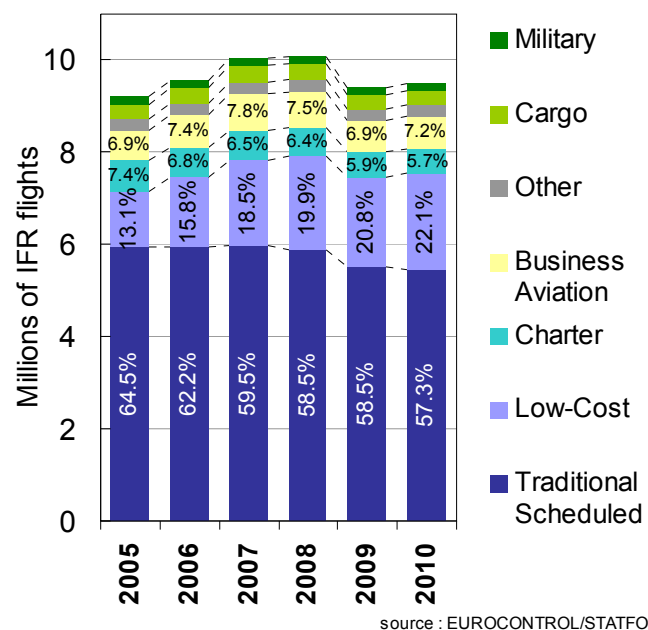


Figure 3-15: Distribution of IFR flights by market segment

#### TRAFFIC VARIABILITY

3.3.4 If traffic is highly variable, resources may be underutilised during off peak times but scarce at peak times. Different types of variability (seasonal, within-week, hourly variability) require different types of management practices to ensure that the ANS can operate efficiently in the face of variable demand.

3.3.5 Figure 3-16 shows the variability between average daily traffic and peak day traffic at European level.

3.3.6 In 2010, the traffic level on the peak day (2 July 2010) was 24% higher than the average traffic.

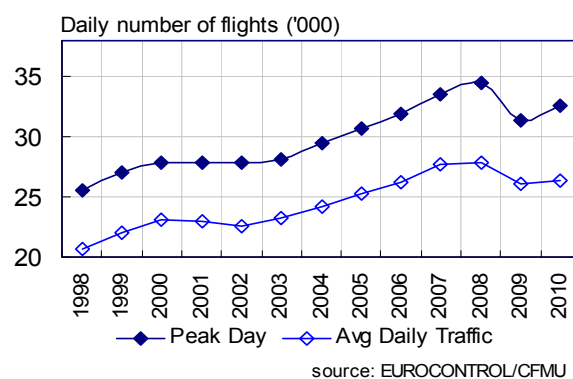
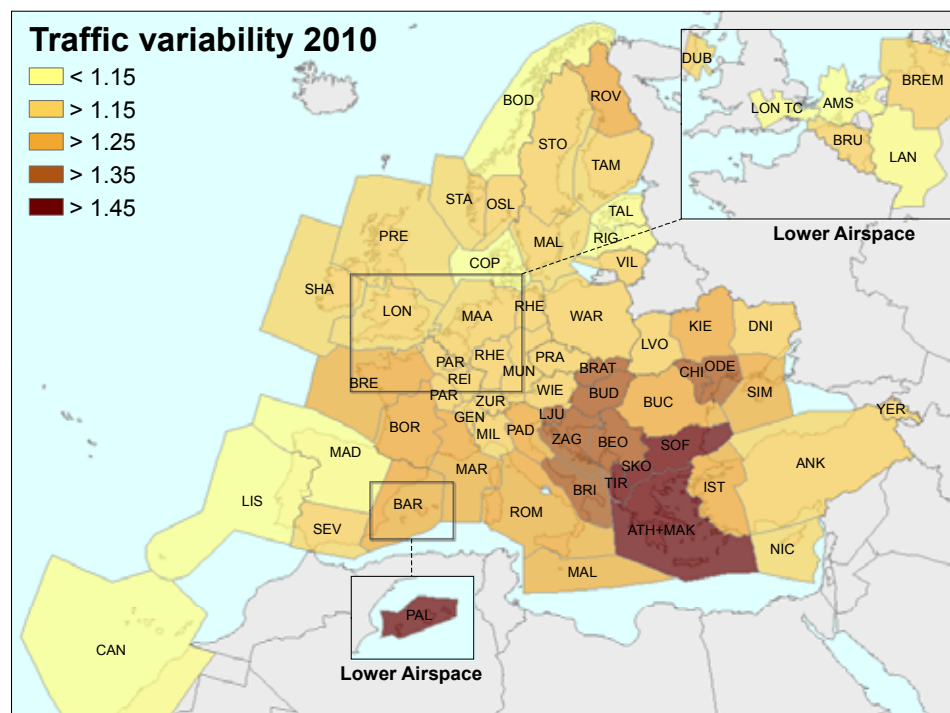


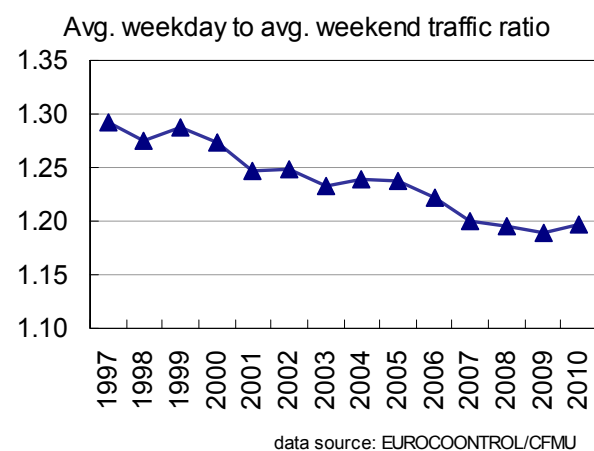
Figure 3-16: Peak day and average daily traffic

- 3.3.7 Figure 3-17 shows a measure of seasonal variability, which is computed as the ratio between the peak weekly traffic demand and the average weekly traffic demand over the year.
- 3.3.8 At European level, seasonal traffic variability is 1.24 in 2010 which means that the traffic is 24% higher than average in the peak week. As shown in Figure 3-17, similar to the complexity score, the picture is contrasted across Europe.
- 3.3.9 Whereas the core area of Europe shows only a moderate level of seasonality, high levels of traffic variability are observed in South-East Europe. The highest level of seasonal variability is observed for Palma (1.8), Skopje (1.6), and Sofia (1.5) which is due to high number of flights during the holiday season in summer.



**Figure 3-17: Seasonal traffic variations at ATC-Unit level [2010]**

- 3.3.10 In addition to the seasonal variability, the weekday/weekend traffic ratio which compares the traffic levels between weekdays and weekends reveals an interesting trend.
- 3.3.11 Whereas weekend traffic is still lower than on weekdays, Figure 3-18 shows a gradual change over the past ten years.
- 3.3.12 While in 1997 the average traffic level was 29% higher on weekdays than on weekends the ratio was only 20% in 2010.



**Figure 3-18: Week/weekend traffic ratio**

3.3.13 The complexity indicator is a composite measure [Ref. 17] calculated for the entire year which combines adjusted density (concentration of traffic in space and time) and structural complexity (structure of traffic flows<sup>10</sup>). A complexity score of 10 means that for each flight hour within the respective airspace, there were on average 10 minutes of potential interactions with other aircraft.

3.3.14 At European level, the aggregate complexity score is relatively stable. In 2010, it is close to 6 minutes of interactions per flight hour. At local level, the aggregate complexity scores differ quite significantly, as shown in Figure 3-19.



- ### 3.4 Conclusions

- 10 It is defined as the sum of interactions between flights: horizontal interactions (different headings), vertical  
interactions (climb/descend) and interactions due to different speeds (see also Annex II).
- 11 The high level of complexity at London Terminal Control (TC) is mainly driven by the high traffic density in the  
London terminal areas.

- 3.4.2 The weak economic growth, compounded by exceptional events (volcanic ash cloud, industrial actions, and unusually severe weather conditions) had a negative impact on traffic growth.
- 3.4.3 Approximately 111 000 flights were cancelled due to volcanic ash clouds in April, which reduced air traffic by some 48% during 8 days and annual air traffic growth by 1.2% in 2010.
- 3.4.4 Approximately 26 000 flights were cancelled due to industrial action and some 45 000 flights due to bad weather conditions in 2010.
- 3.4.5 STATFOR [Feb. 2011] forecasts a rebound of traffic in 2011 (+4.3% vs. 2010), and an annual average growth rate of 3.2% between 2010 and 2014.
- 3.4.6 However, traffic growth is not evenly spread across Europe. High traffic growth is forecast for the emerging markets in the Eastern European States in the next 5 years, albeit from a smaller base. A small to moderate growth is expected for the more mature markets in Western Europe.
- 3.4.7 Traditional scheduled traffic declined by -1.1% in 2010 but still accounts for the largest share of total IFR traffic (57.3%). The “low cost” traffic increased by +6.9% reaching a total market share of 22.1% in 2010. After a decline over the past two years, business aviation grew again by +5.5% in 2010 and accounted for 7.2% of total IFR traffic.
- 3.4.8 Although no statistically significant correlation could be demonstrated thus far, it should be noted that traffic variability and complexity can have an impact on ANS performance. The core area of Europe shows only a moderate level of seasonality but the highest levels of complexity. The situation is reversed in South-East Europe.

## KEY POINTS

1. Incident reporting remains unsatisfactory in some areas of Europe. The SRC estimates that, while some 15 000 incidents are reported, as many as 30 000 incidents remain un-reported. Thirty EUROCONTROL States reported in 2009, one more than in 2008. No or limited progress has been made in the remaining 8 States during the past 6 years.
2. Aggregated data on incidents remain provisional for up to two years due to the length of investigation and late submission of final data by some States. Moreover, the lack of consistency in reporting and assessing incidents across the EUROCONTROL States does not permit trends to be identified confidently.
3. The number of reported high-risk Separation Minima Infringements (SMIs) decreased by 20% in 2008 based on confirmed data, and decreased by another 44% in 2009 based on provisional data. However, the lack of consistency in reporting and assessing SMIs across the EUROCONTROL States and during successive years does not permit trends to be identified confidently.
4. The number of reported high-risk runway incursions decreased by 4% in 2008, and by another 7% in 2009. The number of not investigated runway incursions in 2009 remains too high for assessing the trend.
5. Regulatory provisions concerning the publication of investigation reports for accidents and serious incidents (Regulation (EU) No 996/2010, Articles 16.6 and 16.7) would need (i) to be reinforced, (ii) to be applied to all EUROCONTROL States and (iii) to be extended to all reported incidents. The ratio between open and closed reports should be published by States annually and implementation of the respective recommendations should be tracked.
6. There is an urgent need to accelerate the deployment of automatic safety data reporting tools in Europe in order to improve the reporting culture and consequently the level of reporting. Sufficient resources are needed to validate the data properly, analyse the results and draw lessons. A single European database that meets data quality criteria is an essential enabler for effective safety analysis.

## 4.1 Introduction

- 4.1.1 This chapter reviews the ANS safety performance of EUROCONTROL Member States for the year 2010. The review of ATM-related accidents and incidents is based on provisional data for 2009. It also provides an update to PRR 2009, based on final 2008 data.
- 4.1.2 The chapter is structured as follows:
  - Section 4.2 explains the framework, which is used for the analysis of ANS safety performance.
  - Section 4.3 analyses the number of accidents and most severe incidents available from the SRC Annual Report 2010 [Ref. 18] and other public data sources. It also looks at the quantity and quality of safety reporting in the EUROCONTROL Member States.
  - Section 4.4 analyses the capabilities of safety oversight and safety management based on information from ICAO and EUROCONTROL.
  - Section 4.5 looks at the implementation of Just Culture.
- 4.1.3 With the view to the start of the first reference period of the SES II performance scheme in 2012, Section 4.7 addresses the status of preparation regarding the three PIs during the first reference period 2012-2014.
- 4.1.4 In 2010, in the EU context, following the extension of scope of EASA competence to ATM/ANS and aerodromes, the fast track process for adoption of opinions related to: (i) the provision of air navigation services, and safety oversight, and (ii) licensing and medical certification of air traffic controllers was applied to quickly extend the

standardisation concept used by EASA in other domains to ATM/ANS.

- 4.1.5 EASA is continuing the development of ATM implementing rules in accordance with its rulemaking programme based on the total system approach, and has started the development of a more comprehensive standardisation approach including the ATM/ANS domain. To support a European safety strategy, EASA has developed the European Aviation Safety Programme<sup>12</sup> and Plan<sup>13</sup>.

## 4.2 Framework for the analysis of ANS safety performance

- 4.2.1 A safety system in the context of ANS has the objective of mitigating risk from two different sources of hazards: (i) pre-existing hazards (e.g. risk of collision without ATM being present) and (ii) hazards generated by the system (e.g. ATM) itself.
- 4.2.2 A safety system as a whole can fail when the weaknesses of all individual barriers align, permitting "a trajectory of opportunity", either (i) not controlling a pre-existing hazard appropriately or (ii) not mitigating the consequences of a system-generated hazard, and letting them pass through holes in all layers of the defences (barriers), ultimately leading to an accident or an incident.
- 4.2.3 Safety performance is the health status of a safety system, which can be measured through (i) the number and severity of accidents and incidents ('lagging' indicators) or (ii) the verification of the effectiveness of all barriers, which are put in place to prevent accidents and incidents to occur ('leading' indicators). Safety performance review is about assessing and measuring the status of the ANS safety system with respect to its effectiveness. Currently three Performance Indicators are analysed in the context of ANS safety.
- 1) Accidents and incidents<sup>14</sup>, including key risk areas as identified through appropriate analyses. The accident data used in this report refer to commercial air traffic. The data on incidents used in this report are separation minima infringement and runway incursion as defined in ESARR2. Key risk areas are any ANS operational factors (software, procedures, particular weather situations, etc.), which may be precursors for incidents or accidents.
  - 2) Capability of safety oversight and safety management:
    - International safety audits or inspections conducted by ICAO and EUROCONTROL to ensure that States/CAAs/NSAs have and maintain the capability for safety oversight of Air Navigation Service Providers (ANSPs), complemented by safety maturity surveys of States/NSAs/CAAs conducted by EUROCONTROL.
    - Safety Maturity surveys of ANSPs conducted by EUROCONTROL to establish the extent of progress made with respect to the introduction of safety management systems.
  - 3) Just Culture environment within which safety management operates, enabling its effectiveness through an open reporting culture. The measure will be the level of reporting of Just Culture.

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12 An integrated set of regulations and activities aimed at improving safety.

13 High level safety issues assessment and related action plan.

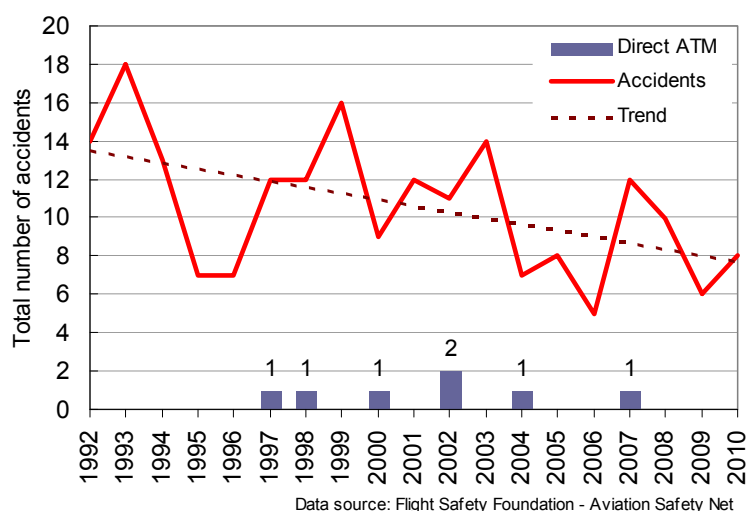
14 Definition of accident and incident as in ICAO Annex 13 (see Glossary).



## 4.3 ATM-related Accidents and Incidents

### ACCIDENTS WITH ATM CONTRIBUTION

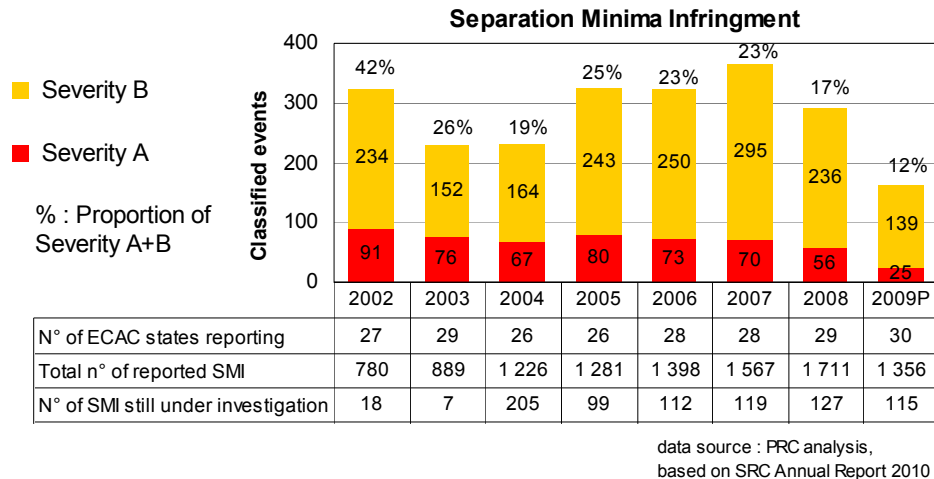
- 4.3.1 The numbers of accidents in EUROCONTROL Member States with ATM contribution for commercial air traffic are depicted in Figure 4-1. The observable trend may suggest that the absolute number of accidents with ATM contribution<sup>15</sup> continues to decrease. However, the displayed numbers cannot provide a reliable indication of any trends due to their limited number and, therefore, their limited statistical relevance.
- 4.3.2 As was the case in preceding years, safety incident reports for 2009 were compiled and reported to EUROCONTROL's Safety Regulation Unit (SRU) in 2010. Therefore, the corresponding analysis refers to 2009, still based on provisional data because some States had not communicated their final data at the time of writing this report.



**Figure 4-1: Accidents in EUROCONTROL States with ATM contribution**

- 4.3.3 Figure 4-2 depicts the number of reported high-risk (Severity A and B) **Separation Minima Infringements (SMIs)**. The confirmed data for 2008 show a 20% decrease to the preceding year (from 365 to 292), while the total number of reported SMIs increased by 9% (from 1 567 to 1 711). The percentage of high risk SMIs decreased in 2008 from 23% to 17% of the total number of occurrences reported.
- 4.3.4 In 2009 (based on provisional data) the number of reported high risk SMIs decreased by 44% in comparison to the preceding year (from 292 to 164). The total number of reported SMIs decreased by 20% (from 1 711 to 1 356). The percentage of high risk SMIs decreased from 17% to 12%. The numbers for 2009 are subject to finalisation in 2011 and may be influenced by the final classification of SMIs still under investigation (115 in 2009). However, the lack of consistency in reporting and assessing SMIs across the EUROCONTROL States does not permit trends to be identified confidently.

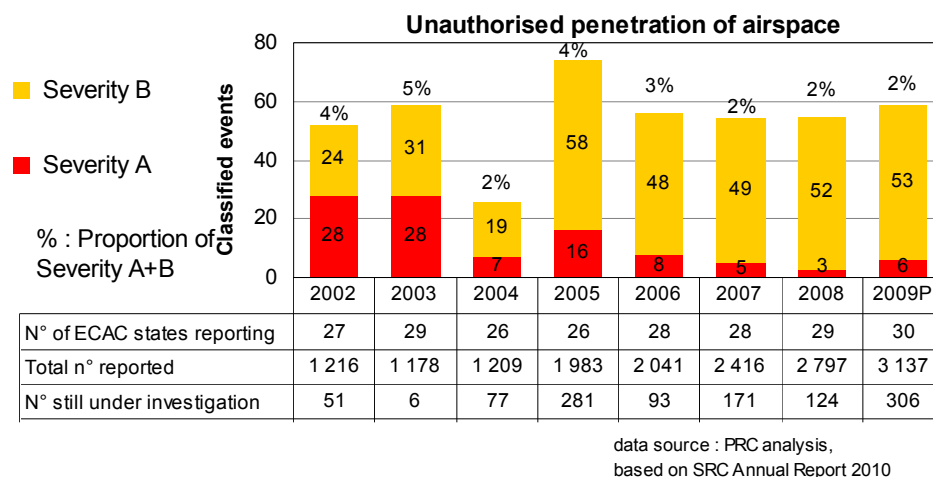
<sup>15</sup> The notion of 'ATM-contribution' is to consider occurrences to which ATM has contributed directly or indirectly (or that are accountable to ATM); 'ATM-related' refers to occurrences to which ATM has potential for improvement. See also the paragraph 2.6 of the NLR study "A framework of indicators for the potential influence of ANS on air traffic safety in Europe."



**Figure 4-2: Reported high-risk separation minima infringements in ECAC Member States**

4.3.5 An **unauthorised penetration of airspace** (also commonly referred as **airspace infringement**)<sup>16</sup> is a frequent precursor for separation minima infringements and inadequate separations<sup>17</sup>. All classes of flights are prone to airspace infringement, but the majority of incidents recorded involve General Aviation. This is not a surprise, as most GA VFR flights are conducted outside controlled areas and zones, and are in general flown by less trained/experienced leisure pilots, whereas IFR flights are usually contained within controlled airspace and carried out under the supervision of ATC units.

4.3.6 The preliminary data for 2009 shows a significant increase of 12% in the number of airspace infringements reported after a 16% increase the year before (see Figure 4-3). Notably, the proportion of occurrences” still under investigation” in this category has increased significantly too.

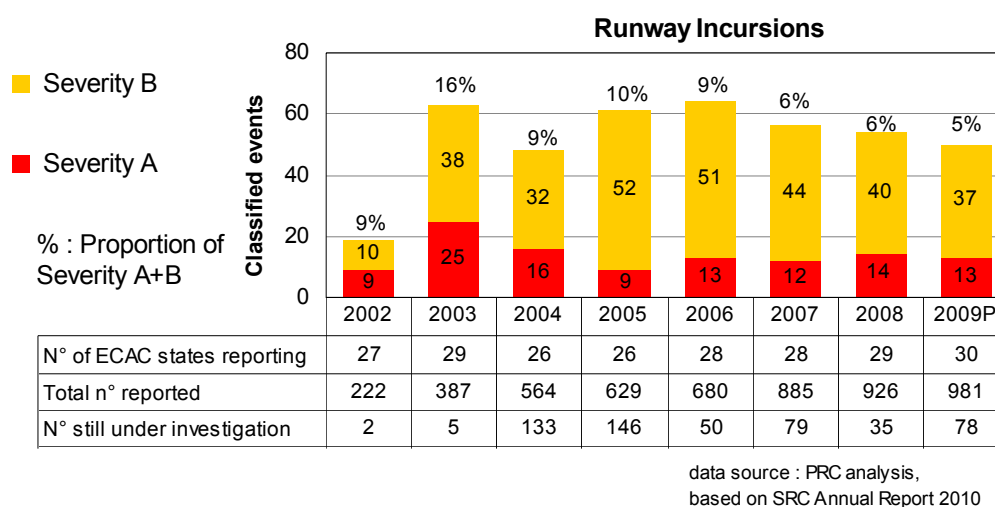


**Figure 4-3: Reported unauthorised penetration of airspace in ECAC Member States**

16 Definition of unauthorised penetration of airspace (EUROCONTROL HEIDI – ESARR 2 taxonomy): The penetration by an aircraft into a portion of airspace without prior permission of the appropriate authorities (when such prior permission is required).

17 Definition of inadequate separation (EUROCONTROL HEIDI – ESARR 2 taxonomy): in the absence of prescribed separation minima, a situation in which aircraft were perceived to pass too close to each other for pilots to ensure safe separation (e.g. VFR and IFR flights perceived to pass too close to each other in airspace Class D or E).

- 4.3.7 The EUROCONTROL Provisional Council approved the “European Action Plan for Airspace Infringement Risk Reduction” in December 2009 [Ref. 19]. However, while reporting and analysis of airspace infringements is improving, States need to actively support the implementation of the Action Plan with the utmost urgency.
- 4.3.8 The number of reported high-risk (Severity A and Severity B) **runway incursions** (RIs) are depicted in Figure 4-4. For 2009 they decreased by 7% (from 54 to 50), although the total number of reported runway incursions increased by 6% (from 926 to 981). The final data for 2008 have only changed marginally from the provisional status as recorded in PRR2009 (+1 Severity B, +18 total n° reported). However, the number of not investigated runway incursions in 2009 remains too high for a reliable assessment of the trend.
- 4.3.9 While the RI investigation process showed an improvement in 2008, the number of RIs still under investigation has gone up again for 2009.

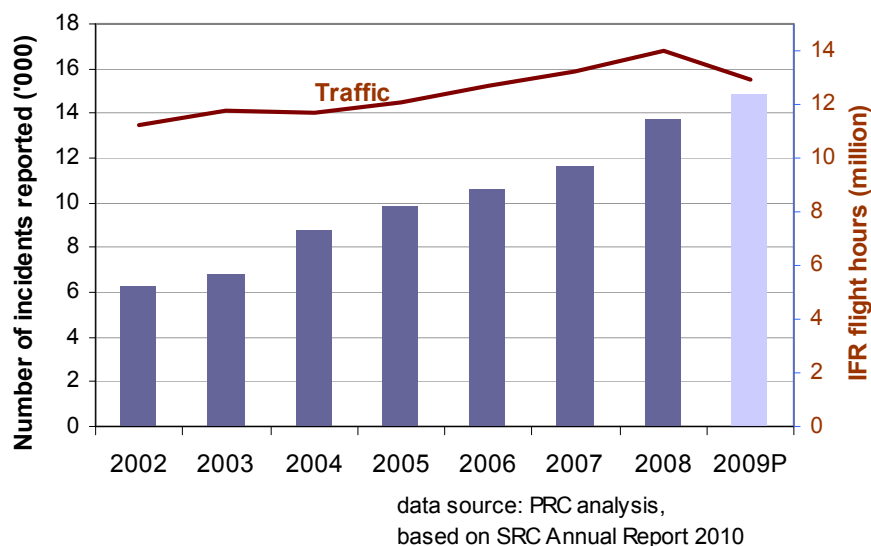


**Figure 4-4: Reported high-risk runway incursions in ECAC Member States**

- 4.3.10 Some States have duly considered the recommendations of the European Action Plan for Prevention of Runway Incursion (EAPPRI) [Ref. 20] and have incorporated them as such in a series of recommendations to CAAs. The Plan has also been included in the European Aviation Safety Plan of EASA. Actual implementation remains discretionary and is applied diversely throughout the ECAC area. As a consequence, it is possible that the degree of implementation varies throughout an area or within a single State.

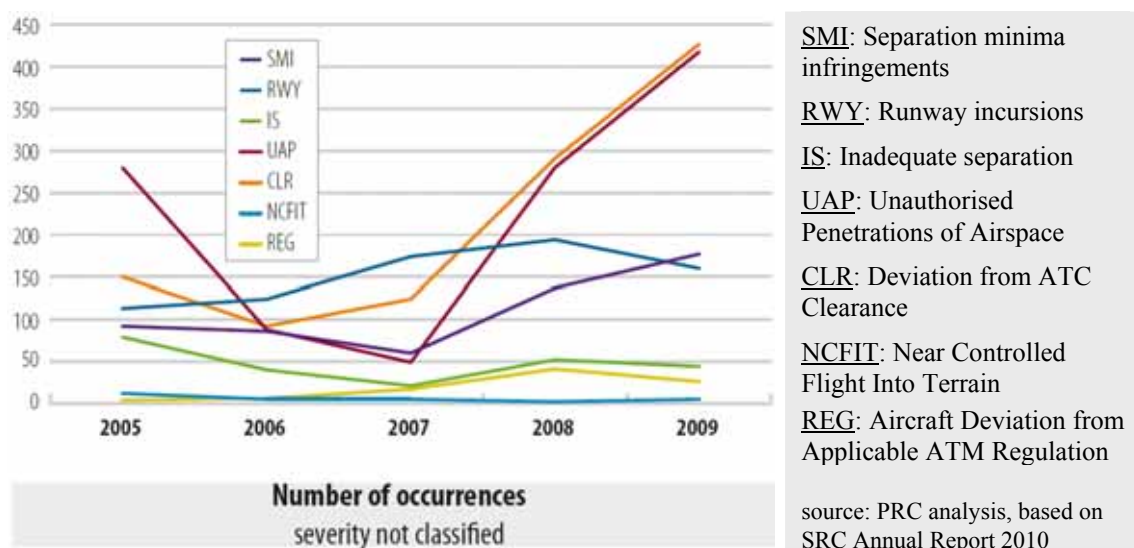
#### AMOUNT AND QUALITY OF SAFETY REPORTING

- 4.3.11 The total numbers of reported ESARR 2 safety incidents are displayed in Figure 4-5, showing a continuous trend over the past eight years.
- 4.3.12 The number of States reporting safety incidents has not shown improvement over the past six years. Out of the 43 ECAC States, 13 did not report in 2009 of which eight are EUROCONTROL Member States (Bulgaria, Croatia, Luxemburg, Malta, Monaco, Slovenia, Turkey and Ukraine).



**Figure 4-5: Reported ATM incidents vs. million flight hours in EUROCONTROL airspace**

4.3.13 It is important to note that the currently available data on total numbers of incidents reported do not allow to judge, whether the upward trend is caused by an improved level of reporting (positive) or by an increasing number of incidents (negative). Most likely it is a mix of both. It should also be noted that the number of reporting States did marginally increase over time. In the SRC Annual Safety Report 2010 [Ref.18] it is estimated that, while some 15 000 incidents are reported to EUROCONTROL, as many as 30 000 incidents remain un-reported for two reasons: either they are not reported at all or the national data flows do not work properly and the data is not reaching EUROCONTROL. ESARR2 requires States to ensure ‘that the severity of occurrences is determined, the risk posed by occurrences classified, and the results recorded’. The SRC Annual Safety Report 2010 concludes that the severity assessment situation of ATM-related incidents reported through the ‘Annual Summary Template’ mechanism is deteriorating (see Figure 4-6).



**Figure 4-6: Number of occurrence reports without severity classification in ECAC States**

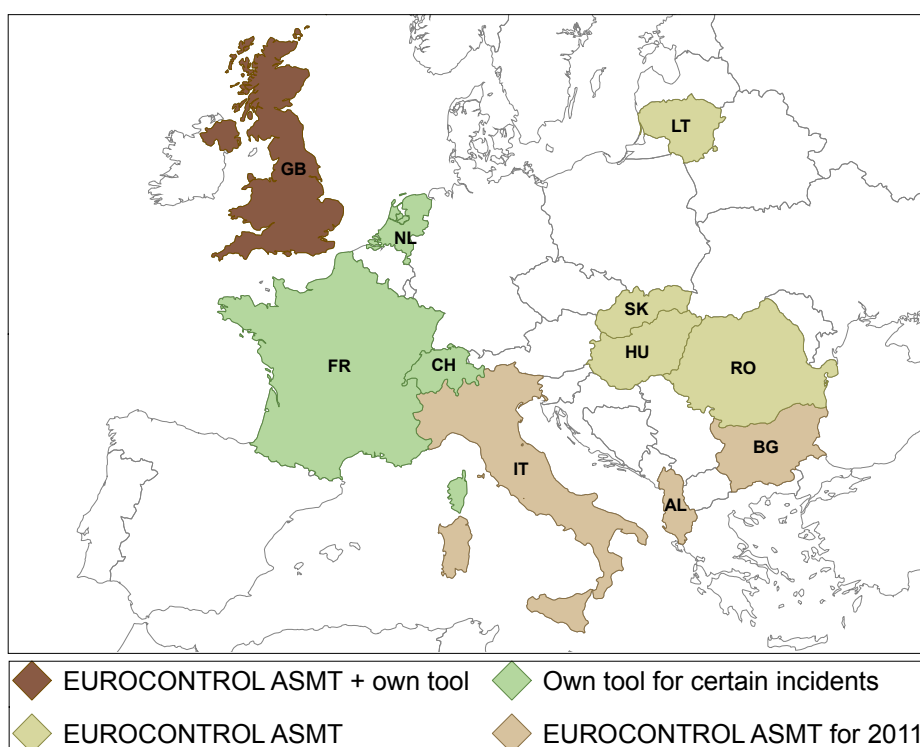
4.3.14 Safety related occurrences in the civil aviation domain are collected in EASA Member States, in accordance with Directive 42/2003, into the European Central Repository (ECR). This repository is managed by the EC Joint Research Centre (JRC) as part of the ECCAIRS system, according to Regulation EC 1321/2007 [Ref. 21]. The EASA Annual Safety Review 2009 [Ref. 22] refers to some 50 000 ATM safety occurrences reported

into ECR by today. Data quality is a major concern, because essential information is missing for more than half of the records. Therefore, efforts have to be made to enhance data quality and allow for validation of the records.

- 4.3.15 The first voluntary ATM incident data collection organised at pan-European level is the EUROCONTROL Voluntary ATM Incident Reporting (EVAIR). It is aiming for a proactive approach to safety by learning, not just from accidents and serious incidents but from the lower level risk bearing incidents. It shall be considered as an element of the safety data flow to be established for the first reference period of the SES Performance Scheme.

#### AUTOMATIC SAFETY DATA REPORTING

- 4.3.16 The PRC has long advocated the general introduction of automated safety data reporting tools as one enabling element to improve the level of reporting. Figure 4-7 displays the current status of deployment of the EUROCONTROL Automatic Safety Monitoring Tool (ASMT) and comparable tools in EUROCONTROL Member States. The EUROCONTROL Agency is currently in advanced discussions with four more Member States. Discussions to commence implementation have been started with a further 12 Member States. The implementation of automated safety data reporting tools shall be based on the same basic principles such as confidentiality, adequate protection, trust and mutual respect as any other incident reporting system.



**Figure 4-7: States with automatic reporting tools**

- 4.3.17 It is important to note that the success of implementing automatic safety data reporting on State level is dependent on a clear mandate and right of access to data, a clear definition of the operational concept, sufficient resources for data analysis, respective training and an appropriate link into the overall Safety Management System. Relevant guidance material is available from the EUROCONTROL Agency.

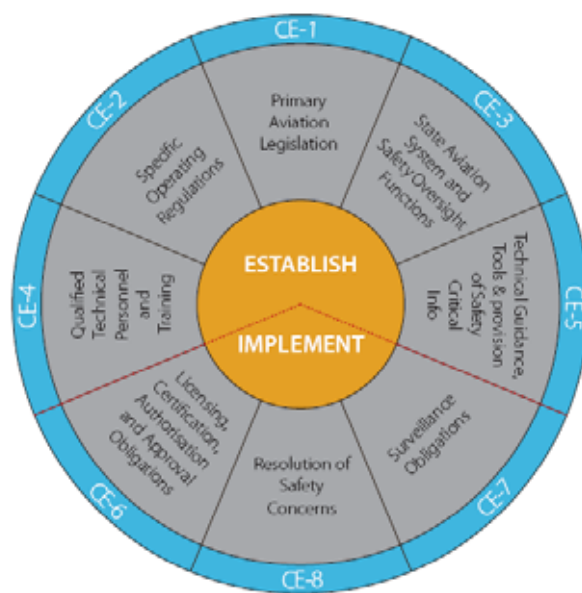
## 4.4 Capability of safety oversight and safety management

4.4.1 The analyses in this section result from ICAO USOAP audits, ESIMS audits, SES implementation annual reports (as part of the LSSIPs); LSSIP and maturity surveys. These were the tools available in 2010. As explained in section 4.6, and reflected in Recommendation d. in the Executive Summary, this system is evolving for EU Member States.

### ICAO USOAP AUDITS

4.4.2 The objective of the ICAO Universal Safety Oversight Audit Programme (USOAP) is to promote global aviation safety through auditing States on a regular basis to determine States' capability for safety oversight.

4.4.3 The first USOAP cycle only assessed the States capability with regard to personnel licensing, airworthiness and flight operations. The last USOAP cycle - denominated "Comprehensive System Approach" (CSA) - included the assessment of States capability to oversee Air Navigation Services. The USOAP CSA cycle started in 2005 and it will terminate in 2011. In October 2010 the ICAO General Assembly adopted by resolution A37-5 a new Continuous Monitoring Approach (CMA) aiming at monitoring the safety performance of all the ICAO Contracting States on an ongoing basis. The CMA will be under preparation in 2011 and start in 2012.



ICAO Model  
The Eight Critical Elements of a State's Safety Oversight System

#### ICAO Eight Critical Elements

CE-1. Primary aviation legislation. The provision of a comprehensive and effective aviation law.

CE-2. Specific operating regulations. The provision of adequate regulations to address requirements emanating from the primary aviation legislation, in conformance with the ICAO SARPs.

CE-3. State civil aviation system and safety oversight functions. The establishment of a CAA and/or other relevant authorities, headed by a CEO, supported by the appropriate and adequate staff and provided with adequate financial resources. The State authority must have stated safety regulatory functions, objectives and safety policies.

CE-4. Technical personnel qualification and training. The establishment of minimum knowledge and experience requirements for the technical personnel performing safety oversight functions and the provision of appropriate training to maintain and enhance their competence at the desired level.

CE-5. Technical guidance, tools and the provision of safety-critical information.

CE-6. Licensing, certification, authorization and approval obligations.

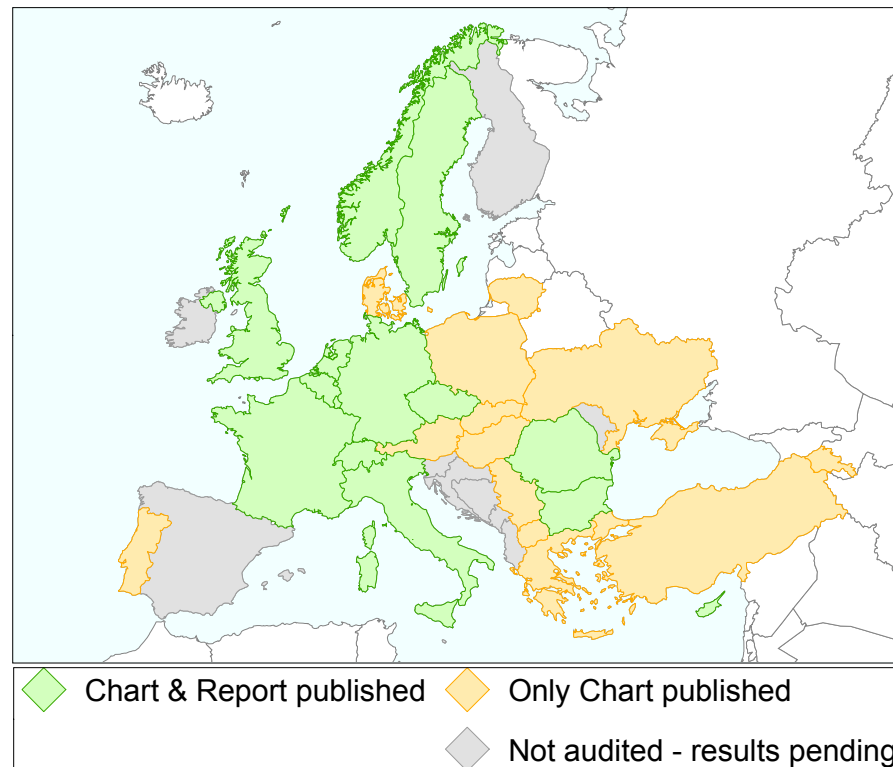
CE-7. Surveillance obligations. The implementation of processes, such as inspections and audits, to proactively ensure that aviation licence, certificate, authorization and/or approval holders continue to meet the established requirements and function at the level of competency and safety required by the State.

CE-8. Resolution of safety concerns. The implementation of processes and procedures to resolve identified deficiencies impacting aviation safety, which may have been residing in the aviation system and have been detected by the regulatory authority or other appropriate bodies.

4.4.4 The USOAP high-level results are published as a chart organised in accordance with the Eight Critical Elements of a State's Safety Oversight System developed by ICAO [Ref. 23].



- 4.4.5 On top of the high-level results, States could also decide to release to the public the final audit ICAO report which includes detailed findings, ICAO recommendations and the corrective action plan presented by the State.
- 4.4.6 Figure 4-8 shows the level of transparency reached by EUROCONTROL Member States regarding the publication of USOAP safety oversight audit results on the ICAO public website <http://www.icao.int/fsix/>, following a decision by all ICAO Contracting States at the DGCA Conference held in Montreal in March 2006.



**Figure 4-8: Publication of USOAP audit results on ICAO public web site**

#### EUROCONTROL ESIMS AUDITS

- 4.4.7 The ESARR Implementation Monitoring and Support (ESIMS) Programme was established in 2002 to monitor the rate of ESARR adoption by States. In 2005 a formal audit approach in line with the ICAO Universal Safety Oversight Audit Programme (USOAP) was developed. Since then, the ESIMS Programme has focused on auditing States' ATM safety oversight capabilities. The audits cover the relevant legislative and institutional arrangements as well as the ATM safety regulations in place, the safety regulatory arrangements and their capabilities (policy and principles, rulemaking procedures, safety oversight and personnel licensing, and resources and staff competency). On-site audits are followed by the development of a State Corrective Action Plan which is incorporated into the Final Audit Report. Until now 34 on-site audits and 4 follow-up audits have been completed. For 2011, 8 on-site and 4 follow-up audits are planned. At the end of 2011 the whole 6-year cycle of ESIMS audits will be finalised.
- 4.4.8 The Memorandum of Co-operation signed in 2005 between ICAO and EUROCONTROL regarding safety oversight auditing ensured that ESIMS and USOAP audit schedules are co-ordinated to maximise synergies.



- 4.4.9 The ESIMS high-level results are published<sup>18</sup> by the EUROCONTROL SRC as ‘Audit Results Summary Sheets’ for each audited Member State. The Summary Sheet depicts the level of compliance with the mandatory provisions related to the implementation of each of the eight ICAO critical elements at the time of the audit.

#### **SINGLE EUROPEAN SKY (SES) IMPLEMENTATION ANNUAL REPORTS**

- 4.4.10 Pursuant to Article 12.1 of Regulation (EC) N° 549/2004 [Ref. 24] EU-Member States are obliged to submit to the European Commission annual reports on the actions taken to implement the Single European Sky legislation. The States that submitted reports in addition to the EU-Member States include also Norway and Switzerland stemming from their contractual relation to the European Union. The States signatory to the European Common Aviation Area Agreement (ECAA), Albania, Bosnia and Herzegovina, Croatia, FYROM, Montenegro and Serbia also submitted reports. The reports are collected through the LSSIPs.
- 4.4.11 The SES implementation annual reports contain useful information to assess the States’ oversight capabilities. Information contained in these reports could be easily organised in accordance with the Eight Critical Elements developed by ICAO.
- 4.4.12 In May 2010, EUROCONTROL published a Summary Report on the SES legislation implementation in the year 2009 [Ref. 25].

#### **EUROCONTROL LOCAL SINGLE SKY IMPLEMENTATION PLANS/REPORTS (LSSIP)**

- 4.4.13 The Local Single Sky ImPlementation plans/reports (LSSIPs)<sup>19</sup> constitute the medium-term plan and progress information of ECAC national Stakeholders for achieving the implementation objectives identified in the European Single Sky ImPlementation plan (ESSIP), in line with the EUROCONTROL ATM 2000+ Strategy [Ref. 26] and the ATM SESAR Master Plan. They also contain information to assess the States’ oversight capabilities in accordance with the Eight Critical Elements developed by ICAO, and information related to performance progress and plans.

#### **EUROCONTROL SAFETY MATURITY SURVEY 2010**

- 4.4.14 Taking account of considerable changes in European ATM since the original maturity survey methodology was established in 2002, the whole methodology has been reviewed and brought up to date to be in line with ICAO and European Safety requirements.
- 4.4.15 The new methodology establishes the extent of progress made by (i) ANSPs with respect to the introduction of ATM safety management systems and (ii) ATM Regulators with respect to the introduction of ATM regulatory oversight. The aim of the surveys is to:
- Determine the level of SMS improvement and ATM safety regulatory oversight within the industry;
  - Determine the extent to which learning is transferred across the industry; and
  - Establish the paths along which ANSPs and ATM regulatory authorities respectively can focus their activities for continuous improvement.
- 4.4.16 The maturity survey addressing the ANSPs indicates to which extent the ICAO Global Aviation Safety Roadmap is being implemented. The study areas (Figure 4-9) of the survey are fully aligned with the CANSO/EUROCONTROL SMS Standard of Excellence.

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18 SRC webpage: [www.eurocontrol.int/src/public/standard\\_page/auditresults.html](http://www.eurocontrol.int/src/public/standard_page/auditresults.html).

19 Formerly Local Convergence and Implementation Plan (LCIP).

Area No.		ANSP Study Areas
<b>Safety Culture</b>	SA1	Development of a positive and proactive safety culture
<b>Safety Policy</b>	SA2	Organisational and individual safety responsibilities
	SA3	Timely compliance with international obligations
<b>Safety Achievement</b>	SA4	Safety standards and procedures
	SA5	Competency
	SA6	Risk management
	SA7	Safety interfaces
<b>Safety Assurance</b>	SA8	Safety reporting, investigation, and improvement
	SA9	Safety performance monitoring
	SA10	Operational safety surveys and SMS audits
<b>Safety Promotion</b>	SA11	Adoption and sharing of best practices

**Figure 4-9: ANSP Safety Framework Maturity Study Areas**

4.4.17 For the ATM Safety Regulators the survey evaluates to which extent the ICAO Eight Critical Elements of a State's Safety Oversight System are being implemented. The study areas (Figure 4-10) can be mapped to the ICAO Eight Critical Elements.

Area No.	ATM Regulator Study Areas
S-1	State safety framework
S-2	Safety resources
S-3	Safety interfaces
S-4	Safety reporting, investigation and improvement
S-5	Safety performance monitoring
S-6	Implementation of safety oversight
S-7	Adoption and sharing of best practices
S-8	Safety culture
S-9	Resolution of safety deficiencies and concerns

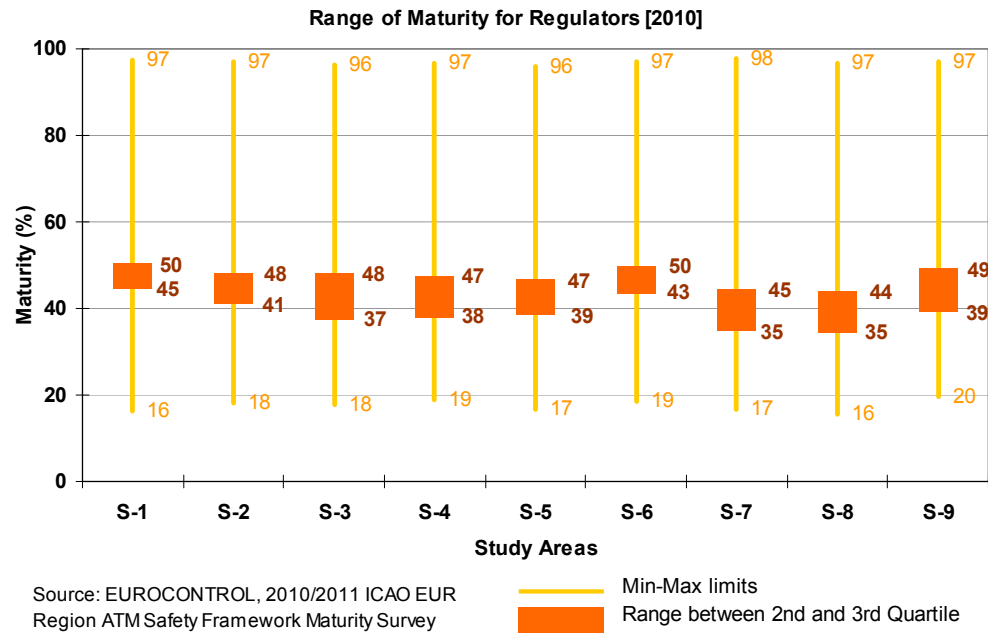
**Figure 4-10: ATM Regulator Safety Framework Maturity Study Areas**

4.4.18 The surveys are not comparable to an audit and are not based on detailed evidence. They are an instrument based on self-assessment, which is verified during telephone interviews. The new methodology, applied from 2010 onwards, intends to strengthen the verification mechanism of the replies through face-to-face interviews that need to be agreed by stakeholders to avoid duplication with EASA standardisation inspections.

#### **ATM REGULATOR RESULTS – STATES/ CAAS/ NSAS CAPABILITY FOR SAFETY OVERSIGHT**

4.4.19 36 of the 38 Regulators from the EUROCONTROL States answered the 2010 Safety Maturity Survey. Figure 4-11 presents the survey findings for the 9 study areas, displaying the minimum and maximum score and the band within which 50% of the regulators fall (interquartile range). The average rate for the individual study areas is around 50%, with two thirds of Regulators rating themselves to be at level 2 (25% to 50%) or below. Detailed findings for the EUROCONTROL States can be found in the respective study report<sup>20</sup>. Since 2010 is the first year of the comprehensive use of the new Safety Framework Maturity Survey methodology results cannot be compared in a meaningful way to preceding years.

20 2010/2011 ICAO EUR Region ATM Safety Framework Maturity Survey, Issue 1 (Draft A).



**Figure 4-11: Maturity for Regulators**

4.4.20 The following paragraphs summarise the findings with respect to the Eight Critical Elements of a State's Safety Oversight System developed by ICAO based on the different sources described above.

#### **CE-1 (PRIMARY AVIATION LEGISLATION)**

4.4.21 The SES Legislation ensures a comprehensive and effective legal framework across EU States, Switzerland, Norway and ECAA States.

4.4.22 For States which have not incorporated the EU legal framework, the ICAO USOAP results would indicate that the legal framework is equally comprehensive and effective.

#### **CE-2 (SPECIFIC OPERATING REGULATIONS)**

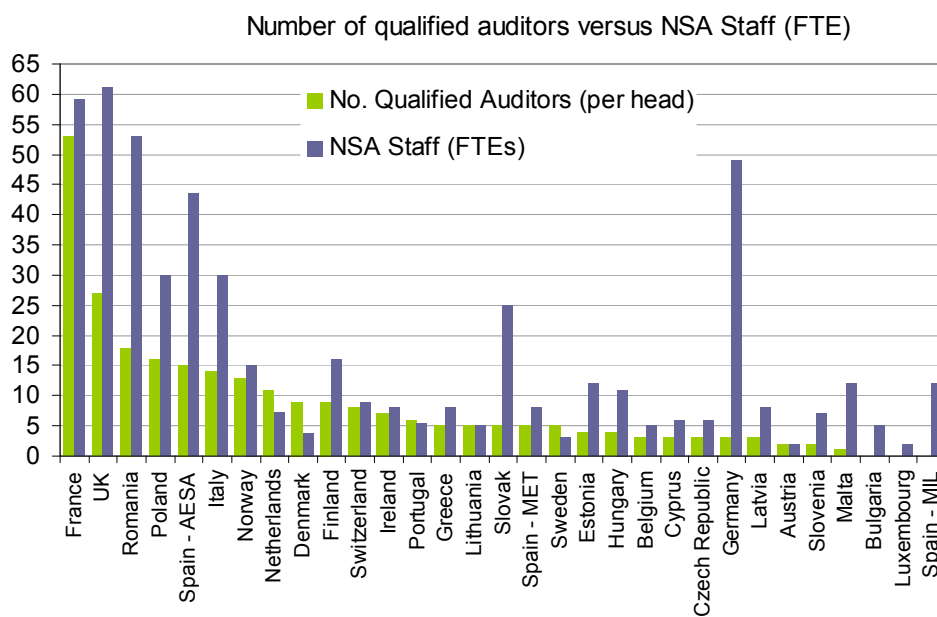
4.4.23 EU States, Switzerland, Norway and partially ECAA States have satisfactorily addressed SES requirements into the national regulatory systems.

4.4.24 The EU SES legislation leaves to States the competency to transpose ICAO SARPs into the national regulatory system. The degree of success in EUROCONTROL States to transpose ICAO SARPs into the national regulatory system is variable and not uniform.

#### **CE-3 (STATE CIVIL AVIATION SYSTEM AND SAFETY OVERSIGHT ORGANISATION)**

4.4.25 In EUROCONTROL States there is not a sufficient amount of qualified staff (particularly ANS auditors or inspectors<sup>21</sup>) to fulfil CAA/NSA obligations (Figure 4-12).

21 In this report the word "auditors" and "inspectors" are used interchangeably. EUROCONTROL ESARR 1 and EC 1315/2007 refer to "safety regulatory audits", while EASA Basic Regulation uses the term "standardisation inspections". ICAO refers to inspectors.



source: Report on the SES Legislation Implementation in 2009  
[Eurocontrol on behalf of EC DG-Move]

**Figure 4-12: Number of Qualified Auditors vs. NSA Staff [2009]**

- 4.4.26 The only exception may be France and Romania where there are respectively 53 and 18 qualified ANS inspectors, most likely sufficient in comparison to the level of traffic and of the number of ANS infrastructures.
- 4.4.27 It would appear that there will not be enough financial resources for funding an increase in the recruitment of qualified staff at least until 2014. Additional restrictions to recruitment are brought in by a lack of autonomy for CAAs/NSAs which are bound to rigid governmental rules and coordination for allocating funds and for establishing new recruitments.
- 4.4.28 Given the lack of autonomy of many CAAs/NSAs, the use of “recognised entities” in support of safety oversight tasks is still very rare. It would seem that agreements for mutual support between CAAs and NSAs are a more viable solution for the time being.
- 4.4.29 Finally it should be noted that many international audits, inspections and surveys increase the workload on already stretched resources and they have also the negative impact to distract NSAs from their principal task of overseeing their ANSPs.
- 4.4.30 There is the need to integrate and make consistent all these international audits, inspections and surveys. ICAO CMA is a best practice as it has foreseen to integrate results from other international audits and inspections provided that sufficient evidences are forwarded to the ICAO CMA team. A description of the future system in the EU context is included in Section 4.6.

#### **CE-4 (TECHNICAL PERSONNEL QUALIFICATION AND TRAINING)**

- 4.4.31 The lack of funding and scarcity of staff has also negative consequences in the implementation of training programmes and plans. ANS rule-makers and inspectors are not enough trained to maintain their competency at the desired level.

#### **CE-5 (TECHNICAL GUIDANCE AND TOOLS)**

- 4.4.32 According to USOAP and ESIMS audits, guidelines to Service Providers on how to implement safety requirements are not effectively implemented in many States.

4.4.33 Best practice in this field is the UK Civil Aviation authority which makes publicly available exhaustive and up-to-date guidelines in its website.

4.4.34 The safety reporting system should also be improved in many States with a particular attention for the data flow between the ANSPs and the NSAs. An enabling factor to improve the reporting system will definitely be the implementation of Just Culture (see section 4.5).

#### CE-6 (LICENSING, CERTIFICATION, AUTHORIZATION AND APPROVAL OBLIGATIONS)

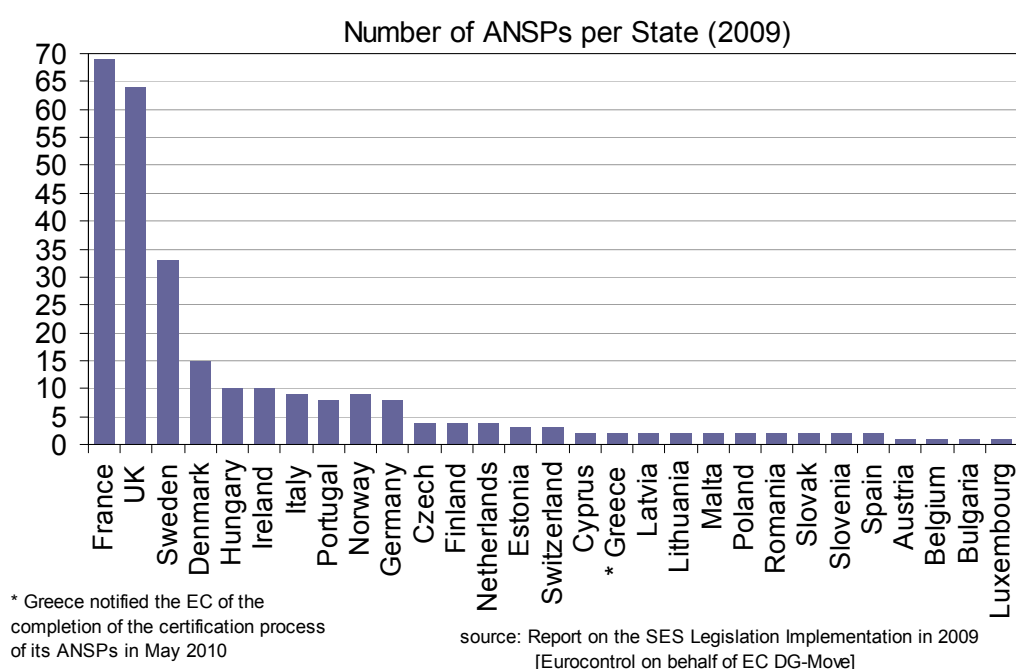
4.4.35 In accordance with EU-SES legislation, EU States, Switzerland, Norway and ECAA States have the obligation to certify the ANS providers and to transpose the EU ATCO licence directive into their legislative framework.

4.4.36 The obligation to certify ANS providers does not apply to EUROCONTROL States not subject to the SES (e.g. Turkey or Ukraine). Nevertheless the obligation stemming from ICAO Annex 11 to approve the safety management system established by ATS providers remains.

4.4.37 The ICAO standard for an ATCO licensing system in EU States is prescribed in EU Directive 2006/23. For those EUROCONTROL States which are not bound by EU legislation, the ICAO standard is based on EUROCONTROL ESARR 5.

4.4.38 EUROCONTROL States have reported a total of 276 certified ANSPs in Europe (Figure 4-13). The renewal of many ANSP certificates in 2009 demonstrates that the certification process has been consolidated since its inception and now appears as a well established process. However, the procedures for introduction of safety changes are not adequately implemented by 12 NSAs.

4.4.39 As far as multi-national service providers are concerned, in 2010, the French NSA has certified ESSP, which is the EGNOS satellite service provider, while the certification of EAD is under preparation. No other State reported on similar activities for the certification of multi-national service providers.



**Figure 4-13: Number of ANSPs per State [2009]**

- 4.4.40 All EUROCONTROL States, except Luxembourg, reported in their SES implementation Annual Reports (as part of the LSSIPs) that they had transposed the ATCO license Directive and/or ESARR 5 into their national legal system.

#### **CE-7 (SURVEILLANCE OBLIGATIONS: CONTINUOUS COMPLIANCE MONITORING)**

- 4.4.41 All EUROCONTROL States have established an annual inspection programme in 2009. The only exception was Greece which did not establish an inspection programme as the ANSP certification was only concluded in 2010.
- 4.4.42 The implementation of the inspection programme is in many cases unsatisfactory given the lack of ANS inspectors and/or external support. Furthermore, the implementation is heterogeneous across States.

#### **CE-8 (RESOLUTION OF SAFETY CONCERNS)**

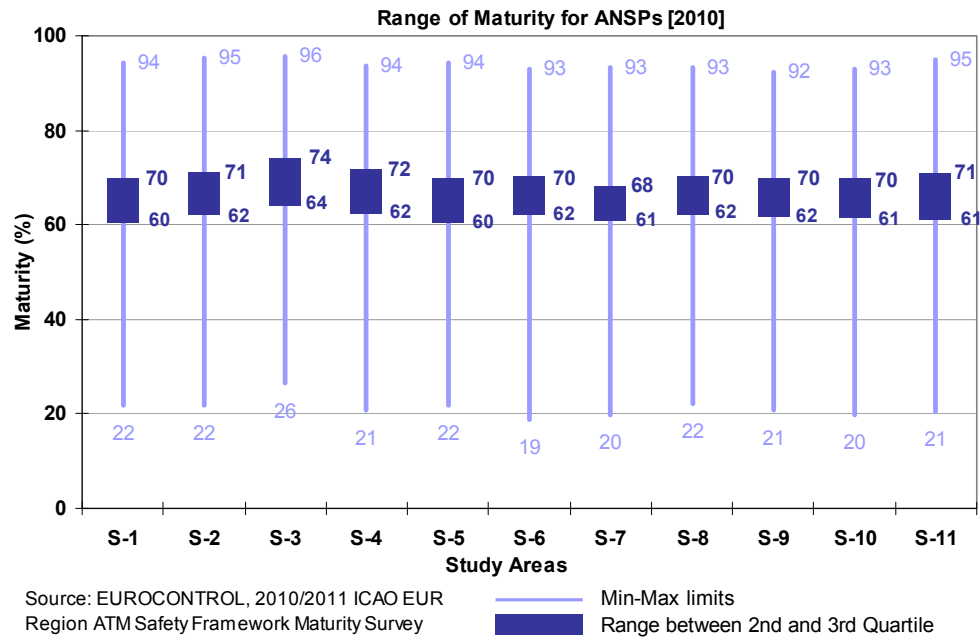
- 4.4.43 Once findings and recommendations have been established as a result of audits and/or analyses of safety occurrences, their enforcement and consequently the resolution of safety concerns are not properly addressed by the authorities.

#### **SAFETY OVERSIGHT CAPABILITIES: CONCLUSIONS**

- 4.4.44 As the main issue the lack of resources for safety oversight tasks can be identified. This has a negative impact on training and surveillance activities. In this situation, it appears that NSAs have prioritised resources to certify ANSPs. The stretched resources in the NSAs have also to cope with an additional load generated by a considerable amount of international audits, surveys, questionnaires, etc. The national audit techniques are not harmonised across Europe; which could generate a difference in oversight effectiveness. NSAs and States are not adequately applying the provisions contained in EC Regulation 549/2004 [Ref. 24] for resolving the safety concerns: the penalties that Member States shall lay down for infringements of SES Regulations in particular by airspace users and service providers shall be effective, proportionate and dissuasive.

#### **ANSP RESULTS – ANSP SAFETY MANAGEMENT MATURITY**

- 4.4.45 All of the 38 (en-route) ANSPs from the EUROCONTROL States answered the 2010 survey. As pointed out above 2010 is the first year of the comprehensive use of the new Safety Framework Maturity Survey methodology. Therefore, the specific objective is to establish a baseline for surveys in the subsequent years. Consequently, this year's results cannot be compared in a meaningful way to preceding years.



**Figure 4-14: Range of maturity for ANSPs in EUROCONTROL States [2010]**

4.4.46 Figure 4-14 displays the survey findings for the 11 study areas. The average rate for the individual study areas is slightly below 70% in the EUROCONTROL States, except for Study Area 3 ‘timely compliance with international obligations’, where the average reached 72%. 33 ANSPs (87%) rated themselves at level 3 (50% to 75%) or level 4 (75% to 100%). 4 ANSPs were rated at level 2 and one State at level 1. Detailed findings for the EUROCONTROL States can be found in the respective study report [Ref. 27]. Since the results are not comparable with those from past years no conclusions can be drawn on improvements since 2009. However, five ANSPs urgently require improvements.

## 4.5 Just Culture

4.5.1 Article 2(k) of Regulation EC 691/2010 [Ref. 8] defines ‘Just Culture’ as ‘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’.

### STATUS

4.5.2 PRC recommendations leading to PC decisions related to just culture date back as far as 1999 and 2002. In 2006 the PRC published a report entitled ‘Legal and Cultural issues in relation to ATM Safety Occurrence Reporting in Europe’ [Ref. 28]. The key finding of the report was that, although some progress has been made, significant legal and cultural impediments to safety reporting still exist in many States. The PRC made the findings of the report available to the Safety Regulation Unit and the EUROCONTROL Agency for further action.

4.5.3 The implementation of Just Culture across the European States will be one of the important success-factors for the performance scheme during the first reference period 2012-2014 in order to achieve confidence that open reporting of safety incidents is implemented as one of the basic elements for effective safety management. The implementation of a non-punitive and learning environment will allow for the collection of reliable and concrete safety data.



## 4.6 New system for EU Member State inspections

- 4.6.1 The optimisation of EU Member State inspections should result in a system organised around the EASA standardisation inspections and complemented by the ICAO Audits and peer reviews as amended by the EASA opinion 02/2010 [Ref. 29]. The rationale for this is outlined as follows:
- The EASA standardisation inspections are mandated by EU Regulation 216/2008 as amended by Regulation 1108/2009 [Ref. 12]. The standardisation process includes a system of follow-up of the findings;
  - The ICAO audits are the result of an international agreement;
  - Peer reviews are required by EU Regulation 2096/2005 [Ref. 30] and are included with modifications in EASA opinion 02/2010; and,
  - EUROCONTROL Member States that are not EU Member States nor EU associated States can conclude agreements with EASA, as this has been done for other domains.

## 4.7 Situation today for RP1

- 4.7.1 The European Commission, EASA and EUROCONTROL have developed proposals for metrics for the three Safety performance indicators as mandated by the Performance Regulation. They were submitted to the EC at the end of April 2011 for formal Stakeholder consultation. Some informal Stakeholder consultation has already taken place through a number of existing Stakeholder fora during the extremely short development phase.
- 4.7.2 The regulation mandates the first performance indicator to ‘be the effectiveness of safety management as measured by a methodology based on the ATM Safety Maturity Survey Framework’. The proposed conceptual design for the indicator is based on the ICAO framework for the State Safety Programme and Safety Management System as defined in the ICAO Safety Management Manual (ICAO Doc 9859) [Ref. 31]. It will make use of the existing ATM Safety Framework Maturity Survey to the greatest extent possible.
- 4.7.3 The second performance indicator is ‘the application of the severity classification of the Risk Analysis Tool to allow harmonised reporting of severity assessment of Separation Minima Infringements, Runway Incursions and ATM Specific Events at all Air Traffic Control Centres and airports with more than 150 000 commercial air transport movements per year within the scope of the Regulation’. It is proposed that the application of the severity classification of the RAT is measured as a Yes/No value of application of the RAT methodology for severity classifications of occurrences with category C or above (i.e. C, B and A), for all separation minima infringements, runway incursions and ATM specific technical events including a dedicated questionnaire for the States. Furthermore the States will continue reporting on Separation Minima Infringements, Runway Incursions and from now on also on ATM Specific Technical Events.
- 4.7.4 The third performance indicator ‘shall be the reporting of just culture’. The proposal has been constructed to respond to the criteria of being clearly defined, auditable, verifiable, repeatable and indicative of the level of Just Culture being implemented covering the main areas of (i) Just Culture policy and its implementation; (ii) legal/judiciary provisions; and (iii) occurrence reporting.

## 4.8 Conclusions

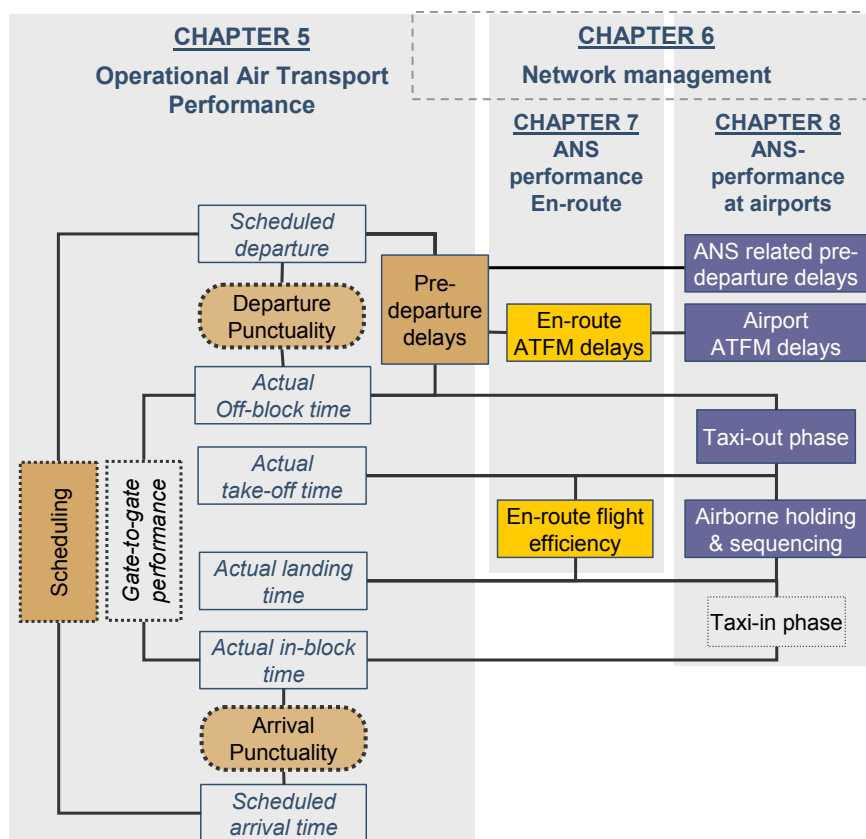
- 4.8.1 Incident reporting remains unsatisfactory in some areas of Europe. The SRC estimates that, while some 15 000 incidents are reported, as many as 30 000 incidents remain unreported. Thirty EUROCONTROL States reported in 2009, one more than in 2008. No or limited progress has been made in the remaining 8 States during the past 6 years.
- 4.8.2 Aggregated data on incidents remain provisional for up to two years due to the length of investigation and late submission of final data by some States. Moreover, the lack of consistency in reporting and assessing incidents across the EUROCONTROL States and during successive years does not permit trends to be identified confidently.
- 4.8.3 Regulatory provisions concerning the publication of investigation reports for accidents and serious incidents (Regulation (EU) No 996/2010, Articles 16.6 and 16.7 [Ref. 32]) would need (i) to be reinforced, (ii) to be applied to all EUROCONTROL States and (iii) to be extended to all reported incidents. The ratio between open and closed reports should be published by States annually and implementation of the respective recommendations should be tracked.
- 4.8.4 There is an urgent need to accelerate the deployment of automatic safety data reporting tools in Europe in order to improve the reporting culture and consequently the level of reporting. Sufficient resources are needed to validate the data properly, analyse the results and draw lessons. A single European database that meets data quality criteria is an essential enabler for effective safety analysis.
- 4.8.5 NSAs need to be provided with the requisite resources to discharge fully their safety oversight responsibilities. International safety audits, inspections and surveys of NSAs and ANSPs should be rationalised.

# Chapter 5: Operational Air Transport Performance

KEY POINTS	KEY DATA 2010		
1. Air transport punctuality in 2010 was the worst recorded since 2001 (24.2% of flights delayed more than 15 minutes vs. schedule), although traffic was below 2007 levels and traffic growth was modest.	Flights with arrival delay > 15 compared to schedule (%)	24.2%	+6.3% pt.
	Avg. delay (all causes) per flight (min.)	14.8	+38.8%
2. ANS-related delays (+32.5%) and their share in air transport delays (+7.3% points) increased significantly in 2010, primarily due to the unusual amount of industrial actions.	Flights arriving more than 15 min. ahead of schedule (%)	7.8%	-2.4% pt.
	Relative share of ANS delays in primary air transport departure delays (%) <sup>22</sup>		
3. Weather-related delays (snow, freezing conditions) were higher than usual during winter 2009 and in December 2010.	Total ANS-related delays	≈ 32.5%	+7.3% pt.
	ANS en-route delays	≈ 19.1%	+8.6% pt.
4. The ash cloud in April/May 2010 had a limited impact on punctuality as the majority of the flights were cancelled.	ANS-related airport delays	≈ 13.4%	-1.3% pt.

## 5.1 Introduction

5.1.1 The analysis of operational air transport performance is divided into four complementary chapters (Chapter 5 to 8), as outlined in the conceptual framework in Figure 5-1.

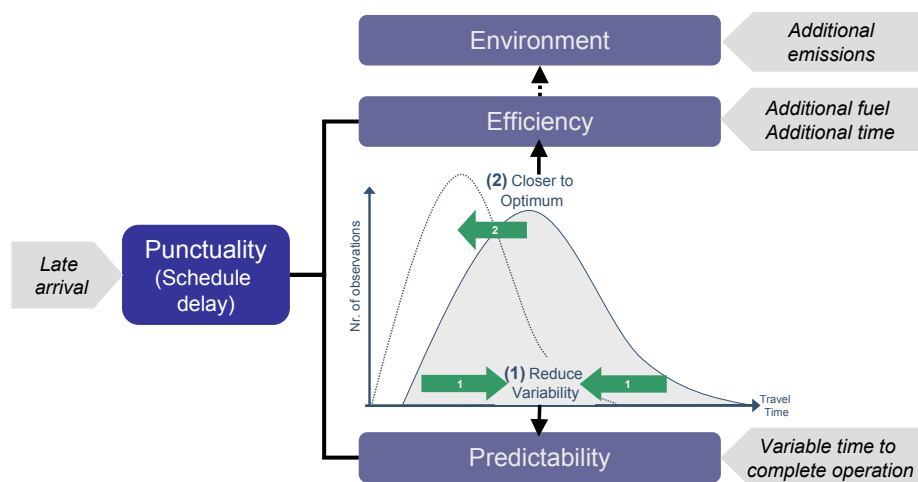


**Figure 5-1: Framework for the analysis of operational air transport performance**

5.1.2 Chapter 6 addresses the management of the European ATM network which has an important role in coordinating activities and performance at local and regional level for the benefit of the entire network.

<sup>22</sup> Only primary delays were included. Reactionary delays were not considered.

- 5.1.3 This chapter evaluates operational air transport performance (gate-to-gate) and underlying delay drivers in order to provide an estimate of the ANS-related contribution towards overall air transport performance.
- 5.1.4 The proportion of flights delayed by more than 15 minutes compared to airline schedule (punctuality) is generally used as Key Performance Indicator (KPI) for air transport performance and a relevant indicator from a passenger viewpoint.
- 5.1.5 However the inclusion of strategic time buffers in airline schedules to account for a certain level of anticipated travel time variation in order to achieve a satisfactory punctuality level makes a more detailed analysis for the evaluation of ANS performance necessary.
- 5.1.6 From an airline scheduling point of view, the "predictability" of operations months before the day of operations influences the extent to which the use of available resources (aircraft, crew, etc.) can be maximised. The lower the predictability of operations, the more time buffer (and scheduled block times) is required to maintain a satisfactory level of punctuality and hence the higher the 'strategic' costs to airspace users.



**Figure 5-2: Schedule delay, predictability and efficiency**

- 5.1.7 Figure 5-2 illustrates the interrelation between punctuality (delay vs. airline schedule) as reported by airlines, and the predictability and efficiency of actual operations.
- 5.1.8 "Predictability" measures the variation in travel times as experienced by the airspace users. It consequently focuses on the variance (distribution widths) associated with the individual phases of flight (see (1) in Figure 5-2). Reducing the variability of actual block times can potentially reduce the amount of excess fuel that needs to be carried for each flight in order to allow for uncertainties and improve the efficient use of aircraft and crews. However, due to the unpredictability of weather and operational conditions of airlines, airports and ANS, predictability is not easy to improve.
- 5.1.9 "Efficiency" generally relates to fuel efficiency or reductions in flight times of a given flight and can be expressed in terms of fuel and/or time. The analysis of ANS performance in Chapter 7 and 8 therefore compares actual travel times to "unimpeded" or "idle" reference times (see (2) in Figure 5-2) rather than to airline schedules.
- 5.1.10 As illustrated in Figure 5-2, the efficiency of operations has also an environmental impact through additional fuel burn and hence gaseous emissions. The environmental impact of ANS is discussed in more detail in Chapter 9.

- 5.1.11 The goal is to minimise overall direct (fuel, etc.) and strategic (schedule buffer, etc.) costs whilst maximising the utilisation of available en-route and airport capacity.

## INTERPRETATION OF OPERATIONAL PERFORMANCE

- 5.1.12 For the interpretation of the results of operational performance in the next chapters, the following points should be borne in mind:

- 1) Due to the stochastic nature of air transport (winds, weather) and the level of accuracy at which the system is operated today (time windows for airport slots, traffic flow management), some delay may be unavoidable or even desirable to maximize the use of scarce capacity. Hence, depending on local circumstances, not all “delay” is to be seen as negative. However, the ANS system should provide an effective queue while keeping fuel burn to a necessary minimum.
- 2) Some indicators measure the difference between the actual situation and an ideal (uncongested or unachievable) situation where each aircraft would be alone in the system and not be subject to any constraints without considering inevitable operational trade-offs, environmental or political restrictions, or other performance affecting factors such as weather conditions. This is for example the case for horizontal flight efficiency (see Chapter 7) which compares actually flown distance to the great circle distance. Other measures compare actual performance to an ideal that is based on a statistical measure of flights in the system today (see additional times in the taxi-out and ASMA phases in Chapter 8). More analysis is needed to better understand what is and can be achievable in the future.
- 3) A clear-cut allocation between ANS and non-ANS-related causes is often difficult, especially in the airport environment. While ANS is often not the root cause of the problem (weather, etc.) the way the delay is managed and distributed along the various phases of flight (i.e. distribution of delay between air and ground) has an impact on airspace users (time and fuel), the utilisation of capacity (en-route and airport), and the environment (emissions).
- 4) ANSP performance is also affected by airline operational trade-offs on each flight. The operational measures do not attempt to capture airline goals on an individual flight basis. Airspace user preferences to optimise their operations based on time and costs can vary depending on their needs and requirements (fuel price, business model, etc.).

- 5.1.13 The next section analyses the performance compared to published airline schedules which is part of the quality of service expected by airline passengers (see also framework in Figure 5-1).

## 5.2 Air Transport Punctuality

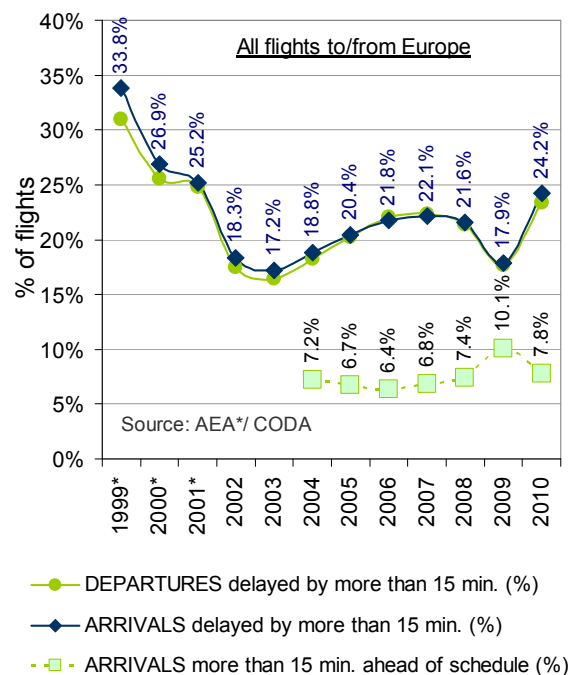
- 5.2.1 Figure 5-3 shows the share of flights delayed by more than 15 minutes compared to airline schedule between 2000 and 2010 in Europe.
- 5.2.2 European on-time performance deteriorated continuously between 2003 and 2007.
- 5.2.3 There was a slight improvement in on-time performance in 2008. There was a significant improvement in 2009, however, it needs to be seen in the context of the unprecedented drop in traffic in 2009 (-6.6% vs. 2008).

### Punctuality/ On time performance

The share of flights delayed by more than 15 minutes compared to airline schedule is the most commonly used industry standard.

There are many factors contributing to the on time performance of a flight. Punctuality is the “end product” of complex interactions between airlines, airport operators, the CFMU and ANSPs, from the planning and scheduling phases up to the day of operation. Strong network effects are expected in air transport performance.

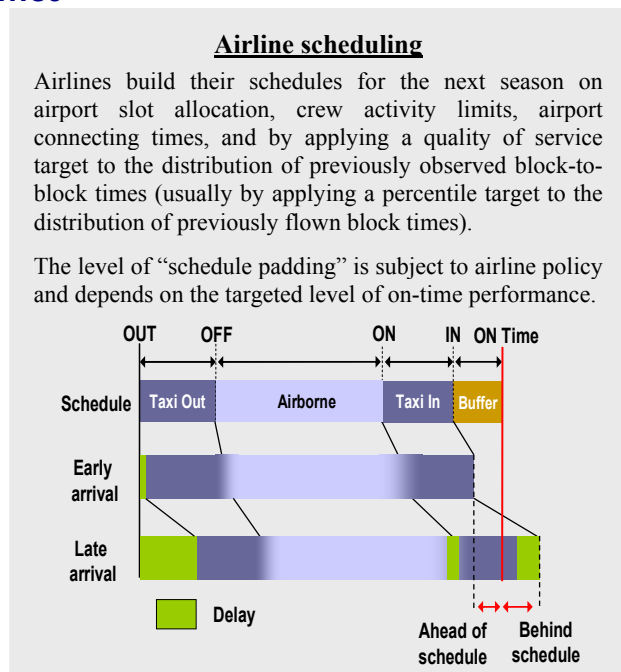
- 5.2.4 Air transport punctuality in 2010 was the worst recorded since 2001 (24.2% of flights were delayed more than 15 minutes vs. schedule) although traffic was below 2007 levels and traffic growth was modest.
- 5.2.5 The underlying drivers for the sharp increase and the contribution of ANS is analysed in more detail in Section 5.5 of this chapter.
- 5.2.6 Figure 5-3 shows also the share of “early” flights arriving more than 15 minutes ahead of schedule. For airports and ATC “early” flights are relevant as they may have a similar negative effect on capacity and resources (i.e. TMA capacity, handling resources, gate availability, etc.) as delayed flights.



**Figure 5-3: On time performance in Europe**

### 5.3 Evolution of scheduled block times

- 5.3.1 Punctuality can change as a result of improved operations but also if more strategic time buffers are included in airline schedules.
- 5.3.2 Hence, Figure 5-4 is complementary to Figure 5-3 and shows the evolution of scheduled and actual block times on Intra European flights between 2003 and 2010. Additionally, the departure delay at origin and the arrival delay at destination are shown.
- 5.3.3 The changes observed are relative to the average for the entire period (2003-2010) and enable the trends in performance over time (DLTA Metric<sup>23</sup>) to be visualised.

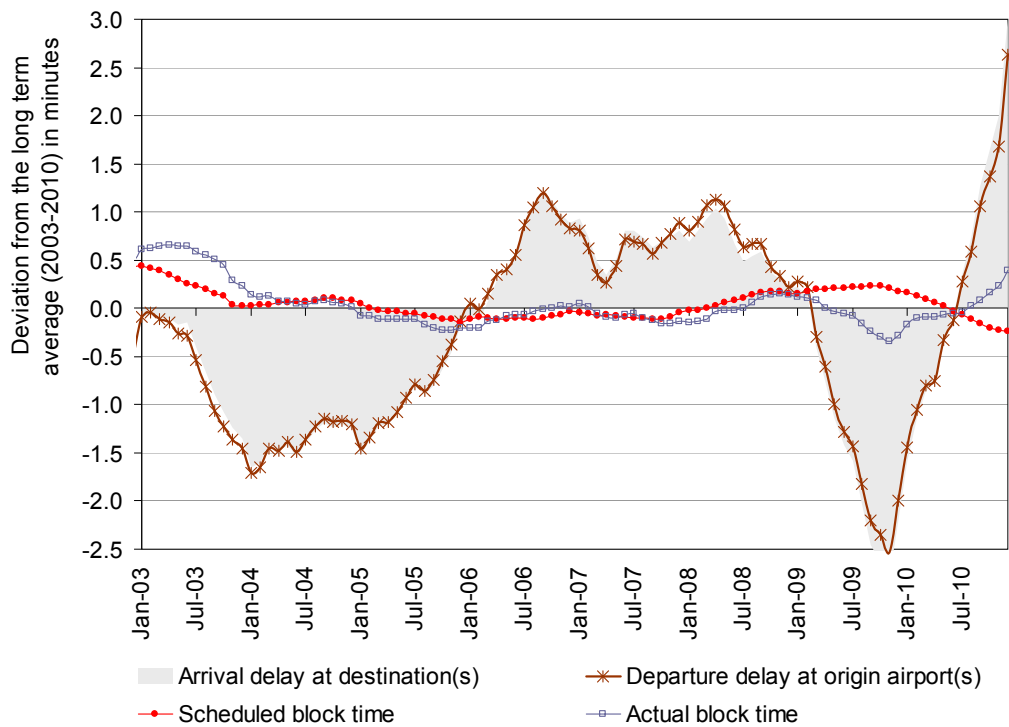


- 5.3.4 Figure 5-4 shows that overall the scheduled (red line) and actual (blue line) block times remained fairly stable between 2003 and 2010<sup>24</sup>. The low level of variation in the actual block times is partly due to the way air traffic is managed. In Europe, flights are usually held at the gates with only comparatively few constraints once they have left the gate

23 The Difference from Long-Term Average (DLTA) metric is designed to measure relative change in time-based performance (e.g. flight time) normalised by selected criteria (origin, destination, aircraft type, etc.) for which sufficient data are available. The analysis compares actual performance for each flight of a given city pair with the long term average (i.e. average between 2003 and 2009) for that city pair.

24 It should be noted that Figure 5-4 illustrates the performance at European level. The situation at airport level (taxi time, airborne holdings) or city pair level can be different. See Chapter 8 for ANS performance at airports.

[Ref. 33] (compare also Figure 5-5 in the next section).



**Figure 5-4: Evolution of scheduled block times in Europe (intra-European flights)**

- 5.3.5 Arrival delay (shown in grey) is clearly driven by departure delay at the origin airports (brown line) and only to a small extent by variations in the actual block time (taxi, en-route, airborne holdings). The drop in departure delay and actual block times in 2009 when traffic levels fell as a result of the economic crisis is noticeable.
- 5.3.6 In 2010, departure delays increased again significantly (ANS contribution is addressed in the following sections) but also the actual flown block times (taxi times, flight efficiency, terminal holdings, etc.). Scheduled block times decreased slightly in 2010 as they follow the pattern of actual block times in the previous season.

## 5.4 Predictability of air transport operations

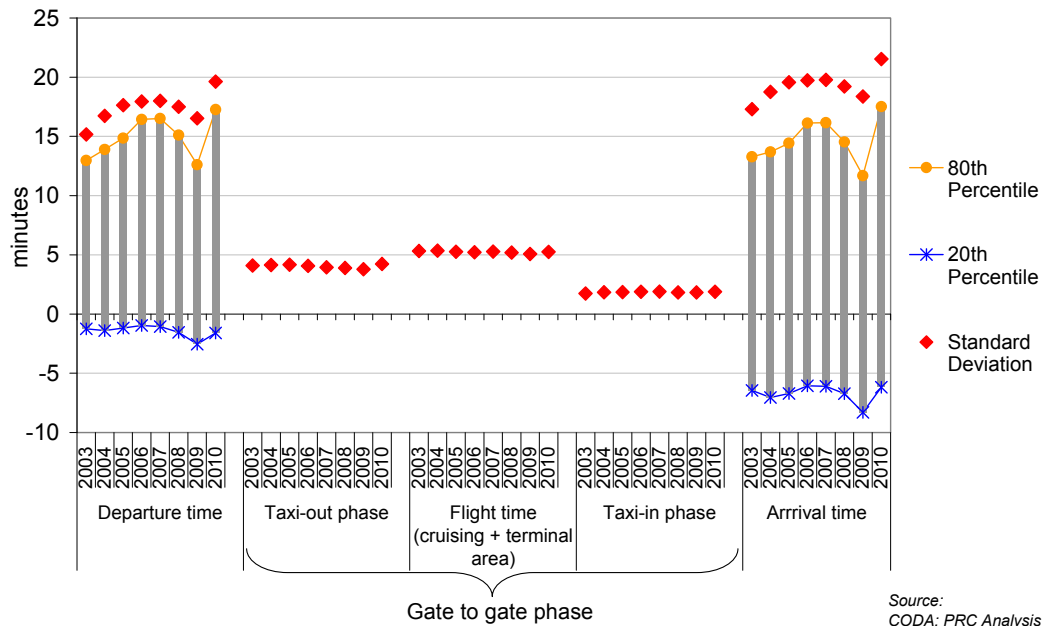
- 5.4.1 Figure 5-5 shows the variability on intra European flights<sup>25</sup> by flight phase. The band between the 80th and 20th percentile<sup>26</sup> (grey bar) shows that very few flights depart before their scheduled departure time but a considerable number of flights arrive before their scheduled arrival time. The high share of early arrivals is consistent with the observation made in Figure 5-3.
- 5.4.2 Although the gate-to-gate phase is affected by a multitude of variables including congestion (queuing at threshold and airborne holdings in terminal area), aircraft operators flight planning processes, wind and flow management measures applied by ANS, the level of variability in the gate to gate phase is small<sup>27</sup> at system level and relatively stable compared to the departure time variability (see Figure 5-5).

<sup>25</sup> Only intra European flights were considered to avoid the considerable effects of wind on long haul flights.

<sup>26</sup> In order to limit the impact from outliers, variability is measured as the difference between the 80th and the 20th percentile for each flight phase. Flights scheduled less than 20 times per month are excluded.

<sup>27</sup> Approximately 68% of the flights are within 1 standard deviation of the mean.





**Figure 5-5: Variability of flight phases on Intra European flights**

- 5.4.3 It should however be noted that the level of variability in the taxi-out phase and the level of airborne holdings in the terminal area can differ significantly between airports (see Chapter 8 on ANS performance at airports).
- 5.4.4 The main driver of arrival time variability is clearly departure delay induced at the various origin airports which is consistent with Figure 5-4 which shows a high correlation between departure delays (orange line) and arrival delays (grey bars).
- 5.4.5 Departure-time variability, and hence arrival-time variability, increased between 2003 and 2006 but showed a strong improvement between 2007 and 2009, which reflects the significant decrease in departure delay due to the reduction in air traffic starting in 2008.
- 5.4.6 Similar to on time performance in Figure 5-3, a significant increase in the level of variability originating from departure delays can be observed for 2010. The contribution of ANS toward the increase in departure delays (mainly ATFM delays) is evaluated in more detail in Section 5.5 of this chapter.
- 5.4.7 The next section provides a more detailed analysis of the drivers of departure delays in Europe and the contribution of ANS towards departure delays which were identified as the main source of variability in the European air transport network (see Figure 5-5).

## 5.5 Drivers of departure delays

- 5.5.1 The analysis in Figure 5-6 is based on airline data reported voluntarily to the Central Office for Delay Analysis (CODA). All delays reported refer to delays compared to scheduled departure times.
- 5.5.2 In order to improve overall air transport performance, a clear understanding of all causes of departure delay is needed. However, as this report

### **Central Office for Delay Analysis (CODA)**

In Europe, CODA collects data from airlines each month. The data collection started in 2002 and the reporting is voluntarily<sup>28</sup>. Currently, the CODA coverage is approximately 60-70% of scheduled flights. The data reported include OOOI

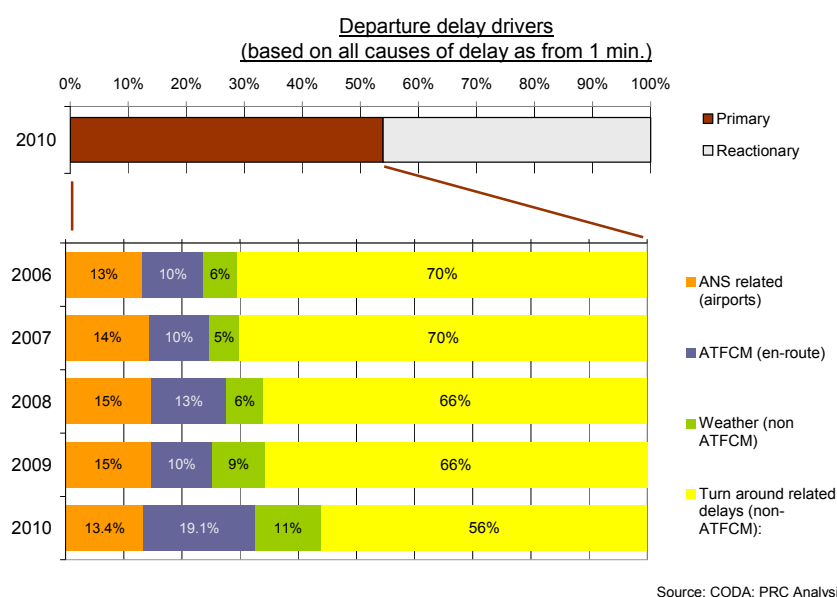
28 Air carriers operating more than 35 000 flights within the geographical scope of Regulation EU No 691/2010 are obliged to submit data as of 1<sup>st</sup> January 2011 (see also Chapter 2 of this report).

focuses on ANS performance, a thorough analysis of the complex and interrelated non ANS-related pre-departure processes is beyond its scope.

data (Gate Out, Wheels Off, Wheels On, and Gate In), schedule information and causes of delay, according to the IATA delay coding system. The reported delays refer to the scheduled departure times.

5.5.3 For a better understanding of ANS-related delays, the various delays reported to CODA were grouped into the following main categories<sup>29</sup>:

- Turn around related delays (non-ATFCM): 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.
- ANS-related delays: are primary delays resulting from an imbalance between demand and available capacity. The analysis in Figure 5-6 distinguishes between en-route (IATA codes 81, 82) and ANS-related delays at airports (IATA codes 83, 84<sup>30</sup>, 89).
- Weather-related delays (non-ATFCM): This group contains delays due to unfavourable weather conditions including delays due to snow removal or de-icing. Weather-related delays handled by ANS are not included (see previous).
- Reactionary delays are secondary delays caused by primary delays on earlier flight legs which cannot be absorbed during the turn-around phase at the airport. Due to the interconnected nature of the network, reactionary delay can propagate throughout the network and therefore have a considerable knock-on effects on subsequent flights.



**Figure 5-6: Drivers of departure delays [2007-2010]**

5.5.4 Despite the large share of almost 50% of reactionary delay, there is presently only a limited knowledge of how airline, airport and ATM management decisions affect the propagation of reactionary delay throughout the air transport network.

5.5.5 Reactionary delay is driven by primary delays. By far the main share of primary delays is related to turn around delays (airline, airport and other reasons) but there has been a significant increase in the relative share of ANS-related delays in 2010.

<sup>29</sup> The complete list of IATA delay codes is enclosed in the CODA - Public Reports at [www.eurocontrol.int/coda](http://www.eurocontrol.int/coda). Stakeholders are encouraged to contribute with complementary studies in their respective domains which will result in positive effects for the entire air transport network.

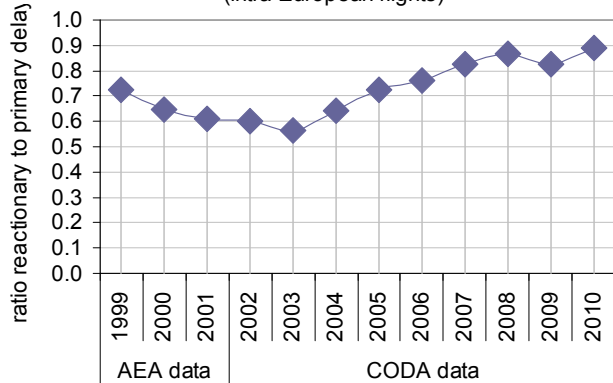
<sup>30</sup> Please note that ANS-related delays at airports also include weather related delays (IATA Code 84) which are managed by ANS (ATFM regulations and reduced acceptance rates for safety reasons due to adverse weather).

5.5.6 Figure 5-7 shows the sensitivity of the air transport network to primary delays by relating reactionary delays to primary delays.

5.5.7 For instance, a ratio of 0.8 means that every minute of primary delay generates 0.8 minutes of additional reactionary delay, on average.

5.5.8 With the exception of 2009 when there was a drop in traffic, the ratio shows a continuous increase since 2003.

Sensitivity of the European air transport network to primary delays (intra-European flights)



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

**Figure 5-7: Sensitivity of the air transport network to primary delays**

5.5.9 Reasons for changes in the sensitivity to primary delays are multi-faceted (changes in primary delay parameters, utilisation level of resources, schedule padding, airline strategies, airport CDM, etc.). Broadly, two elements determine the magnitude of delay propagation:

- 1) the primary delay parameters (i.e. time of the day, length of the delay, etc.) and,
- 2) the ability of the air transport system to absorb primary delay (i.e. aircraft and crew utilisation including scheduled block times and turnaround times, airline business model, contingency procedures, turn around efficiency at airports, effectiveness of airport CDM processes, etc.).

5.5.10 Reactionary delays are by definition a network issue and a better understanding of the contribution of airports, airlines and ANS towards those network effects and possible measures to mitigate those effects would be desirable, particularly with a view to the network manager that will be established under the SES II initiative. However such a study is complex as it requires linking the individual legs of aircraft (i.e. linking gate-to-gate and turn around phases of aircraft) at European scale.

#### **ANS CONTRIBUTION TOWARDS PRIMARY DELAYS**

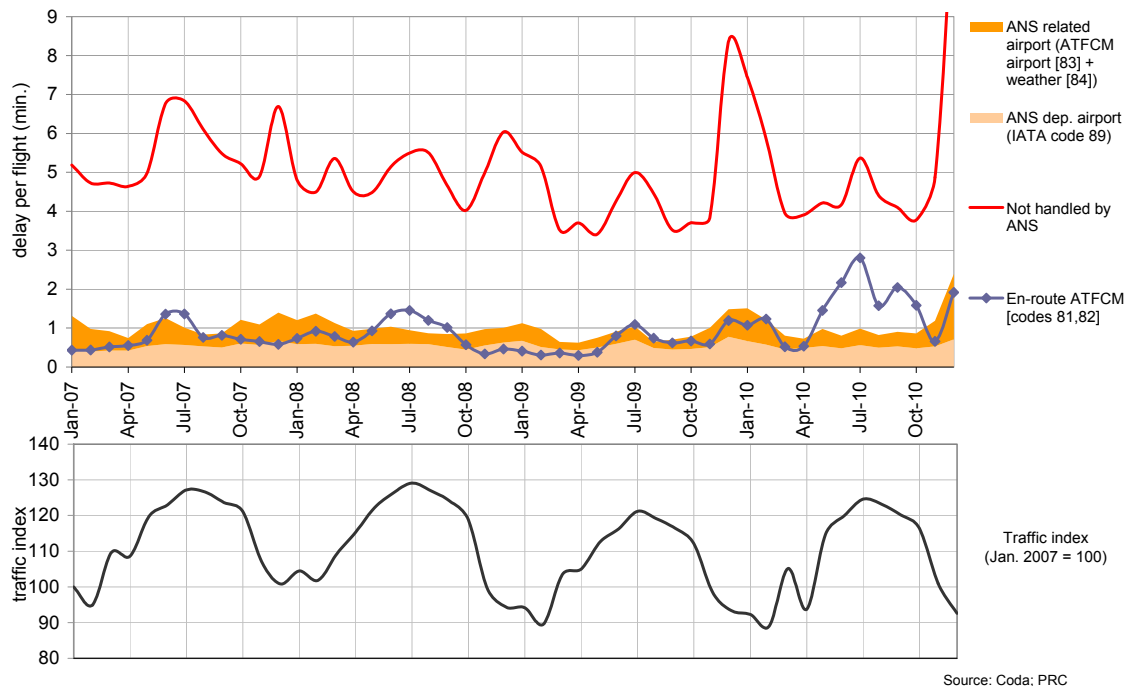
5.5.11 ANS-related delays (including weather related delays handled by ANS) increased by approximately +7.3% points compared to the previous year and accounted for some 32.5% of all primary departure delays in 2010.

5.5.12 Complementary to Figure 5-6, a more detailed monthly breakdown of ANS-related primary delays is shown in Figure 5-8. While the largest share of departure delays still originates from areas not handled by ANS (i.e. turn-around, etc.), there has been a dramatic increase of the relative share of ANS-related delays in 2010.

5.5.13 Figure 5-8 shows a monthly breakdown of the ANS-related delay groups compared to the other primary delay between 2007 and 2010. There are some interesting points to note from Figure 5-8:

- Seasonal patterns with an increase of en-route ATFM delays in summer when traffic levels are high are clearly visible;
- There was a significant increase in en-route ATFM delays in 2010, primarily due to industrial actions, despite traffic still below 2007 levels;
- While there was a notable drop in traffic due to the ash cloud in April/May 2010, the impact was more in terms of cancellations (see also Chapter 3) than in terms of delay;

- The significant increase in non ANS-related delay (red line) and ANS-related airport delays (orange) during winter 2009 and in December 2010 is mainly due to unusually severe weather conditions and associated effects on performance.



**Figure 5-8: ANS-related primary delays between 2007 and 2010**

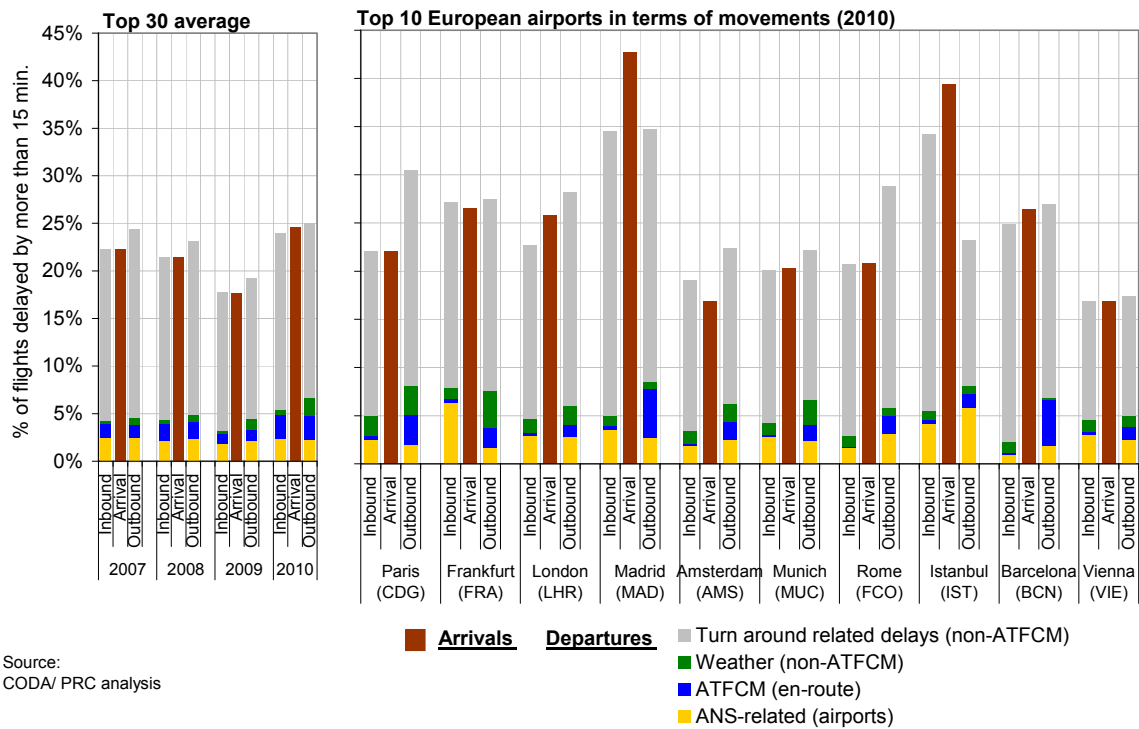
5.5.14 The system wide on-time performance is the result of contrasted situations among airports. While a detailed analysis of ANS-related performance at the top 30 European airports is provided in Chapter 8, Figure 5-9 illustrates overall air transport performance at the top 10 airports in 2010 showing:

- departure punctuality on inbound flights including underlying delay drivers (i.e. delays were experienced at the various origin airports);
- arrival punctuality on inbound flights; and,
- departure punctuality on outbound flights including departure delay drivers (i.e. delays experienced at the analysed airport).

5.5.15 At some airports there is a notable difference between departure and arrival punctuality on the inbound flow which is the result of time variations in the gate-to-gate phase (i.e. taxi out, en-route, airborne holding, and taxi-in).

5.5.16 The difference between the arrival punctuality (inbound) and the departure punctuality on outbound flights is mainly affected by local turn-around performance but also by ANS constraints which require aircraft to wait at the gate at origin airports.

### Punctuality at the main European airports by delay group



**Figure 5-9: Air transport performance at European airports**

5.5.17 Complementary to the analysis of ANS-related delays reported by airlines to CODA, the analysis in Figure 5-10 shows a breakdown of ATFM delays<sup>31</sup> measured by the CFMU.

5.5.18 While ATFM delays correspond only to a portion of the total delay perceived by the passengers (see ANS-related delays in Figure 5-6), they can be accurately and consistently measured across the European network, because they are centrally managed by the CFMU. The ATFM delays calculated by the CFMU will also be used for ANS performance measurement within the SES performance scheme.

5.5.19 ATFM delays can be due to capacity constraints where ANS is the root cause (i.e. capacity, staffing, ATC equipment, etc.) but also due to other constraints (i.e. weather problems, military training, etc.) where the situation was handled by ANS. For analysis purposes the delay reasons are usually reorganised in larger ATFM delay groups.

#### ATFM delays

In Europe, when traffic demand is anticipated to exceed the available capacity in en-route centres or at airports, Air Traffic Control (ATC) units may call for an Air Traffic Flow Management (ATFM) regulation

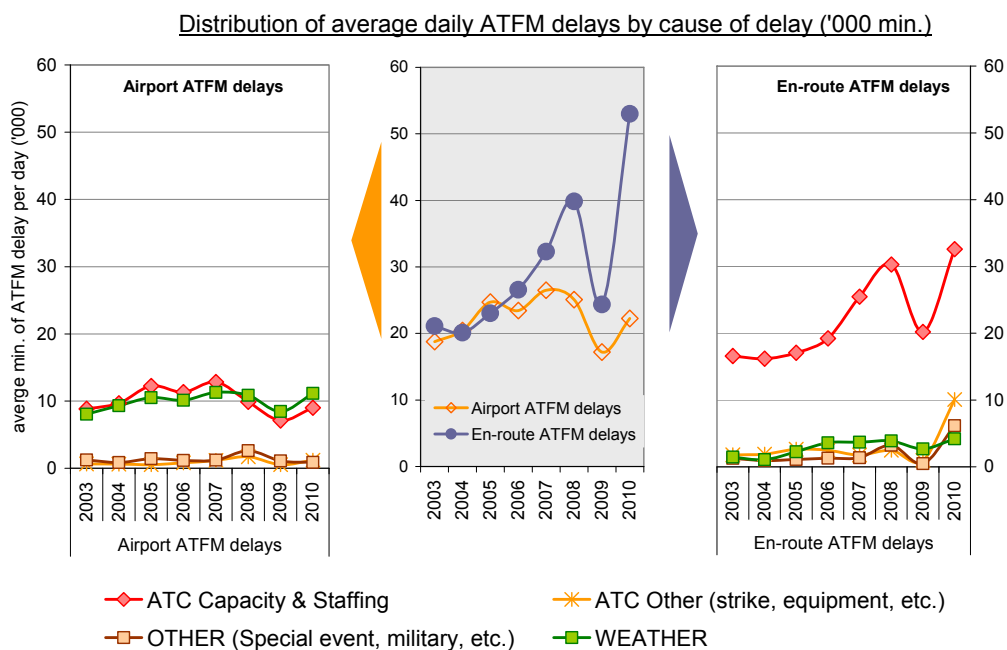
Aircraft expected to arrive during a period of congestion are held upstream at the departure airport by the CFMU until the downstream en-route or airport capacity constraint is cleared.

The delays are calculated with reference to the times in the last submitted flight plan and the reason for the regulation is indicated by the responsible Flow Management Position (FMP). The delay is attributed to the most constraining ATC unit.

5.5.20 En-route and airport ATFM delays were almost evenly split between 2003 and 2006 but the en-route related share has been growing, particularly in 2010.

5.5.21 There was a sharp increase in en-route ATFM delays in 2010 but only a small increase in airport ATFM delays, which is consistent with the findings in Figure 5-6 and Figure 5-8.

<sup>31</sup> Note that the ATFM delays reported by the CFMU relate to the flight plan while the delays reported by airlines to CODA relate to the published scheduled departure time.



**Figure 5-10: Distribution of average daily ATFM delays by cause of delay**

5.5.22 En-route delays are driven almost entirely by ATC capacity and staffing related constraints (see right side of Figure 5-10). En-route ATFM delays are analysed in more detail in Chapter 7 ANS performance en-route.

5.5.23 While the majority of en-route ATFM delays are under the direct control of ANS, the situation is more complex in the airport environment where weather delays managed by ANS play a much larger role. Airport ATFM delays are analysed in more detail in Chapter 8 ANS performance at airports.

## 5.6 Conclusions

5.6.1 Air transport punctuality in 2010 was the worst recorded since 2001 (24.2% of flights delayed more than 15 minutes vs. schedule) although traffic was below 2007 levels and traffic growth was modest.

5.6.2 The main causes of this poor performance are as follows:

- ANS-related delays (+32.5%) and their share in air transport delays (+7.3% points) increased significantly in 2010, primarily due to industrial actions; and,
- weather-related delays (snow, freezing conditions) were higher than usual during winter 2009 and in December 2010.

5.6.3 The volcanic ash cloud in April/May 2010 had a limited impact on punctuality, as the majority of the flights were cancelled.

5.6.4 Departure delays remained the principal drivers of arrival punctuality and predictability, with relatively small flight time variations in the gate-to-gate phase.

# Chapter 6: Network Management

KEY POINTS	KEY DATA 2010		
1. The creation of the Central Flow Management Unit (CFMU) in 1994 was a major step forward towards improved air transport network performance, as far as ATFM is concerned.	ATFM slot adherence (% of take offs outside the allocated ATFM window)	15%	-1.9%pt.
2. In the current ATM organisation, EUROCONTROL already performs a number of essential operational support functions for the European ATM network.	ATFM over-deliveries (% regulated hrs. with actual demand/ capacity >110%)	9.3%	-2.6%pt.
3. The evolution towards the more comprehensive Network functions defined in SES II legislation, and their application in the full EUROCONTROL area, are crucial for improved network performance, and should be effectively supported by all stakeholders.	Avoidable ATFM regulations (% of delays due to regulations with no excess demand)	11.1%	+3.3%pt.

## 6.1 Introduction

- 6.1.1 Network Management is seen as a fundamental enabler for the safe and efficient provision of services in the European ATM network as it is considered to play a vital role in the coordination with stakeholders, for the optimisation of the European ANS and further integration of airports into the ATM network.
- 6.1.2 Network Management should be established for the benefit of all States in the European ATM network, EU and EUROCONTROL Member States, and offered to all States exchanging significant flows of traffic with the European ATN network.
- 6.1.3 In the current ATM organisation, the essential function of managing the air traffic flows and co-ordinating the network design is already performed centrally by EUROCONTROL in close co-operation with the ANSPs. The need for such a function has been once more highlighted during the volcanic ash crisis in April/May 2010. EUROCONTROL is also involved in the management of frequencies, in support to ICAO.
- 6.1.4 This chapter addresses the management and performance of the European ATM network today and illustrates how the development of a formal Network function<sup>32</sup> through EU legislation - a key component of SES II (see Chapter 2), is expected to further enhance performance for the benefit of the entire European ATM network.

## 6.2 Managing today's ATM network

- 6.2.1 With thousands of airspace users, hundreds of airports and more than 250 ANSPs in the European air transport network, the risk of operational and environmental inefficiencies (e.g. delays, route extension) would be high in the absence of a central Network function.
- 6.2.2 As illustrated in Figure 6-1, network management takes a central position in the European ATM system. It has a supportive role and contributes in a collaborative partnership with stakeholders, towards the achievement of wider performance improvements.

<sup>32</sup> The Network function to be established in the context of the SES initiative only applies to EUROCONTROL States which are subject to the relevant EC regulations.



6.2.3 The network management role is comparable to the role of a “supply chain manager” which optimises – in close co-operation with stakeholders - the operational performance for the benefit of the entire network.

6.2.4 This requires a continuous evaluation of user needs and expectations and facilitates, in a collaborative partnership, all elements and contributions required to match capacity and demand being delivered by the stakeholders at the right time and place, in the appropriate quantity and quality, at an acceptable cost and without impairing safety.

6.2.5 In the current ATM organisation, EUROCONTROL already performs a number of essential network functions. In order to ensure optimal management of the entire European ATM network, it will be important to maximise synergies between EUROCONTROL activities and the Network functions established under the Single European Sky.

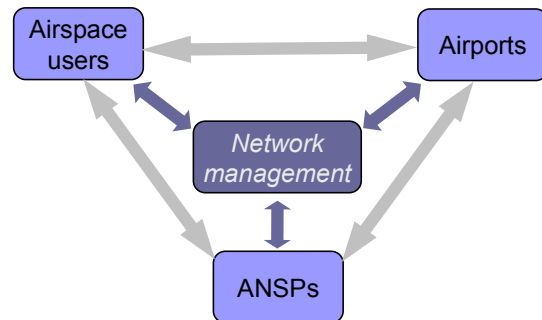
6.2.6 The evolution of the current ATFM and Network Design functions of EUROCONTROL towards the Network functions of SES II is crucial for the future, and should be effectively supported by all stakeholders.

6.2.7 In order to adapt to the changing business environment and to provide a separation between service provision and regulation, two new Directorates were established within the EUROCONTROL organisation:

- The Directorate Single European Sky serves as the focus for regulatory support activities to the European Commission and EASA, alongside the continuing work in support of all EUROCONTROL Member States.
- The Directorate Network Management contains activities which provide services to ANSPs, airspace users and airports or which support the service provision activities of the industry at pan-European level.

6.2.8 As it is building on and reinforcing its existing activities, it is expected that EUROCONTROL will accept to be entrusted with the SES Network functions. These functions include a number of strategic (initiate the right things: 5-10 years), planning (do the things right: <5 years) and tactical tasks. Broadly they can be divided into four different groups:

- Improvement and optimisation of the European Network;
- Coordination of Scarce Resources;
- Air Traffic Flow Management, slot coordination and allocation; and,
- Assist in the planning, coordination and deployment of technologies:



**Figure 6-1: Central role of network management**

#### Network management in SES

The legal basis for the Network functions is provided in Article 6 of the revised airspace regulation [Ref. 10].

Designated by the EC (Art. 6.2), an impartial and competent body responsible for the optimum use of airspace including the design of the European route network and coordination of scarce resources within aviation frequency bands used by general air traffic, in particular radio frequencies and radar transponder codes.

Designated by the States (Art. 6.6), an impartial and competent body responsible for Air Traffic Flow Management (ATFM).

The Commission may add to the list of Network functions after consultation of stakeholders.

In this context, two implementing rules (IR) are of particular relevance:

- (i) Commission Regulation (EU) No 255/2010 laying down the common rules on air traffic flow management and
- (ii) the IR laying down the detailed rules for the implementation of the Network functions, which was agreed by the SSC on 15 February 2011.

6.2.9 Figure 6-2 provides an overview of tasks given entrusted to the Network under the SES and relates them to current EUROCONTROL activities.

	Tasks entrusted to the Network functions under the SES	Current EUROCONTROL activities
European Network design	<ul style="list-style-type: none"> <li>• Develop, in collaboration with States, an improvement plan for the European Network (independent of national boundaries, but taking MIL requirements into account);</li> <li>• Ensure that national/FAB airspace design solutions are consistent with European network efficiency requirements to optimise user trajectories;</li> <li>• Establish a medium and long term capacity plan based on the best possible forecast and identify bottlenecks in the network;</li> <li>• Ensure, in a collaborative partnership with ANSPs, that capacity plans match the forecasts, and that capacity delivery is adapted to match actual demand;</li> <li>• Identify and mitigate safety hotspots and conduct analyses of the safety implications of proposed network improvements.</li> </ul>	<ul style="list-style-type: none"> <li>• Provision of STATFOR traffic forecasts;</li> <li>• Capacity enhancement function (CEF): promoting cohesive, timely, capacity planning and provision, in close co-operation with stakeholders, at European ATM network and local level;</li> <li>• Improvement of European route network design (coordination of ARN on behalf of ICAO) and implementation of the DMEAN Framework Programme (FP).</li> </ul>
Coordination of scarce resources	<ul style="list-style-type: none"> <li>• Coordination of scarce resources, such as radio frequencies and transponder codes, through a centralised inventory of these resources, with a view to optimising their use and satisfying operational requirements;</li> </ul>	<ul style="list-style-type: none"> <li>• Frequency management on behalf of ICAO;</li> <li>• Centralised SSR Code Assignment and Management System.</li> </ul>
Air traffic flow management	<ul style="list-style-type: none"> <li>• Allocate ATFM slots as a function of the “required time of arrival” to improve predictability of operations;</li> <li>• In close cooperation with national FMPs and FABs, manage ATFCM for Europe, adjust and organise the flows of traffic, manage events and crisis in ATM;</li> <li>• Reduce constraining procedures and airspace restrictions to a necessary minimum;</li> <li>• Manage special events and crises on behalf of stakeholders;</li> <li>• Better integration of the airport dimension (A-CDM) in the capacity planning and management process to increase overall efficiency and to share dynamic traffic information with the network;</li> <li>• Provide support to ensure consistency between ATFM and airport slots.</li> </ul>	<ul style="list-style-type: none"> <li>• Central Flow Management Unit (CFMU);</li> <li>• Airport Operations Programme (AOP): assisting stakeholders in airport airside capacity analysis and enhancement; Airport Collaborative Decision Making (A-CDM); Surface movement optimisation and runway safety.</li> </ul>
Deployment of technologies	<ul style="list-style-type: none"> <li>• Materialize the potential added value from SESAR developments through synchronised deployment.</li> <li>• Support and coordination of operational/technical deployments of ATM/CNS improvement enablers (Network technical enablers).</li> </ul>	<ul style="list-style-type: none"> <li>• Coordination of deployment of major European projects, such as RVSM, TCAS, 8.33, EAD, PENS, etc.</li> </ul>

**Figure 6-2: SES Network functions and current EUROCONTROL activities**

6.2.10 The SES performance scheme provides for the “periodic review, monitoring and benchmarking of ANS and network functions (Art 11.1c)”. However, no binding targets on Network functions performance are to be set for the first reference period.

6.2.11 Although the EC regulation does not apply to all EUROCONTROL Member States, such a performance based approach will benefit the entire European ATM network. The following section briefly addresses the current assessment of Network Management performance.

### 6.3 Network Management performance assessment

- 6.3.1 The Network Manager's (NM) performance would need to be assessed on its ability to perform the role of the supply chain manager for the European ATM network (i.e. its ability to coordinate individual deliveries of all stakeholders timely; to match capacity with demand whilst increasing safety and flight efficiency; and reducing costs).
- 6.3.2 However, the main issue to be overcome in this context is the accountability of the NM in its various entrusted tasks which are to a large extent based on collaboration and partnership making a clear assignment of accountabilities difficult (i.e. airspace remains subject to national sovereignty).
- 6.3.3 Establishing a performance scheme for the NM should not impair the provision of NM support to non-EU and non-EUROCONTROL States.
- 6.3.4 While the Network functions are expected to play an important role in the achievement of the EU-wide operational performance targets (i.e. flight efficiency<sup>33</sup>, capacity<sup>34</sup>, etc.), the delivery of performance rests ultimately with the individual stakeholders (FABs, ANSPs, airports, aircraft operators, military organisation).
- 6.3.5 In the same way, the NM supports stakeholders (ANSPs, airspace users, airports) to help them achieve the national/FAB targets. The Network function's success will depend to a large extent on the cooperation and support of the same stakeholders.
- 6.3.6 For the aforementioned reasons, the definition of a clear set of indicators measuring European the NM performance is complex. Suitable indicators need to be developed and tested to gain visibility and experience on these matters, before an adequate performance framework is designed, including high level KPIs to be used to set performance targets for and monitor the performance of the NM performance from 2015 onwards.

#### CURRENT EUROPEAN AIR TRAFFIC FLOW MANAGEMENT PERFORMANCE MONITORING

- 6.3.7 This section illustrates three indicators that are presently in use for the evaluation of European ATFM performance coordinated by the CFMU today. ATFM measures are put in place to protect en-route sectors or airports from receiving more traffic than the air traffic controllers can safely handle (declared ATC capacity).
- 6.3.8 Accurate flight plan information and flight plan adherence are essential for the functioning of the air transport network. Changes which are not communicated properly result in inaccurate traffic predictions en-route and for the destination airport, which in turn may lead to an under-utilisation of capacity, or excessive workload for controllers, which can be a safety issue.
- 6.3.9 The following three indicators are used for an overall assessment of ATFM performance:
- ATFM slot adherence;
  - ATFM over-deliveries; and,
  - Avoidable ATFM regulations.

#### **ATFM performance assessment**

Regulation (EC) No 255/2010 [Ref. 34] of 25 March 2010 laying down common rules on air traffic flow management aims at optimising the available capacity of the European air traffic management network (EATMN) and enhance air traffic flow management (ATFM) processes by establishing requirements for ATFM.

It requires, inter alia, the central unit for ATFM to

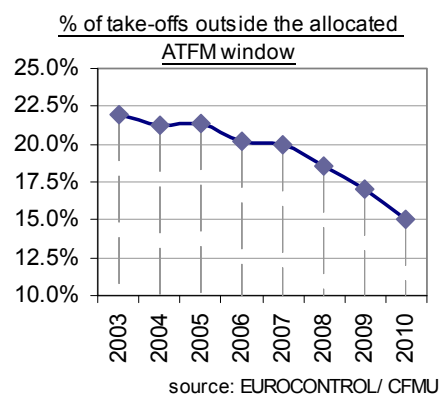
33 In the absence of mandatory local environment targets in RPI, the Network functions are expected to play a key role to ensure that the EU-wide target for environment is achieved.

34 The reference values for the assessment of national/FAB targets were provided by the capacity planning process of EUROCONTROL in accordance with the performance scheme implementing rule.

6.3.10 Additionally, ATFM delays and underlying causes are analysed in more detail in Chapters 7 and 8.

produce annual reports indicating the quality of the ATFM in the airspace of the Regulation including causes of ATFM measures, impact of measures and adherence to ATFM measures.

6.3.11 Figure 6-3 shows European ATFM slot adherence between 2003 and 2010. While a continuous improvement is notable, there is still scope for improvement. In 2010, 15% of ATFM regulated flights departed outside the allocated ATFM window (-1.9% pt. vs. 2009). The ATFM slot adherence at airport level is addressed in more detail in Chapter 8.



**Figure 6-3: ATFM slot adherence**

#### **ATFM slot adherence**

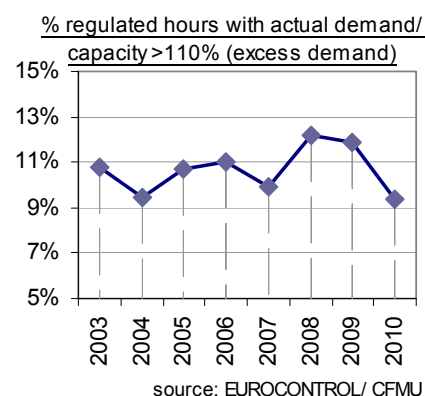
ATFM slot adherence measures the share of take-offs outside the allocated ATFM window.

An ATFM slot tolerance window (-5min +10 min) is available to ATC to organise the departure sequencing.

ATC at the respective departure airport has a joint responsibility with aircraft operators to make sure that the aircraft depart within the allocated ATFM window in order to avoid over-deliveries.

6.3.12 Of similar importance for the network is the adherence to filed flight plans (FPL), and initiatives to better monitor and improve flight plan adherence should be further encouraged.

6.3.13 Initial outcomes of the Flight Level Adherence Days Trial held, initiated, and coordinated by EUROCONTROL (DMEAN FP) on 30 September - 1 October 2010, as part of the Flight Plan and ATFCM Adherence Campaign, are encouraging and suggest positive effects for the CFMU forecast of tactical traffic as well as significant potential for capacity improvements as a result of the higher level of adherence to plan [Ref. 35].



**Figure 6-4: ATFM over-deliveries**

#### **Over-deliveries**

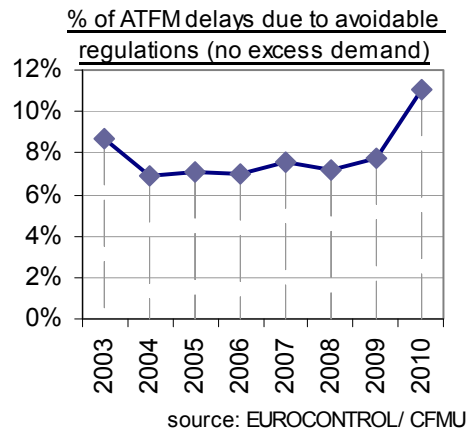
Over-deliveries occur when more aircraft than planned enter a protected sector exceeding the regulated capacity by more than 10%. The share of regulated hours with over-deliveries should be reduced as much as possible to improve confidence in the system (some ATS providers reserve up to 10% to account for possible over-deliveries) and to protect controllers from excessive workload. Over-deliveries can have various reasons including:

- deviation from the initially requested FL;
- deviation from the initially requested route;
- departing at times different from flight plan or the allocated ATFM slot; and,
- deviation from the ground speed initially planned.

6.3.14 Figure 6-4 shows the share of ATFM over-deliveries between 2003 and 2010. With the exception of 2004 and 2007, over-deliveries showed an increasing trend. 2010 showed a substantial reduction to 9.3%, which is a notable positive development.

6.3.15 Figure 6-5 shows the share of ATFM delay due to “avoidable” regulations between 2003 and 2010. In 2010 the share of ATFM regulations considered to be avoidable increased considerably. Approximately 11% of the ATFM delay was considered to be avoidable because there was no excess of demand. It reflects the fact that ANSPs tend to publish

“defensive” regulations in order to cope with potential over-deliveries due to non-adherence to slots and flight plans.



**Figure 6-5: Avoidable ATFM regulations**

#### **Excess use of ATFM regulations**

The use of ATFM regulations is avoidable when there is no excess of demand.

However, the decision to call for an ATFM regulation depends on the level of information available at the time when the decision needs to be taken (i.e. at least two hours before the anticipated capacity shortfall to be effective).

Hence the accuracy of the traffic and MET forecast two or more hours before the actual event is crucial for the decision making process and should be improved as much as possible.

## **6.4 Conclusions**

- 6.4.1 EUROCONTROL already performs essential operational support functions for the European ATM network, which are expected to be reinforced by the “ATM Network functions” being established under the SES.
- 6.4.2 The Network functions are expected to play an important role in the achievement of operational EU-wide performance targets (i.e. ENV/flight efficiency, Capacity), together with co-ordinated actions of individual stakeholders (FABs, ANSPs, airports, aircraft operators, military organisations).
- 6.4.3 The Network functions are also expected to give advance warning on changes in traffic trends and in working with ANSPs to ensure that capacity plans and delivery are adapted to match actual demand.
- 6.4.4 The PRC plans to extend the review and monitoring of the Network functions performance specified under the SES to the entire European ATM network.
- 6.4.5 In view of the complex links between the Network function, ANSPs, airports and users’ performance on the overall network performance, suitable Network Management performance indicators need to be developed and tested before any target can be set for the second reference period (RP2: 2015-2019).

# Chapter 7: Operational En-route ANS Performance

KEY POINTS	KEY DATA 2010		
1. Despite only a moderate traffic growth of 0.8% in 2010, en-route ATFM delay more than doubled from 1.2 to 2.8 minutes per flight in summer 2010 which is the highest level since 2001, and almost three times higher than the agreed PC summer delay target.	Total en-route ATFM delays (min.)	19.4M	+119%
	Summer en-route ATFM delay per flight (min.)	2.8	+ 134%
	Average en-route ATFM delay per flight (min.)	2.0	+ 117%
2. The impact of the ash cloud in April/May was small in terms of delays because flights were cancelled instead of delayed.	Flights delayed > 15 min. en-route (%)	5.2%	+2.6% pt.
	Share of capacity and staffing related delays	61.5%	-21.5% pt.
3. The high delay increase in France (35.4% of total en-route delay) and Spain (17.1%) was to a large extent related to tensions between ATC staff and management. The high delay in Germany (19.2%) was related to the implementation of the VAFORIT system.	Avg. additional km/flight	49.1	+1.6km
	Avg. horizontal en-route extension (+TMA interface)	5.5%	.
	Direct en-route extension	3.8%	+ 0.1% pt.
4. The South-East axis (Austria, Croatia, Greece and Cyprus) remains of major concern and the situation is further exacerbated by high traffic growth in some of the areas.	<i>En-route design</i>	3.8%	- 0.1% pt.
	<i>Route utilisation</i>	0.7%	+ 0.1% pt.
	<i>ATC routing</i>	-0.7%	+ 0.1% pt.
5. Despite further en-route design related improvements, the horizontal en-route extension increased in 2010 which was due to a degradation in route utilisation (ash cloud and strikes) and less direct routeings being provided by ATC on a tactical basis.			

## 7.1 Introduction

- 7.1.1 The analysis by phase of flight (en-route, TMA & airport) enables accountabilities and trade-offs to be viewed more clearly. Hence, building on the framework outlined in Chapter 5, this chapter analyses the operational performance of en-route ANS (ATFM delays, flight efficiency, access to and use of airspace). Chapter 8 analyses ANS operational performance in the TMA and at airports.
- 7.1.2 The environmental impact of flight efficiency, and trade offs between the different flight phases, are addressed in the Environmental assessment in Chapter 9. The economic impact of, and trade offs between, en-route capacity (route charges), ATFM delays and en-route flight efficiency are addressed in Chapter 11.

## 7.2 En-route ATFM delays

- 7.2.1 This section reviews Air Traffic Flow Management (ATFM) delays originating from en-route capacity restrictions.

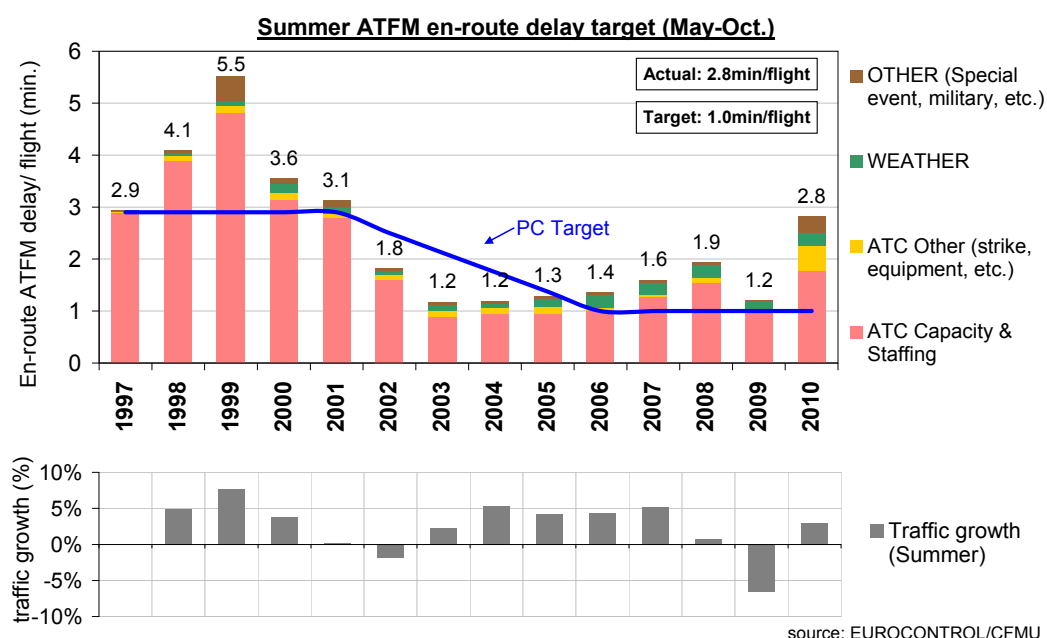
### EUROPEAN ATFM EN-ROUTE DELAY TARGET

- 7.2.2 The European target for en-route ATFM delay is one minute per flight until 2010 (PC, 2007). This target refers to the summer period (May to October), all delay causes included (capacity, weather, etc.).
- 7.2.3 It is important to note that the EU-wide capacity target within the SES II performance scheme (see Chapter 2) will apply to the 27 EU States, Norway and Switzerland from the first reference period (RP1 2012 - 2014) onwards.
- 7.2.4 Different from the current PC en-route ATFM delay target in summer, the Capacity target within the SES performance scheme relates to the full year.



7.2.5 Acknowledging the importance of consistency between SES and EUROCONTROL performance targets, the PC in December 2010 agreed in principle to the adoption of pan-European targets valid until 2014. The PRC is developing proposals for targets which were submitted to the 35<sup>th</sup> Session of the Provisional Council (May 2011).

7.2.6 Figure 7-1 shows the actual performance compared to the PC summer en-route ATFM delay target between 1997 and 2010.



**Figure 7-1: Summer ATFM en-route delay target**

7.2.7 The level of en-route ATFM delay more than doubled from 1.2 to 2.8 minutes per flight which is almost three times higher than the agreed PC en-route summer target and the highest level of delay since 2001.

7.2.8 Although traffic growth in summer 2010 was +3.1% compared to 2009, the severe degradation of performance in summer 2010 needs to be seen in the context of an overall traffic level which was still below 2007 levels. The underlying reasons for the severe degradation in summer 2010 were manifold and are explored in more detail in a later section of the chapter.

7.2.9 Complementary to Figure 7-1, the evolution of effective capacity<sup>35</sup> and air traffic demand in each summer between 1990 and 2010 for the area coordinated by the CFMU is shown in Figure 7-2.

7.2.10 As can be seen in Figure 7-2, the degradation of performance in 2010 is the result of two opposite trends. While there was traffic growth of +3.1% in summer 2010, there was a clear drop in the deployment of capacity which resulted in a strong increase in en-route ATFM delay per flight in summer 2010 (+134% vs. 2009).

7.2.11 It is important to note that traffic and capacity levels are still below 2007 levels where delays were lower, which confirms that the level of en-route delays is not an issue of feasibility but of timely deployment of capacity.

7.2.12 In most cases where capacity was not deployed, the main reasons were related to staff

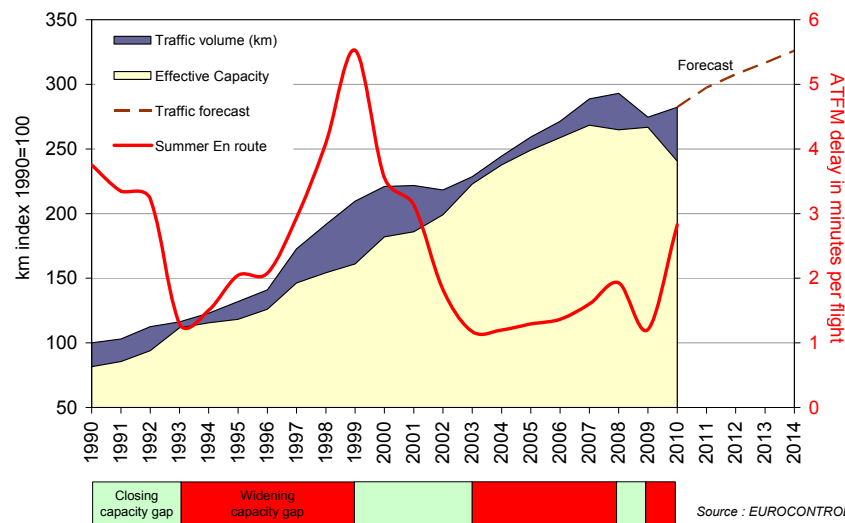
<sup>35</sup> The effective capacity is defined as the traffic which can be handled, given an average ATFM en-route delay of 1 minute per flight in summer (cf. PRR 5 (2001), Annex 6).



availability, social tensions and strike (which is not a genuine capacity issue), less than optimum sector opening schemes, staff utilisation and adaptation of sector opening schemes to demand. Furthermore, capacity was temporarily reduced due to the implementation of new ATC systems and subsequent training needs (i.e. VAFORIT).

7.2.13 Figure 7-2 clearly underlines the importance of forward looking capacity planning which results in the deployment of sufficient capacity at the right time.

7.2.14 Due to the non-linear relationship between capacity and delay, very high levels of ATFM delay can be observed in periods where the deployment of additional capacity lagged behind demand. The resulting capacity gaps are difficult to close in times with a high continuous traffic growth.



**Figure 7-2: Matching effective capacity and air traffic demand**

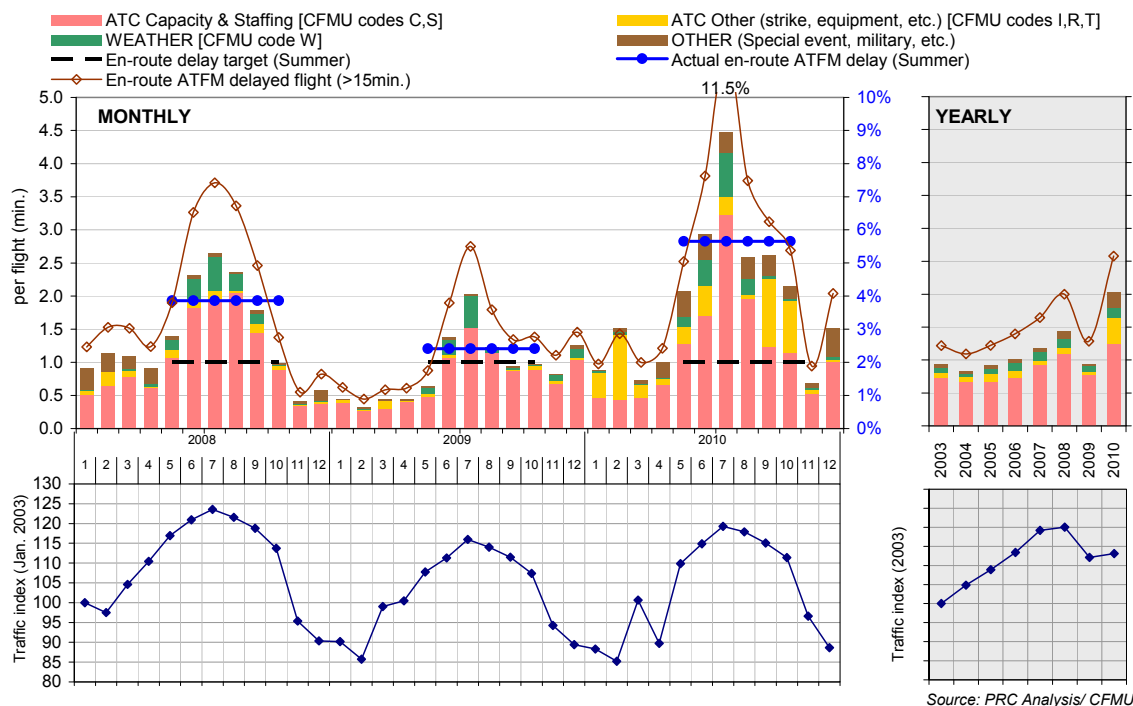
7.2.15 Notwithstanding the uncertainties associated with the recovery from an unprecedented economic downturn, it is important to keep a forward looking and proactive approach to capacity planning in order to close existing capacity gaps and to accommodate future traffic growth, as capacity enhancement initiatives have a certain lead time to take effect. Capacity planning and ACCs envisaging the implementation of new ATM systems are addressed in more detail further on in this chapter.

#### EUROPEAN ATFM EN-ROUTE PERFORMANCE

7.2.16 Figure 7-3 shows the evolution of en-route ATFM delays in Europe between 2003 and 2010. ATFM delays can be due to capacity constraints where ANS is the root cause (i.e. capacity, staffing, ATC equipment, etc.) but also due to other constraints (i.e. weather problems, military training, etc.) where the situation was handled by ANS. For analysis purposes, the delay reasons are usually reorganised in larger ATFM delay groups.

7.2.17 Different from the indicator shown in Figure 7-1, which only relates to summer performance, the average en-route delay per flight shown on the right side of Figure 7-3 relates to the full year. The indicator is consistent with the indicator which will be used for capacity target setting within the SES II performance scheme as of January 2012 (see Chapter 2).

7.2.18 As already observed for the summer period, ATFM en-route delays have increased severely in Europe in 2010. The situation was particularly critical in July 2010 which not only showed by far the highest level of en-route ATFM delay in 2010 (4.5 minutes per flight) but also the highest monthly level over the past 10 years.



**Figure 7-3: Evolution of en-route ATFM delays [2006-2010]**

7.2.19 Accordingly, the number flights affected by ATFM en-route regulations increased. In 2010, 8.8% of flights were en-route ATFM delayed (+3.7% points vs. 2009) of which 5.2% were delayed by more than 15 minutes (+2.6% points vs. 2009).

7.2.20 As illustrated in Figure 7-3, the year 2010 was specific in many respects and the following points can be noted from Figure 7-3:

- While traffic is still below 2007 levels, en-route ATFM delay due to ATC Capacity [C] and Staffing [S] almost doubled compared to 2009 and remains the main driver of en-route ATFM delay in 2010 (61.5%).
- Other ATC-related delays [I,R,T] increased to the highest level ever mainly due to significant industrial tensions in France and Spain and accounted for 19% of all en-route ATFM delays (up from 4% in 2009).
- While the dip in traffic due to the ash cloud is clearly visible in April, the impact in terms of en-route ATFM delay was small because flights were cancelled instead of delayed.
- Finally there was a notable increase of “Other” ATFM en-route delays in 2010 which was mainly related to the implementation of new operational systems.

7.2.21 In this context it is important to recall that the observed high level of en-route ATFM delay<sup>36</sup> is only one symptom of ATC industrial tensions. Depending on how the situation is handled, ATC industrial actions impacts:

- on ATFM delay levels when flights are delayed;
- flight efficiency when aircraft operator circumnavigate affected airspace (see also Section 7.3 of this chapter), and
- the number of cancellations when the flights cannot be operated (see Chapter 3).

7.2.22 Overall, the severe degradation of the European network performance in 2010 was mainly driven by unpredictable events (industrial actions, ash cloud) which could not be foreseen in the strategic/ pre-tactical phase of the capacity planning process.

36 Please note that ATC industrial action has also a negative impact on capacity related ATFM delays.

7.2.23 The unpredicted drop in deployed capacity in 2010 and resulting negative effects on delays, flight efficiency (see also Section 7.5.1 of this chapter) and the number of cancellations was, by and large, not a structural capacity issue, but a social issue with subsequent staffing difficulties, due to social tensions and industrial actions.

7.2.24 The next section evaluates en-route ATFM performance at local level in order to provide a better understanding of the underlying drivers of the severe degradation of network performance in 2010.

## LOCAL ATFM EN-ROUTE PERFORMANCE

7.2.25 The majority of en-route ATFM delays are concentrated in only a comparatively small number of ACCs which negatively affects the entire European network. 90% of the ATFM en-route delay was generated by only 17 ACCs (of a total of 67 ACCs) which controlled 37% of total flight hours in Europe.

7.2.26 Despite the severe increase of en-route ATFM delay in 2010, the vast majority of ATC units including the ACCs in the UK, Italy, Czech Republic and Portugal, to name a few, continued the improvements made in previous years or maintained a constant good level of performance in 2010.

7.2.27 In order to identify constraining ACCs, the following section evaluates the performance at ACC level in line with the capacity objective set out in the ATM 2000+ Strategy [Ref. 26] “to provide sufficient capacity to accommodate demand in typical busy hour periods without imposing significant operational, economic or environmental penalties under normal conditions.”

### Applicability of European wide target at local level

As the European target is set on a per flight level, it is important to point out that the one minute ATFM summer delay target per flight is a European system level target which cannot be directly applied to individual ACCs performance. In Europe, a flight crosses on average three ACCs and, as the measure is not additive, local delay levels have to be consequently below the system wide target.

7.2.28 While capacity constraints can occur from time to time, ACCs should not generate high delays on a regular basis. Figure 7-4 shows the delay performance in terms of the number of days with significant en-route ATFM delays (>1 minute per flight). Thresholds are set at 30 days (congested) and 100 days (highly congested).

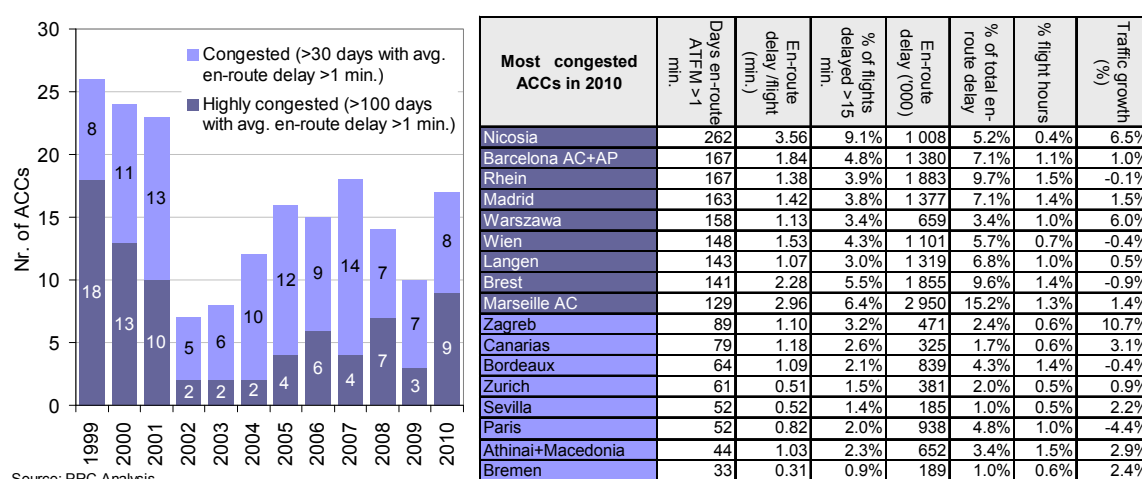
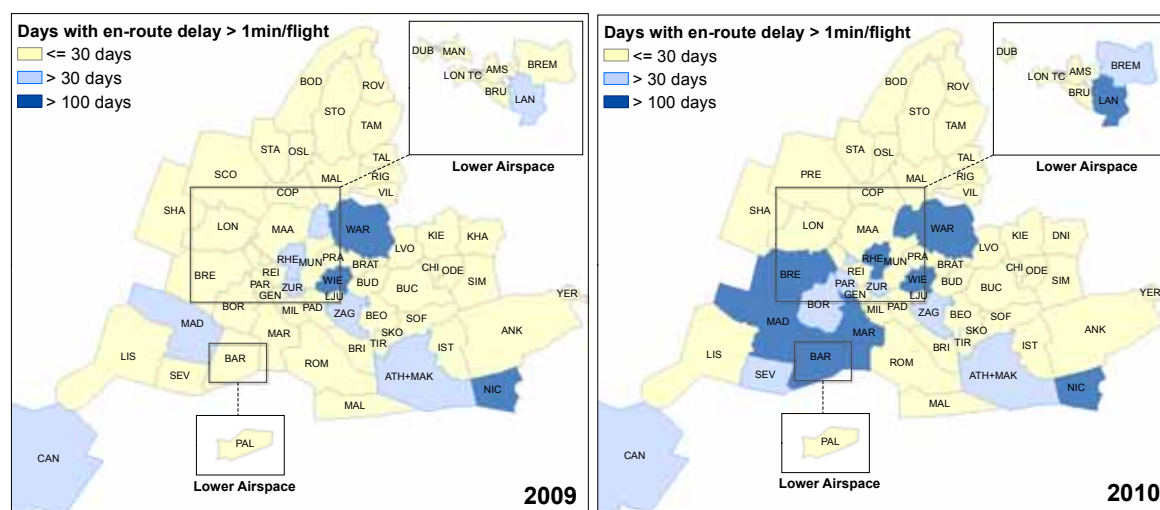


Figure 7-4: Most en-route ATFM constraining ACCs

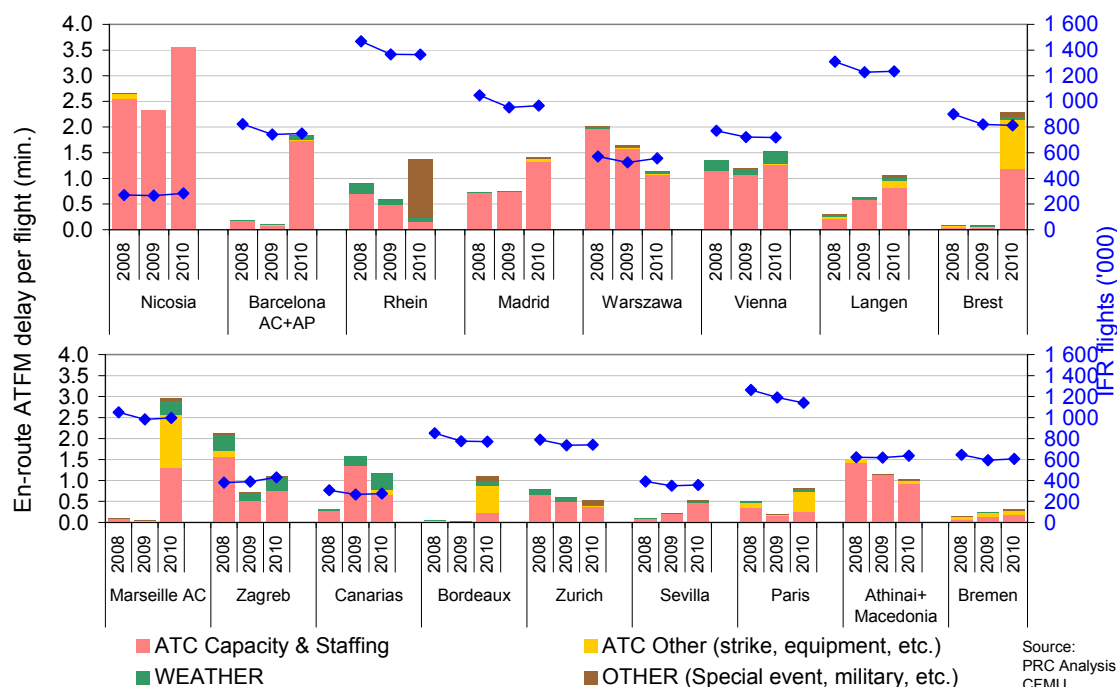
7.2.29 The number of ACCs with more than 30 days with an average en-route delay larger than 1 minute per flight increased from 10 to 17 in 2010. The number of ACCs with more than 100 days with ATFM en-route delay > 1 minute tripled from 3 to 9 in 2010.

7.2.30 A number ACCs have been continuously in the list of most en-route ATFM delay generating ACCs for a number of years (Nicosia, Vienna, Warsaw, Madrid, Zurich, Zagreb) but there are also some new additions in 2010, most notably the French and Spanish ACCs. Figure 7-5 shows the geographical distribution of the 17 most en-route ATFM constraining ACCs in 2009 and 2010.



**Figure 7-5: Geographical distribution of most delay-generating ACCs**

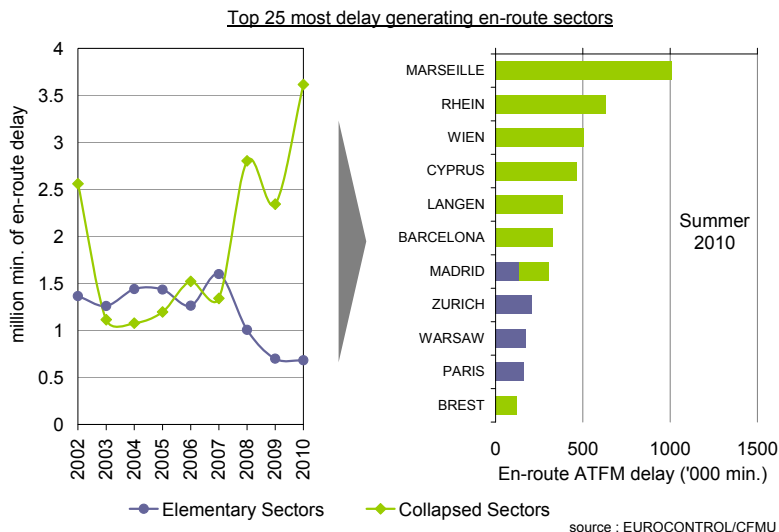
7.2.31 In addition to the south-east axis (Austria, Croatia, Greece and Cyprus) which remains an area of major concern in the European network, (16.7% of total en-route ATFM delays), there was a high level of delay in Spain (17.1%) and in France (35.4%), which comes after a long period of good performance in France.



**Figure 7-6: ATFM en-route delay drivers (most constraining ACCs) [2010]**

7.2.32 Figure 7-6 provides an indication of the underlying en-route ATFM delay causes as reported by the flow managers. The indicator in Figure 7-6 is consistent with the EU-wide capacity KPI of the SES II performance scheme which is expressed in terms of en-route ATFM delay per flight for the full year (all delay causes included). In order to provide an indication of the traffic level, the number of controlled IFR flights is plotted as a blue line.

7.2.33 Complementary to Figure 7-6, the analysis in Figure 7-7 shows the en-route ATFM delays in the top 25 most delay generating en-route sectors by type in summer. The ATFM en-route delays originating from collapsed sectors show a step increase between 2007 and 2010, which gives cause for serious concern.



**Figure 7-7: ATFM delays due to collapsed/elementary sectors**

#### **Elementary/ collapsed sectors:**

The airspace is divided into elementary sectors which can be merged into larger (collapsed) sectors. Subject to workload and staff availability, the sector configurations are adjusted to traffic demand.

En-route capacity shortfalls may result from structural limitations (i.e. inability to further split sectors to accommodate the demand) or staffing limitations (i.e. inability to deploy maximum configurations due to staff availability).

7.2.34 Whereas some of the delay appears to be of a structural nature (i.e. sectors cannot be split further), the vast majority of the delay is due to collapsed sectors which suggests that, at most ACCs, shortcomings in the planning (recruitment, productivity projections, etc.) and deployment of staff (sector opening times, ATCO rating, rostering, overtime regulation, etc.) appear to be the main reason for the observed high level of en-route ATFM delays.

7.2.35 Figure 7-8 which compares traffic and ATFM en-route delay levels between 2008 and 2010.

7.2.36 Despite the traffic recovery in 2010, on average, traffic at the most constraining ACCs was still by 4% lower than in summer 2008 but en-route ATFM delays were on average by 93% higher. This suggests that genuine structural capacity limits had only a small influence on the severe degradation of network performance in 2010, and is consistent with the low share of en-route delay attributed to elementary sectors shown in Figure 7-7.

SUMMER (May.-Oct.)	2010 vs. 2008	
	Traffic	En-route delay
Nicosia	5.2%	37%
Barcelona AC+AP	-6.2%	>500%
Rhein	-4.1%	22%
Madrid	-5.0%	80%
Warszawa	-0.1%	-46%
Wien	-5.4%	1%
Langen	-2.9%	164%
Brest	-8.3%	>500%
Marseille AC	-3.7%	>500%
Zagreb	14.9%	-42%
Canarias	-9.4%	287%
Bordeaux	-7.4%	>500%
Zurich	-3.7%	-33%
Sevilla	-7.3%	>500%
Paris	-8.1%	125%
Athinai+Macedonia	2.0%	-31%
Bremen	-3.4%	91%
	-4.0%	93%

**Figure 7-8: Summer 2010 traffic and en-route ATFM delay vs. 2008**

7.2.37 The combination of the analyses in Figure 7-6, Figure 7-7 and Figure 7-8, gives insights on a number of issues which are relevant for the understanding of performance in 2010. The situation was quite contrasted among ACCs and a number of interesting points can be noted:

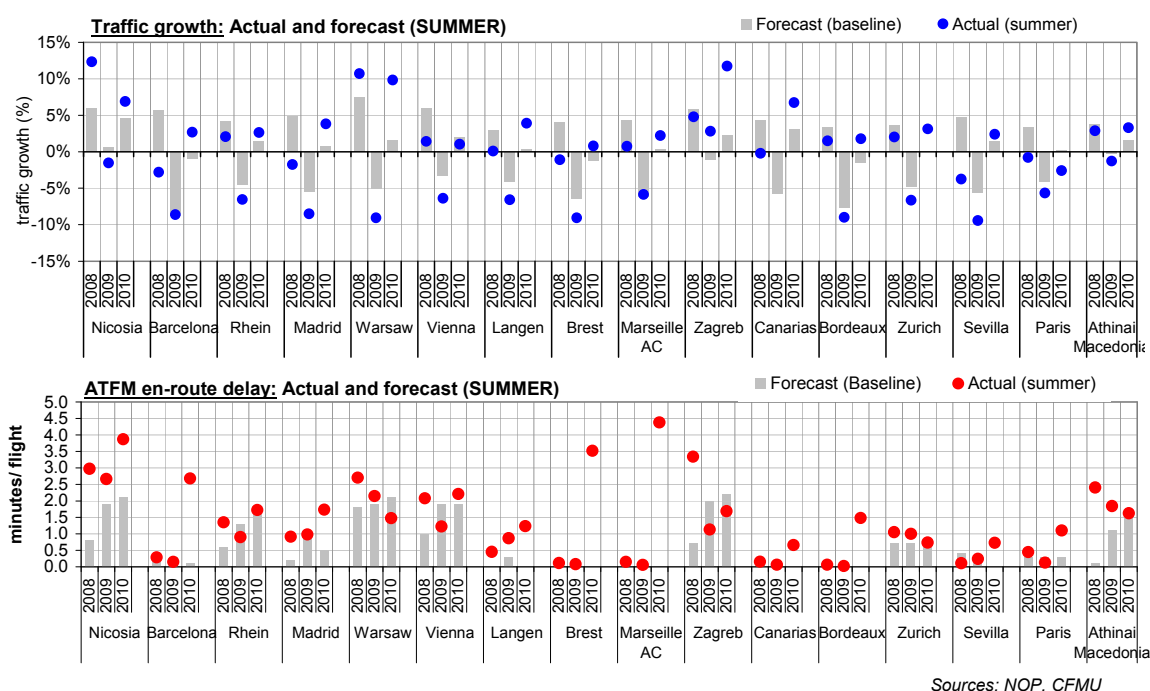
- With the exception of Nicosia, Zagreb and Athinai/Macedonia, the traffic level in summer 2010 was still considerably lower than in 2008.
- The high increase in en-route ATFM delay in France and Spain is not the result of

structural but of social issues. Despite traffic levels below 2007, at those ACCs the en-route ATFM delay increased exponentially in 2010.

- Although delays continued to remain high at Warsaw and Athinai/Macedonia, a positive trend can be observed between 2008 and 2010 (Figure 7-6). Zurich also showed a continuous improvement during the same period.
- Despite a notable reduction of traffic compared to 2007, Vienna ACC was not able to reduce en-route ATFM delays significantly in 2010 which was largely due to the inability to deploy optimum sector configurations when required.
- The notable increase in en-route ATFM delay in Rhein (and to a lesser extent in Langen) in 2010 is largely due to staff training in preparation of the implementation of the VAFORIT system in Rhein. In view of the lower traffic level than in 2007, the high impact on performance is nevertheless noteworthy.

## ACC EN-ROUTE CAPACITY PLANNING

7.2.38 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).



**Figure 7-9: Actual versus forecast performance**

7.2.39 Figure 7-9 compares actual traffic demand and ATFM delays to the forecast levels in the Medium Term Capacity Plan<sup>37</sup> for the most en-route delay generating ACCs in 2010. A number of interesting points can be noted from Figure 7-9:

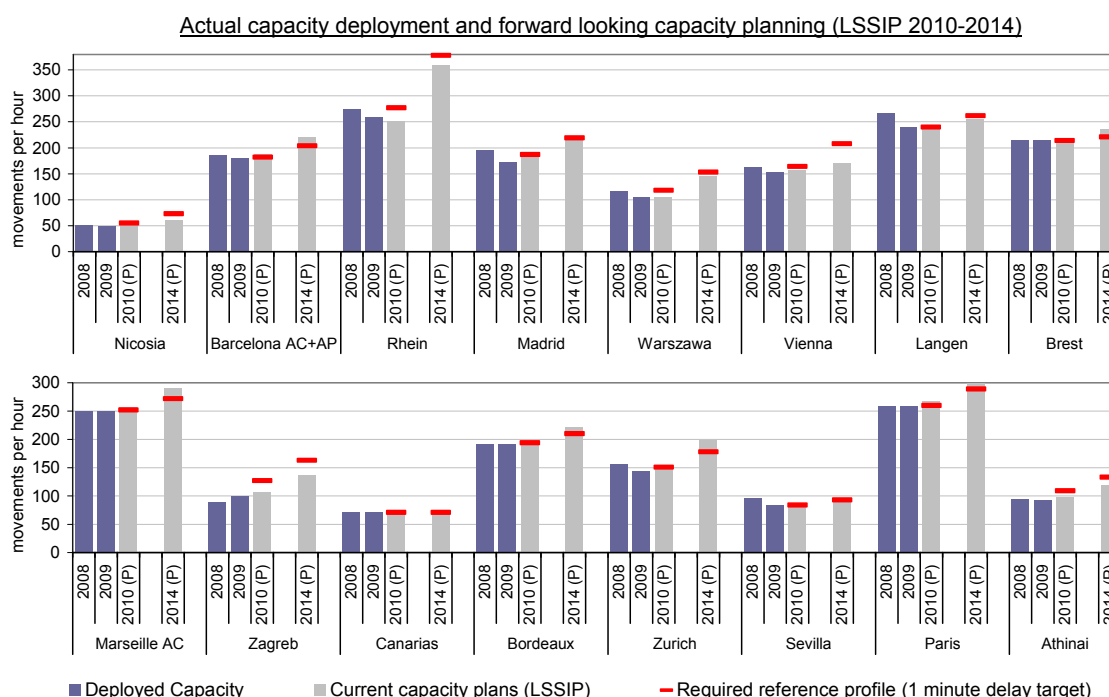
- The delay in French and Spanish ACCs in 2010 was significantly higher than foreseen in the capacity plan because social issues cannot be taken into account in the capacity planning process;
- Delay levels in Nicosia ACC were always higher than forecast which is partly due to the higher than expected traffic growth, but also due to the deployment of inefficient sector configurations and inflexible use of staff;

37 Forecast source: STATFOR medium-term forecast.



- In some years a higher traffic growth than forecast by STATFOR was observed in some ACCs (Zagreb, Warsaw, and Nicosia) which added to the complexities involved in strategic capacity planning.

7.2.40 Figure 7-10 shows achieved capacity levels, currently agreed capacity plans (LSSIP 2010-2014) and the required reference profile which would be required by ACCs to meet the 1 minute summer delay target (baseline traffic forecast).



**Figure 7-10: Actual capacity deployment and forward looking capacity planning**

- 7.2.41 Whereas the plans for most ACCs are in line with the required reference profile, for some ACCs such as Vienna, Zagreb, Nicosia, Athinai and Rhein the planned capacity addition is lower than what would be required to meet the 1 minute summer delay target at a baseline traffic scenario.
- 7.2.42 Notwithstanding the unprecedented drop in traffic, and the resulting need to contain cost, there is clearly a need for adequate and pro-active capacity planning at local and network level, in order to be able to deploy capacity when it is needed.
- 7.2.43 In this context, the elaboration of national/FAB performance plans, which include binding Capacity targets consistent with the EU-wide capacity target and the network functions being established under SES II, will play an important role.

## 7.3 En-route Flight Efficiency

- 7.3.1 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 8.
- 7.3.2 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 in general is of higher economic and environmental importance than the vertical component across Europe as a whole [Ref. 36]. The additional fuel burn due to en-route flight inefficiencies (horizontal and vertical) has an environmental impact, which is addressed in more detail in the environmental assessment in Chapter 9 of this report.



7.3.3 The horizontal en-route flight efficiency indicator takes a single flight perspective. It relates observed performance to the great circle distance, which is a theoretical (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.

7.3.4 While the great circle distance used for the calculation of the indicator is the shortest route, it should be noted that it may not always correspond to the economic preferences of airspace users<sup>38</sup> or the profile with the least impact on climate.

7.3.5 Hence, the aim is not the unachievable target of direct routing for all flights at all times, but to achieve an acceptable balance between flight efficiency and capacity requirements whilst respecting safety standards. These trade-offs are addressed in more detail in Chapter 11.

#### EUROPEAN HORIZONTAL FLIGHT EFFICIENCY TARGET

7.3.6 In May 2007, the Provisional Council (PC) 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.

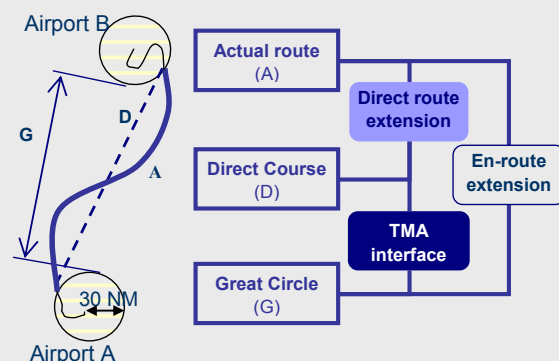
7.3.7 Figure 7-11 shows the actual en-route extension and the evolution of the average distance flown between 2005 and 2010<sup>39</sup>.

7.3.8 While the overall target has never been achieved, a slight improvement can be observed between 2007 (48.9 km/flight) and 2009 (47.6 km/flight) before the notable deterioration in 2010 (49.1 km/flight).

#### Horizontal flight efficiency

The 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 (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 direct course (D); and,
- the TMA interface which is the difference between the direct course (D) and the great circle distance (G).



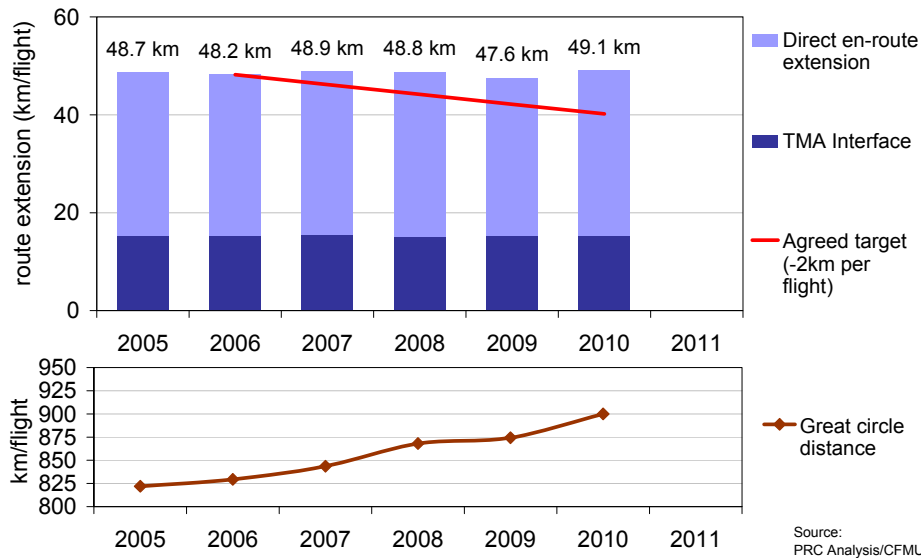
#### Horizontal flight efficiency within the SES performance scheme

With a view to the start of the first reference period of the SES II performance scheme in 2012, it is interesting to note that flight efficiency will be addressed as part of the EU wide environmental target.

Different from the present EUROCONTROL target which is expressed in absolute terms, the EU-wide environment target will be expressed in relative terms (i.e. % difference between the actual en-route trajectory and the great circle distance). The radius around the airports will change from 30NM to 40NM (see also methodology above).

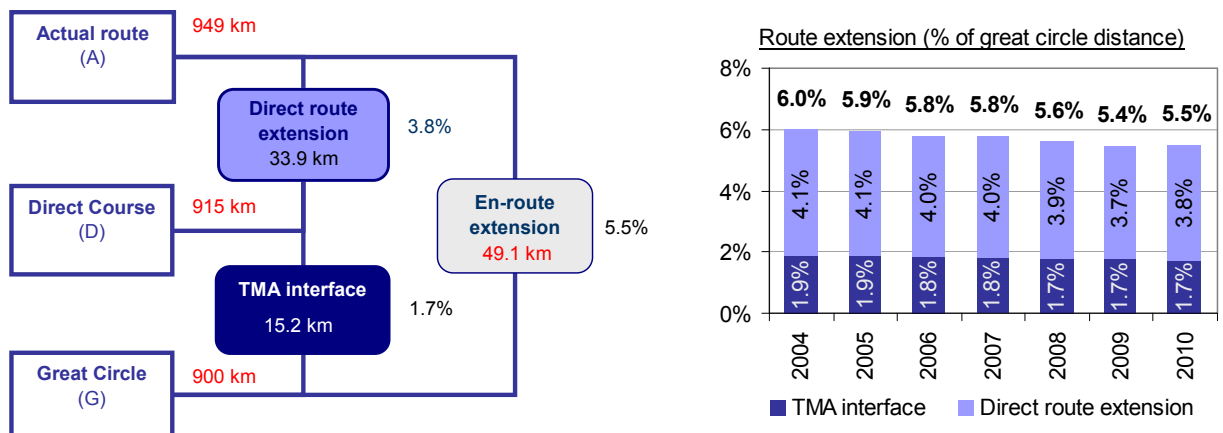
38 Which may be influenced by factors such as wind, route charges and congested airspace.

39 Please note that the horizontal flight efficiency indicator in 2009 and 2010 was statistically adjusted to take a change in the algorithm used for the calculation of the actual CFMU flight profile into account which would have led to an artificial increase of the actual flight distance (A) in those years. The analyses in this chapter have been adjusted accordingly to enable time series analyses.



**Figure 7-11: Horizontal en-route flight efficiency target**

- 7.3.9 The average route extension in 2010 (compared to great circle distance) was 49.1 km (5.5%), of which 33.9 km (3.8%) is attributable to the efficiency of the en-route network and 15.2 km (1.7%) to the interfaces with the TMAs, as outlined in Figure 7-12. The underlying drivers (route network, route utilisation, and ATC routing) are evaluated in more detail in Section 7.4.
- 7.3.10 The absolute changes in route extension have to be seen in the light of the continuously increasing average great circle distance (G) between 2005 and 2010 (see bottom of Figure 7-11) which to some extent masks improvements in relative en-route extension.
- 7.3.11 The increasing average great circle distance means that the proportion of medium/long haul flights operated by aircraft operators in Europe is constantly increasing and the proportion of short-haul flights is decreasing.
- 7.3.12 Although the target set by the EUROCONTROL PC in 2007 has not been achieved, the development of performance measures and targets has put significant focus on initiatives to improve European flight efficiency over the past few years with corresponding positive effects, as shown later in this chapter.



**Figure 7-12: En-route flight efficiency indicator**

## EUROPEAN EN-ROUTE FLIGHT EFFICIENCY PERFORMANCE

7.3.13 In response to the high jet fuel price in 2008, IATA, EUROCONTROL and CANSO jointly developed the Flight Efficiency Plan [Ref. 37] which aims at:

- enhancing European en-route airspace design through annual improvements of European ATS route network including the implementation of additional CDRs for main traffic flows, improvements for the most penalising city pairs and the support of free route initiatives;
- improving airspace utilisation and route network availability, including support to aircraft operators to improve flight plans; improving the use of civil military airspace, and reducing the number of RAD restrictions, where possible;
- efficient TMA design and utilisation, through the implementation of advance navigation capabilities, and CDOs; and,
- Optimising airport operations, through Airport Collaborative Decision Making.

### RAD & CDRs

The Route Availability Document (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.

Conditional Routes (CDRs) are non-permanent routes of the route network usually established through shared airspace (civil/military) or to address specific ATC conditions (sectorisation, etc.). They can be planned and used under specific conditions.

7.3.14 The first two bullet points are addressed in more detail in the next section and the elements related to ANS performance at airports are addressed in Chapter 8.

## 7.4 Components affecting horizontal en-route flight efficiency

7.4.1 As illustrated in the conceptual framework in Figure 7-13, direct en-route extension is affected by a number of components. For a better understanding of the various areas where ANS has an impact, direct route extension is broken down into three components: (1) en-route airspace design, (2) route utilisation and (3) ATC routing.

7.4.2 Access to and the use of civil/military airspace structures can have an impact on all three components and is considered in more detail in section 7.5 of this chapter.

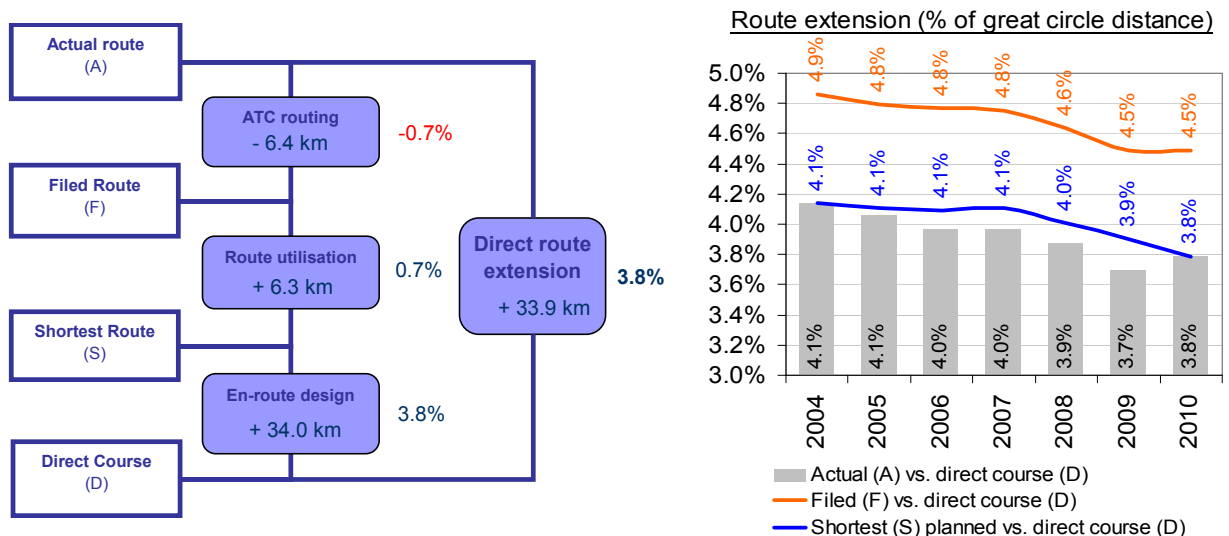
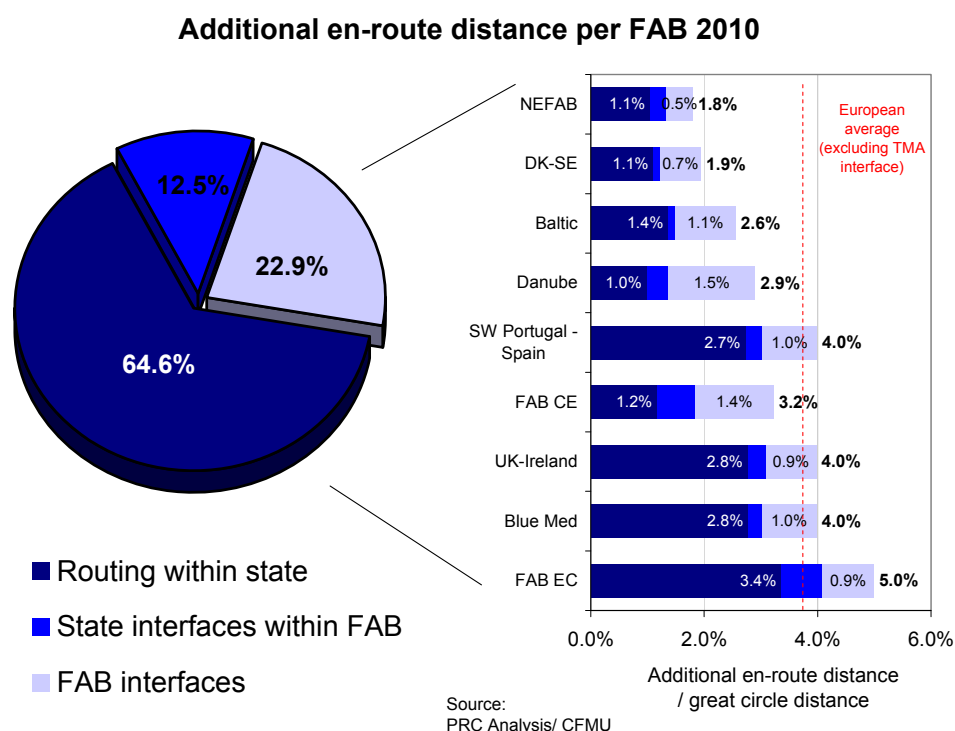


Figure 7-13: Direct route extension by components

- 7.4.3 Notwithstanding further en-route design related improvements, there was an increase in average horizontal en-route extension in 2010 which was due to deterioration in route utilisation and less direct routeings being provided by ATC on a tactical basis.

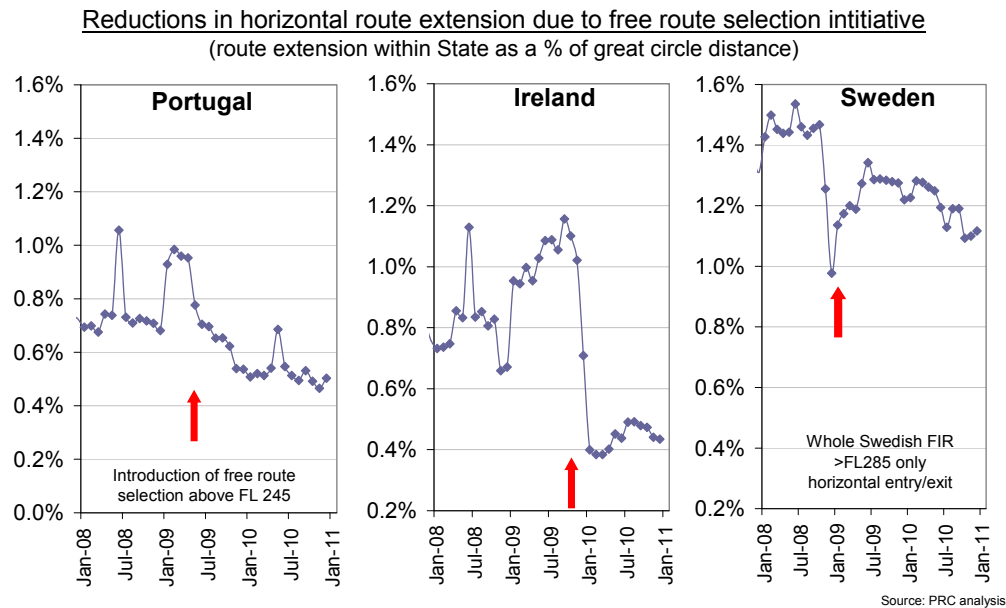
#### EN-ROUTE AIRSPACE DESIGN

- 7.4.4 The European route network is a very complex structure, which has been developed gradually over time. Any proposed change needs to be thoroughly validated, which limits the speed of change.
- 7.4.5 The en-route design component relates the shortest available route (S) to the direct course (D). As can be seen in Figure 7-13, it is by far the most important driver of horizontal en-route extension (3.8% in 2010).
- 7.4.6 A large number of initiatives target the improvement of airspace design and the benefits can be seen by the continuous reduction of the corresponding indicator between 2007 and 2010 to the lowest level ever measured.
- 7.4.7 Improvement of the European route network is, by definition, a Pan-European issue and network management is addressed in more detail in Chapter 6. If uncoordinated, improvements within individual States/FAB may not deliver the desired objective, especially if the airspace is comparatively small and a large proportion of the observed inefficiency is due to the interface with adjacent States, which may not always be under the control of that State. Information at State level is provided in Annex III.
- 7.4.8 Figure 7-14 illustrates the relative savings that could be achieved at national level, Functional Airspace Block (FAB) level, and European level. Route extension could be reduced by 64.6% if flights could fly a direct route within each States, and additional 12.5% savings could be achieved by improving the interface between States within a FAB. A significant part (22.9%) can only be addressed at European level.



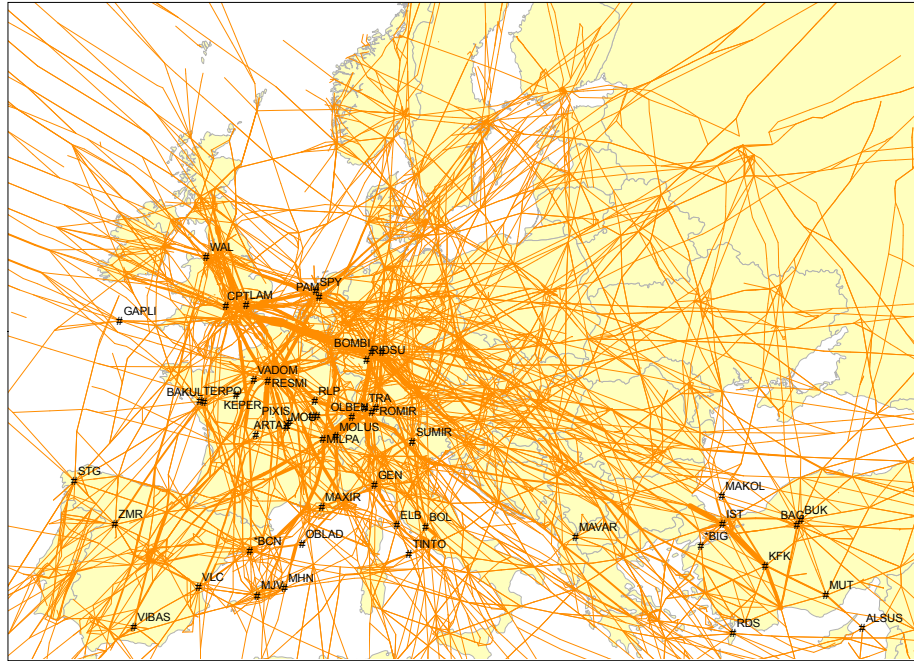
**Figure 7-14: Additional en-route distance per FAB [2010]**

- 7.4.9 There are a number of positive examples where the deployment of new concepts at local level shows clear benefits. Figure 7-15 shows substantial flight efficiency improvements from the free route selection initiatives in Portugal (starting in May 2009), Ireland (starting in December 2009), and Sweden (starting in January 2010).



**Figure 7-15: National flight efficiency improvements from free route initiatives**

- 7.4.10 The observed improvements in Figure 7-15 are up to 0.8% which represents a substantial reduction of additional distance and fuel burn and subsequent CO<sub>2</sub> emissions.
- 7.4.11 “Free Route” initiatives will continue to evolve in the coming years with further projects in Finland, Norway, MUAC, Serbia plus other projects in the context of the FABs.
- 7.4.12 In this context it is interesting to note that the Free Route Concept of Operations has been adopted by the Airspace and Navigation Team and will be integrated into the ATS Route Network (ARN Version 7). Its main purpose is to provide an enabling framework for harmonised implementation of free route operations throughout the European airspace.
- 7.4.13 The deployment of the European night direct routes network (which could benefit up to 10% of the night flights) will continue in the context of FABEC, BLUEMED, FABCE, DANUBE and further help to improve flight efficiency within States and within the network once they are operational.
- 7.4.14 The PRC introduced the concept of most constraining points [see PRR 2006, Ref. 38] as a way to identify and focus the attention on the most critical nodes in the network.
- 7.4.15 The rationale behind this approach was that targeting 50% of the flight inefficiencies would require to reduce inefficiencies on more than 2000 city pairs to close to zero while targeting the 150 most constraining points would have the same effect. Figure 7-16 shows a map of the most constraining points in 2010 of which a list of the top 50 is provided in Annex IV.



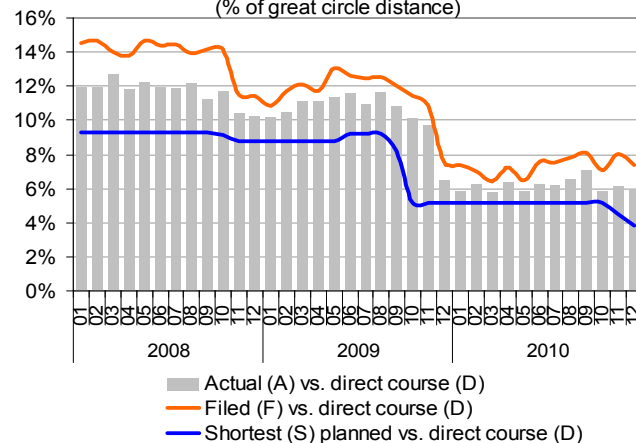
**Figure 7-16: Most constraining points in the European Network**

7.4.16 Nevertheless there is a benefit in targeting selected routes with particularly low level of flight efficiency.

7.4.17 Figure 7-17 shows the results of the effort of FABEC aimed at improving the routing between Paris and Munich which was quoted in previous PRRs as an example of inefficient routing.

7.4.18 On weekends, there was a notable improvement in 2010 on flights from Paris (CDG) to Munich (MUC) due to a better utilisation of shared airspace.

**Route extension on flights from Paris (CDG) to Munich (MUC)  
(% of great circle distance)**



**Figure 7-17: Flight efficiency between Paris and Munich (weekends)**

## ROUTE UTILISATION

7.4.19 The route utilisation component addresses flight planning. It relates the filed route (F) to the shortest available route (S) and accounts for 0.7% of the distance flown in 2010 (see Figure 7-13).

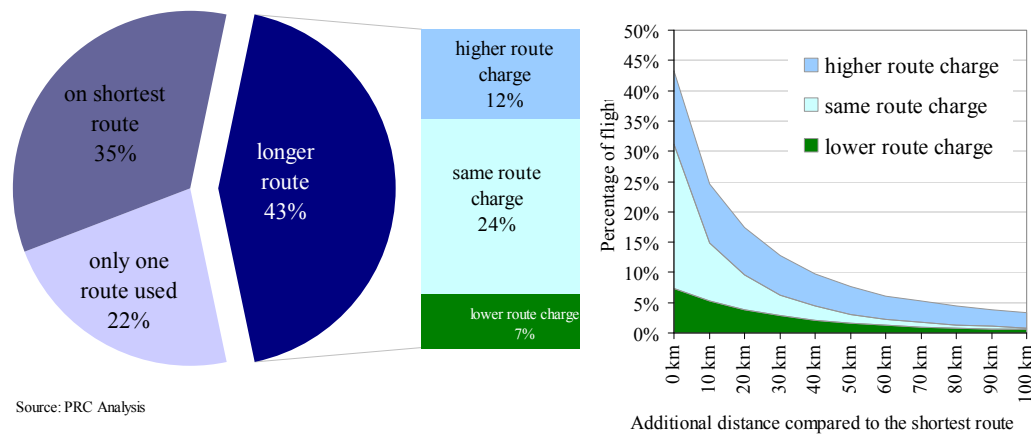
7.4.20 Route utilisation concerns the actual utilisation of routes available for flight planning, in the pre-tactical phase. Influencing factors include:

- the shortest route might only be temporarily available due to the activation of Shared airspace such as TRAs / TSAs (see also Section 7.5 of this chapter).
- disinterest or inability to adapt flight plans to take advantage of available airspace, using RPLs which are valid H24 365 days a year.
- aircraft operators may avoid filing the shortest route due to political or business reasons. This may include requirements for diplomatic clearance; the cost of route charges applicable on the routing, or avoiding congested areas.



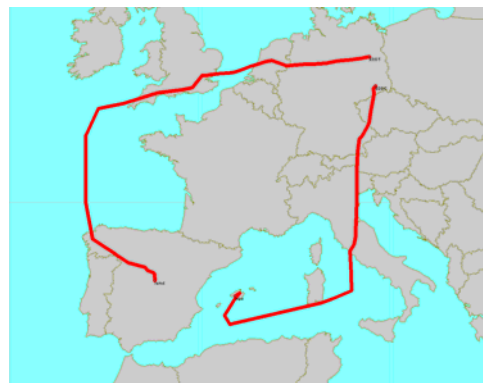
- meteorological conditions, such as jet stream; the aircraft operator may favour filing a more indirect, but quicker, route to destination rather than the “shortest” route.

7.4.21 Figure 7-18 shows that 43% of flights did not file the shortest route on a given city pair. When a longer route was filed, the additional distance was in most cases small and in the majority of cases route charges were the same (24%) or higher (12%). Only 7% of the flights were flying a longer route with lower route charges.



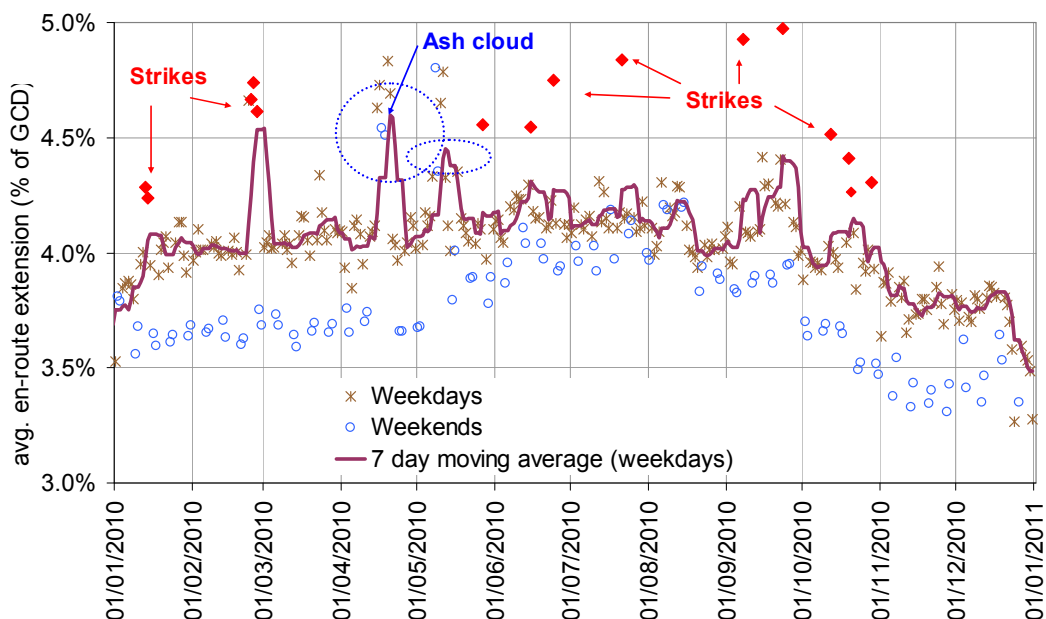
**Figure 7-18: Filed flight plan compared to shortest route filed [2010]**

7.4.22 The deterioration of the route utilisation indicator in 2010 is largely the result of the complex capacity situation in 2010. In order to circumnavigate airspace affected by the ash cloud or ATC industrial action, aircraft operators accepted less efficient flight plans which is reflected in the indicator.



**Figure 7-19: Route extension due to strike**

7.4.23 Figure 7-19 shows two extreme examples as a result of the strike in France.



**Figure 7-20: Average en-route extension by day [2010]**



- 7.4.24 Additionally, Figure 7-20 shows a breakdown of the average daily en-route extension in 2010 by day. A clear increase in en-route extension is visible as a result of ATC industrial action and the ash cloud.
- 7.4.25 Further improvements expected for route utilisation cover:
- (1) the utilisation of civil/military airspace structures (see also Section 7.5) and;
  - (2) proactive support to aircraft operators to ensure that the most beneficial routes are utilised.
- 7.4.26 Active support to aircraft operators includes work by, inter alia, CFMU, aircraft operators (AOs), flight plan service providers (FPSPs) and national airspace management cells (AMCs).
- 7.4.27 Tools have been developed by the CFMU to detect opportunities arising from airspace openings, offering AOs both a route length reduction and no increase in flying time. This approach will allow a more efficient utilisation of the European airspace and the full exploitation of the benefits gained through airspace design actions.
- 7.4.28 Further improvement in route utilisation<sup>40</sup> will require the active participation of aircraft operators and a further reduction of the number and duration of RAD restrictions, particularly during night times and weekends.
- 7.4.29 Work is ongoing with the CFMU to identify for each flight the shortest route that was available at the time of the flight. This will allow a better understanding of the respective impact of RAD restrictions, route availability and aircraft operators' decisions. The PRC will explore the subject in greater detail in future reports.

#### **ATC ROUTING**

- 7.4.30 ATC routing concerns ATC providing aircraft with direct tracks, when traffic and airspace availability permits, in the tactical phase. It relates the actual flown routes (A) to the routes filed by the airspace users (F).
- 7.4.31 Direct ATC routings are estimated to have reduced the flight distance by 0.7%, on average, in 2010 which represents a deterioration compared to 2009 (see Figure 7-13). The fewer number of direct routings is most likely related to the complex capacity situation in 2010.
- 7.4.32 ATC shortcuts given on a tactical basis are usually associated with the flexible use of shared airspace; the next section will evaluate the access and use of shared airspace in more detail.

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40 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".

## 7.5 Access to and use of shared airspace

7.5.1 Access is one of the ICAO key performance areas. This section focuses on access to shared airspace by military and civil users.

7.5.2 To meet the increasing needs of both sets of stakeholders, in terms of volume and time, close civil/military co-operation and co-ordination across all ATM-related activities is key.

### **Shared airspace**

“Shared” is AMC<sup>41</sup> manageable Special Use Airspace (SUA) that can be used alternatively for civil traffic and military activities. It is no longer designated as either military or civil airspace, but considered as one continuum and used flexibly on a day-to-day basis.

7.5.3 From a civil point of view, the benefit of access to shared airspace is improved en-route flight efficiency and additional capacity (see previous section). From a military viewpoint, access to shared airspace enables military training and operational requirements to be met. Locating the shared airspace in relative proximity to airbases has the additional benefit of optimising transit times to and from the training areas.

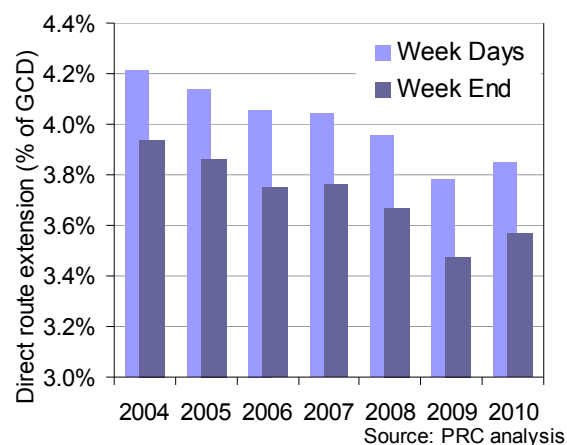
7.5.4 The PRC report “Evaluation of Civil/Military airspace utilisation” in 2007 [Ref. 39] made two main recommendations:

- for States to increase their commitment to design and implement appropriate routes and sector configurations to improve the utilisation of shared airspace particularly during weekends, and
- to establish a performance measurement system for the utilisation shared airspace.

7.5.5 In order to facilitate civil/military coordination and to support a more consistent cross-border implementation of the flexible use of airspace (FUA) planning process, EUROCONTROL has launched a number of initiatives such as LARA<sup>42</sup>, CIMACT<sup>43</sup> and PRISMIL<sup>44</sup>.

7.5.6 Although there is virtually no military activity during weekends, only a small reduction of direct route extension can be observed in Figure 7-21.

7.5.7 Although a gradual improvement in overall direct route extension is visible between 2004 and 2010, the gap between week and weekend remains stable.



**Figure 7-21: Direct route extension week/weekend**

7.5.8 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.

41 Airspace Management Cell.

42 Local And sub-Regional Airspace management support system.

43 Civil-Military ATM/ Air defence Coordination Tool.

44 The Pan-European Repository of Information Supporting Civil-Military Key Performance Indicators (PRISMIL). programme was launched in June 2006 to develop and implement harmonised automated data collection in support of civil- military KPIs.

- 7.5.9 Additionally, the Performance Scheme established as part of the SES legislation shall include a KPI on the effective use of civil military airspace structures. This KPI shall be monitored during the first reference period (2012-2014) and shall be used to set targets for the second and subsequent reference periods thereafter (see also Chapter 2).

## **7.6 Conclusions**

### **CAPACITY**

- 7.6.1 In summer 2010, en-route ATFM delays more than doubled (from 1.2 to 2.8 minutes per flight) which is the highest level since 2001 and almost three times higher than the agreed PC target (1 minute per flight).
- 7.6.2 Although traffic grew by 3.1% compared to summer 2009 (+0.8% annually), traffic levels were still below 2007 levels. At the same time, en-route ATFM delays per flight increased by +134% compared to summer 2009.
- 7.6.3 While there was a dip in traffic due to the ash cloud in April/May 2010, the impact in terms of en-route ATFM delay was small because flights were cancelled instead of delayed.
- 7.6.4 Ninety percent of en-route ATFM delays were concentrated in a comparatively small number of ACCs (17 out of 67), which negatively affected the entire European network. These included:
- specific events such as industrial actions in France and Spain not only resulted in high en-route ATFM delays but also had a negative impact on flight efficiency and cancellations;
  - preparations for the implementation of the VAFORIT system in Rhein ACC (which also affected performance in Langen). Performance is expected to improve in 2011.
  - the south-east axis (Austria, Croatia, Greece and Cyprus) remains of major concern. Capacity issues are compounded by high traffic growth, particularly in Zagreb and Nicosia.
- 7.6.5 However, the vast majority of ACCs (e.g. UK, Italy, Czech Republic and Portugal) continued the improvements made in previous years or maintained a good level of performance in 2010.

### **FLIGHT-EFFICIENCY**

- 7.6.6 Significant improvements were achieved in en-route design (one-third of the improvement to be achieved over 5 years according to the EU-wide target was achieved in one year).
- 7.6.7 However, aircraft operators had to accept less efficient flight plans to circumnavigate airspace affected by the ash cloud or ATC industrial action.
- 7.6.8 As a result, the use of the route network worsened, which negated the improvements in en-route design and resulted in increased horizontal en-route extension. Thus, the PC target was not met.
- 7.6.9 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.

## Chapter 8: Operational ANS Performance at Airports

KEY POINTS	KEY DATA 2010 <sup>45</sup>		
1. Congestion remains an issue at several major European airports, notwithstanding: (i) the traffic downturn in 2009 and (ii) capping of demand through the airport co-ordination process.	Total airport daily movements (mvts./day)	21 000	+1.9%
2. In view of the long lead time required to increase airport capacity (new runways, new terminals, etc.), significant problems can be expected when traffic grows.	Avg. airport ATFM delay per arrival (min.)	1.8	+30%
3. Istanbul, London Heathrow and Gatwick, Madrid and Rome generated high taxi-out additional times (+6 to +10 minutes). CDM/DMAN can contribute to a more efficient management of the departure flow and its implementation should be considered by those airports.	Avg. ASMA <sup>46</sup> additional time per arrival (min.)	2.8	+8.4%
4. Arrival ATFM delays are monitored by EUROCONTROL, but the other TMA/airport efficiency KPIs are not. Active monitoring and management of those performance indicators, both by the Network functions and local ATC units, could bring significant benefits.	Avg. ATC related gate delay per departure (min.)	0.8	-10%
5. Reactionary delays amount to 46% of all air transport delays. The propagation of delays through the network, their potential mitigation by the Network functions, and the revision of the current ATFM priority rule would be worth investigating.	Avg. additional taxi-out time per departure (min.)	4.9	+13%
6. The following measures could be taken to mitigate the impact of adverse weather conditions: <ul style="list-style-type: none"> <li>• provision of early information on the capacity of airport/handling infrastructures (e.g. de-icing), status of the airport movement area, and enhanced meteorological forecasts, combined with effective CDM processes, would help ANS to exercise its role of managing traffic at the airport;</li> <li>• improved management of arrivals in strong wind conditions (weather information input in arrival manager tools and introduction of time-based separations).</li> </ul>			

### 8.1 Introduction

8.1.1 This chapter reviews ANS-related performance at the top 30 European airports<sup>47</sup> in terms of traffic in 2010.

8.1.2 The PRC focuses its activity on measuring how efficiently ANS manages available capacity at airports. The PRC neither evaluates airport performance outside ANS responsibility nor requirements to expand airport capacity (e.g. through new infrastructure such as additional runways, taxiways, etc.). However, it is acknowledged that the lack of airport capacity is already a constraint to growth in a number of airports, and will become even more acute across Europe in the coming years [Ref. 40]. The Community Observatory on airport capacity [Ref. 41] has been established by the European Commission (EC) to address, among other issues, airport capacity matters.

8.1.3 In this chapter, Section 8.2 evaluates the ANS-related efficiency; Section 8.3 provides

<sup>45</sup> Key Data refers to the top 30 airports in terms of movements in 2010, compared to 2009. Currently 4 of the 30 airports (MUC, BRU, CDG, FRA) have established a direct link with the CFMU and provide Departure Planning Information (DPI) messages as part of the A-CDM implementation.

<sup>46</sup> See Annex V for more information on the Arrival Sequencing and Metering Area (ASMA).

<sup>47</sup> These airports are coordinated or facilitated in accordance with the European Council Regulation 95/1993 (including subsequent modifications), which is consistent with the guidelines set out in the IATA Scheduling Manual.

information on factors affecting ANS performance and Section 8.4 looks at possible strategies or initiatives to improve ANS-related performance at airports.

8.1.4 Due to the lack of data currently available, the relationship between flight cancellations and ANS performance is not considered in this chapter. Information to be collected in accordance with Regulation (EU) No 691/2010 will enable such analysis to be made.

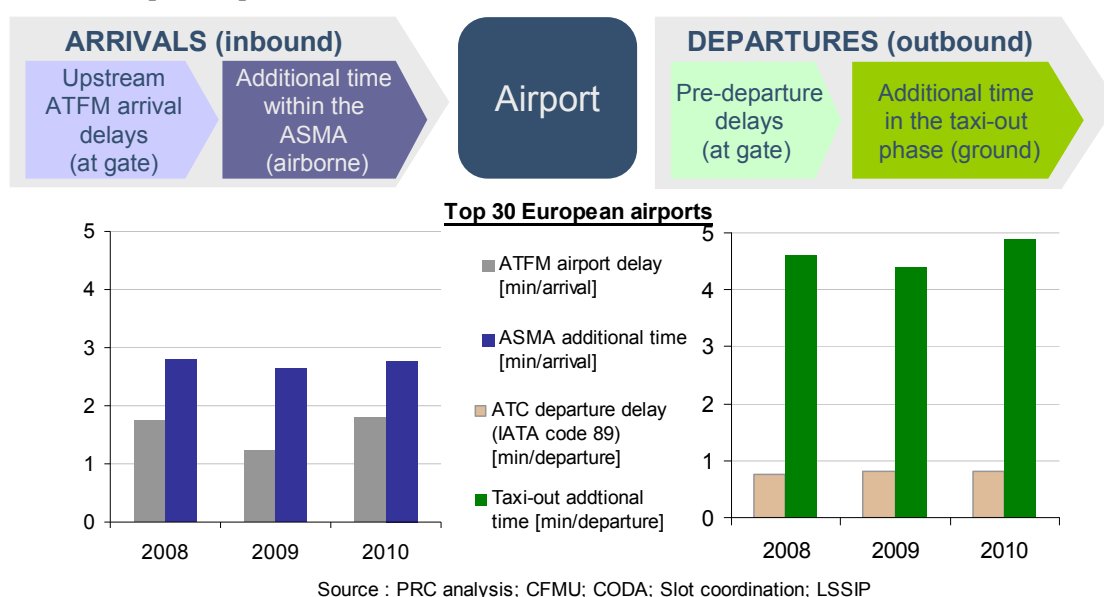
8.1.5 The following points should be considered when reading the following sections:

- 1) Airport Operations performance is the result of complex interactions between many actors (Airport operator, Slot coordinator, local ATC provider, CFMU, Airlines, Ground handlers, and other service providers at the airport). Therefore, identifying clear ANS accountability in overall air transport performance is difficult.
- 2) It is recognised that departure queuing is necessary to optimise runway throughput, although queuing in excess of what is required for that purpose means more fuel burn and gaseous emissions. Therefore, it is desirable that the right balance is achieved, by each airport, in managing departures so as to provide continuous demand for available runway capacity, without unnecessarily increasing the time spent in the queue.
- 3) The analysis presented in this chapter is based on information currently available in EUROCONTROL. In addition, work is ongoing with aircraft and airport operators to enhance the quality, completeness, and availability of data.

## 8.2 ANS-related efficiency at European airports

8.2.1 The analysis of ANS-related efficiency at major airports is based on the “ATMAP performance framework” [Ref. 42], developed in consultation with some of the main ANSPs, airlines and airport operators in Europe. Some of its indicators are incorporated in the performance scheme regulation and used for analysis in this chapter. Information on those indicators can be found in grey boxes below and more details are in Annex V.

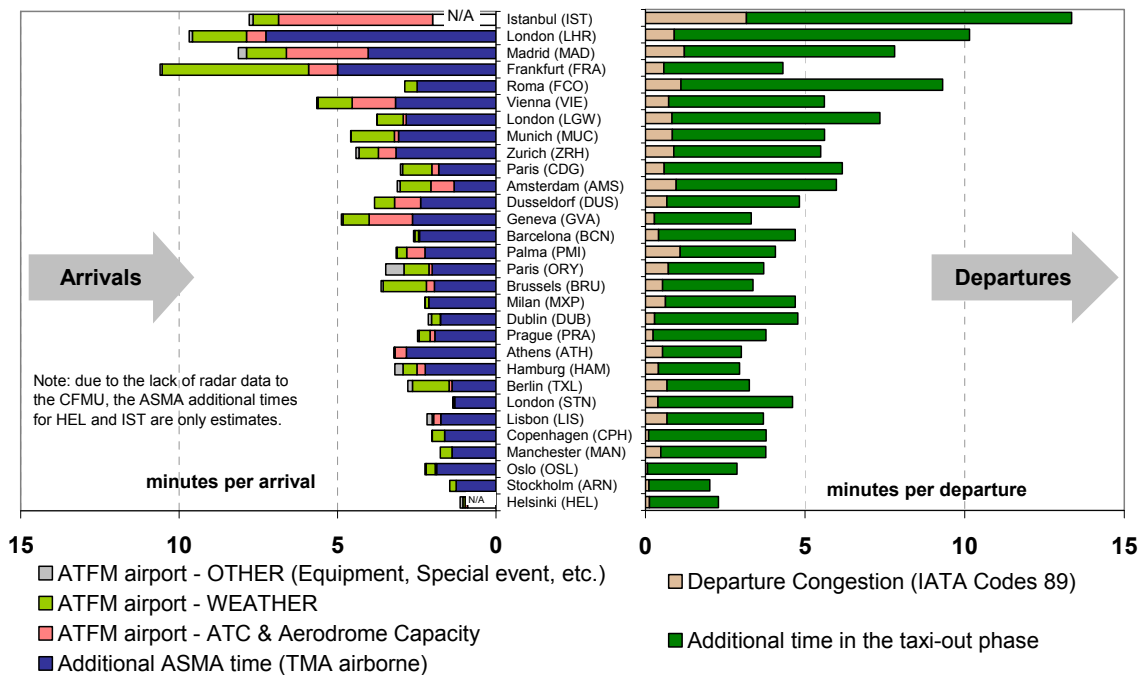
8.2.2 Figure 8-1 presents those indicators and corresponding aggregate values and trends for the top 30 airports over-2008-2010.



**Figure 8-1: Aggregate ANS-related performance at airports [2008-2010]**

8.2.3 The sum of additional transit time in the Arrival Sequencing and Metering Area (ASMA) and additional taxi-out time increased by one minute on average between 2009 and 2010.

8.2.4 Figure 8-2 provides an overview of ANS-related performance at each of the top 30 European airports.



**Figure 8-2: ANS-related operational performance at each of the top 30 airports [2010]**

8.2.5 The right side of Figure 8-2 shows the ANS-related off-block delays and taxi-out additional times on the outbound traffic flow.

8.2.6 ANS-related off-block delays are usually associated with degraded operating conditions<sup>48</sup>, while queuing time represented by additional taxi-out time exists in all operating conditions.

8.2.7 The left side of Figure 8-2 shows airport ATFM delays and ASMA additional times on the inbound traffic flow.

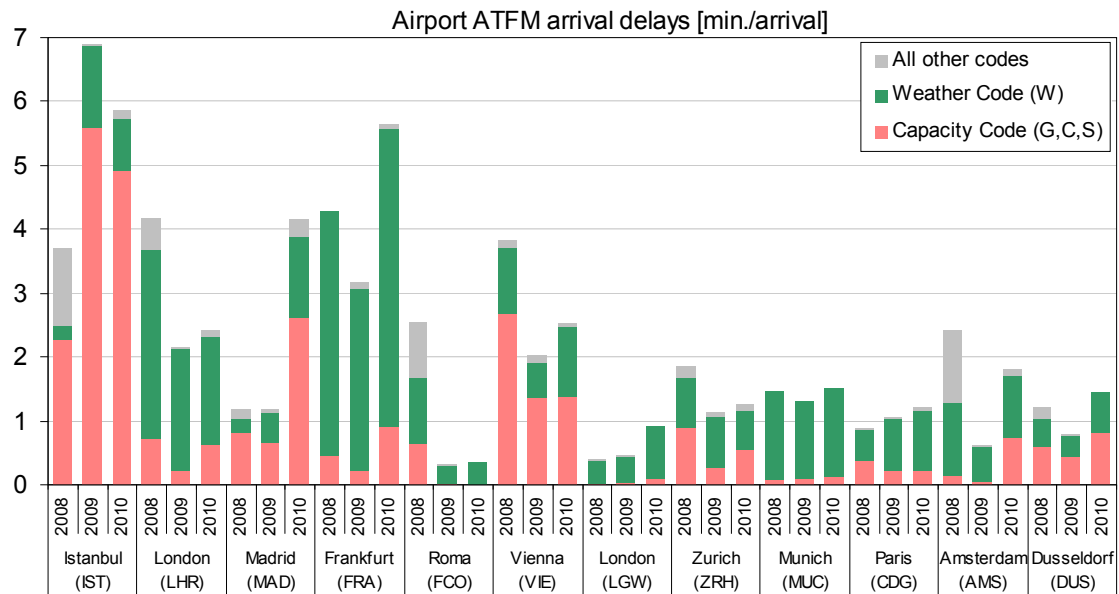
8.2.8 There is a wide variation in ANS-related efficiency across the top 30 European airports. Only the top 12 airports shown in Figure 8-2 (representing 71% of the total ANS-related delays and additional times) are analysed in the following paragraphs.

#### AIRPORT ATFM ARRIVAL DELAYS

8.2.9 Figure 8-3 shows the airport ATFM arrival delay for 2008-2010 at the top 12 airports. ATFM delays are divided in three categories according to the delay codes: capacity (either airport or ATC), weather; and all other codes. The main points to be noted are:

- the high level of capacity-related ATFM delays in Istanbul (despite a notable reduction compared to 2009);
- the continuous high level of ATFM delay in Frankfurt (FRA); and,
- the considerable increase in ATFM delay Madrid (MAD), in 2010.

<sup>48</sup> Operating conditions depend on a number of interacting factors such as weather conditions, status of airport infrastructures and facilities, level of traffic. Operating conditions are degraded when the available operational capacity is insufficient to handle the planned or scheduled number of flights. During winter operations many European airports operate in degraded operating conditions.



Source: PRC analysis; CFMU

**Figure 8-3: Arrival ATFM delay <sup>49</sup>**

#### ADDITIONAL TIMES IN THE ASMA AREA (40NM OUT UNTIL LANDING)

8.2.10 Figure 8-4 shows the ASMA unimpeded and additional times for 2008-2010. The main points to be noted are:

- at the 11 airports<sup>50</sup>, there are variations of unimpeded times over the three years,
- London (LHR) is a clear outlier, having by far the highest level of ASMA additional time<sup>51</sup>, followed by Frankfurt (FRA) and Madrid (MAD) for which a significant increase of ASMA additional time of some 1.2 minutes was observed between 2009 and 2010.

##### **ASMA additional time [Ref. 42]**

ASMA (Arrival Sequencing and Metering Area) is the airspace within a radius of 40Nm around an airport. The ASMA additional time is a proxy for the average arrival runway queuing time on the inbound traffic flow, during times when the airport is congested.

The computation of the indicator is based on three consecutive steps:

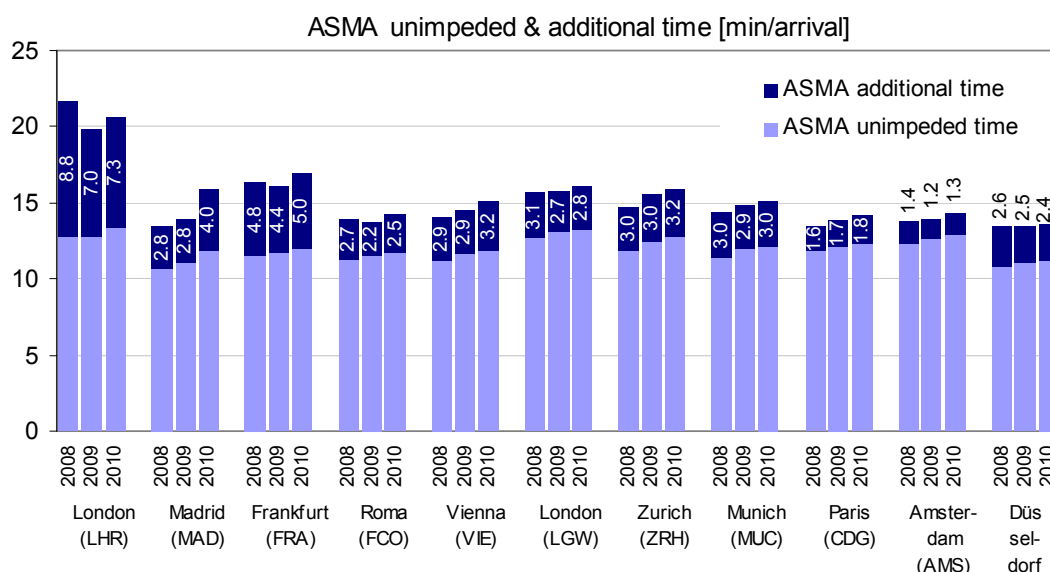
- determination of the average unimpeded time between entering the 40 NM radius and landing, for groups of similar inbound flights (same ASMA entry octagon, same arrival runway, same aircraft class);
- calculation of the average additional time for each group of flights by comparing the average actual to the average unimpeded ASMA time; and,
- the calculation of the average additional ASMA time for the airport which is the weighted average of the average ASMA additional times of all groups of similar inbound flights.

<sup>49</sup> Arrival ATFM delays that are considered in this section are constraints imposed on arrival traffic at destination, that result in delays experienced at the airport of departure.

<sup>50</sup> Note that, due to the lack of radar data to the CFMU, the ASMA additional time for Istanbul (IST) is not included in the analysis.

<sup>51</sup> The ASMA additional time at London (LHR) is to some extent influenced by decisions taken during the airport scheduling process regarding average holding time in stack.





Note: due to the lack of radar data to the CFMU, Istanbul (IST) was not included

Source: PRC analysis; CFMU

**Figure 8-4: ASMA additional time**

## PRE-DEPARTURE DELAYS DUE TO LOCAL ATC

8.2.11 When there are ATC constraints at the departure airport or in nearby airspace, departure traffic may be kept at the stand, without issuing ATFM regulations. Pre-departure delays due to ATC causes are recorded in the eCODA delay reporting system; IATA delay codes 89, (airside and ATC constraints).

8.2.12 Figure 8-5 shows the pre-departure delays at the top 12 airports, due to local ATC for the years 2008-2010.

8.2.13 With the exception of Istanbul (IST) and Madrid (MAD), pre-departure delays at the selected airports remained below one minute in 2010.

8.2.14 Delay reduction at London (LHR) in 2010 is mainly driven by a change in the way delay code 89 is recorded by British Airways, allowing a more accurate identification of ATC pre-departure delays.

### ATC local pre-departure delays

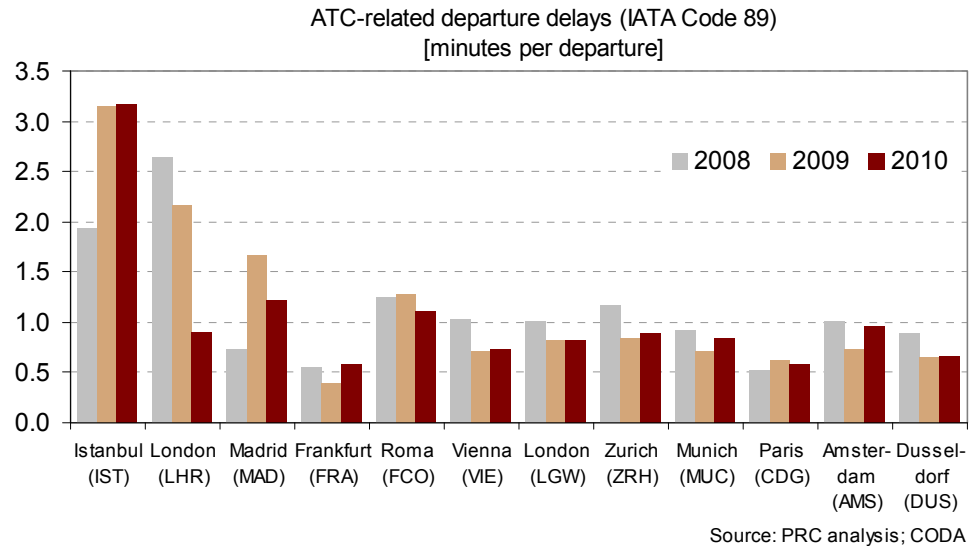
Pre-departure delays due to local ATC are a proxy for ATC induced delays at the departure stand as a result of demand/capacity imbalances in the movement area and/or TMA/CTR airspace nearby the airport.

This delay is measured by using the IATA delay code 89 which, besides delays caused by ATC constraints, also includes delays due to late push-back approval and other reasons. One advantage of using this data is the universal application of the IATA standard delay codes across European aviation. Current limitations of using the IATA delay code 89 are:

- it is currently not possible to filter out delays due to late push-back approval generated by an apron management unit which is not under ANS provider's responsibility; and,
- the data accuracy varies across airports depending on procedures which are in place to control the quality of the assignment of code 89.

Steps to address the identified limitations of IATA code 89 for ANS performance review:

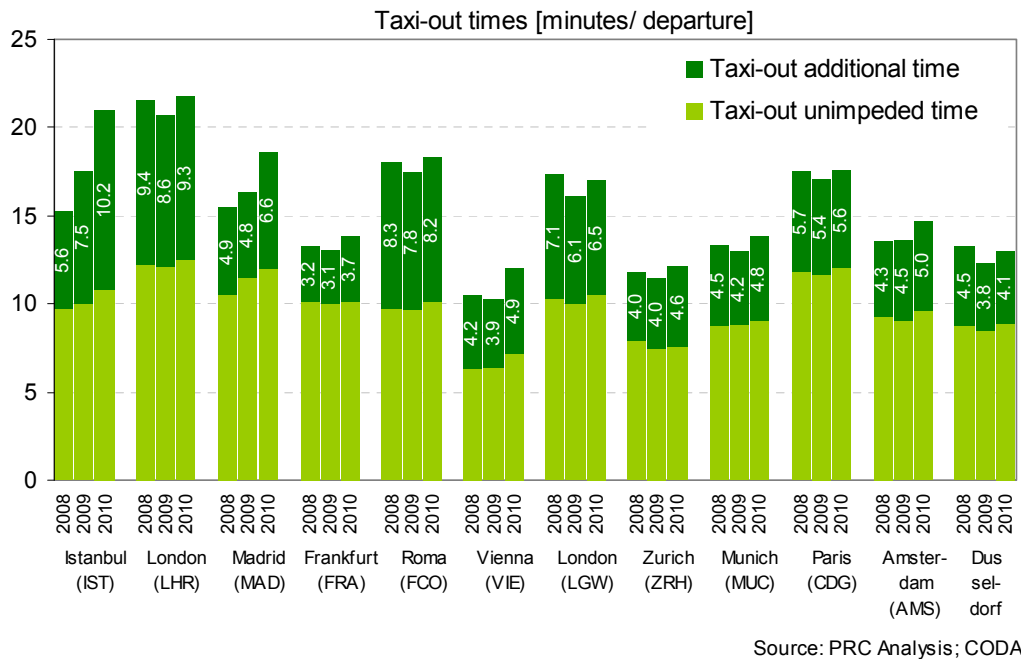
- IATA plans to increase the precision of delay code 89 through the introduction of sub-codes;
- Joint reviews on the quality of IATA delay codes conducted by airlines and airport operators. These initiatives have been increasing in recent years, especially at airports where CDM is either implemented or under implementation.



**Figure 8-5: Pre-departure delays due to local ATC**

#### TAXI-OUT ADDITIONAL TIMES AT THE TOP 12 AIRPORTS

8.2.15 Figure 8-6 shows the top 12 airports results of taxi-out additional times for 2008-2010.



**Figure 8-6: Taxi-out additional times**

8.2.16 The main points to be noted are:

- On average, there are slight variations in unimpeded times over the three years. However there are wide variations across airports, due to the different distances between runways and stands;
- There are a significant number of airports

#### **Taxi out additional time[Ref. 42]**

The taxi-out additional time is a proxy for the average runway queuing time on the outbound traffic flow, during times when the airport is congested.

The computation of the indicator is based on three consecutive steps:

- determination of the unimpeded time

with high taxi-out additional times (IST, LHR, MAD, FCO, LGW);

- When comparing such high taxi-out values at these six airports with the low level of local ATC pre-departure delays (see Figure 8-5), it seems that there is scope for reducing fuel burn and emissions by shifting some taxi-out additional times into ATC pre-departure delays at airports where the number of aircraft stands is not a limitation<sup>52</sup>.

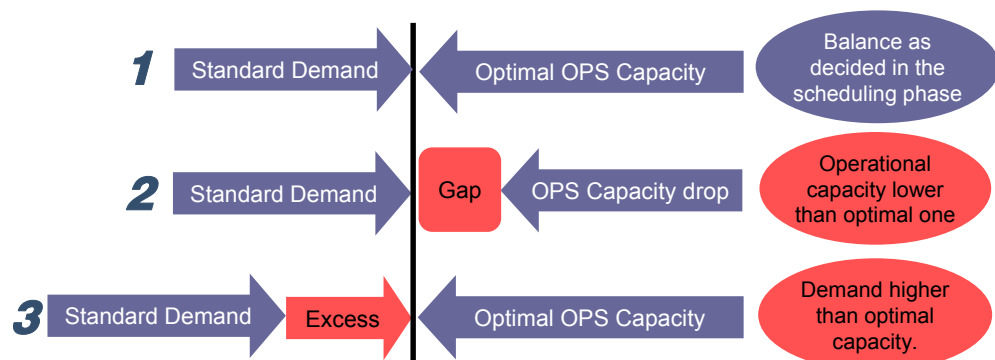
between stand and take-off, for groups of similar outbound flights (same aircraft class);

- calculation of the average additional time for each group of similar flights by comparing the average actual to the average unimpeded taxi-out time; and,
- the calculation of the average additional taxi out time for the airport which is the weighted average of the average taxi-out additional times of all groups of similar outbound flights.

### 8.3 Factors affecting ANS-related efficiency at airports

#### CAPACITY-DEMAND BALANCE AND FACTORS AFFECTING ANS-RELATED EFFICIENCY

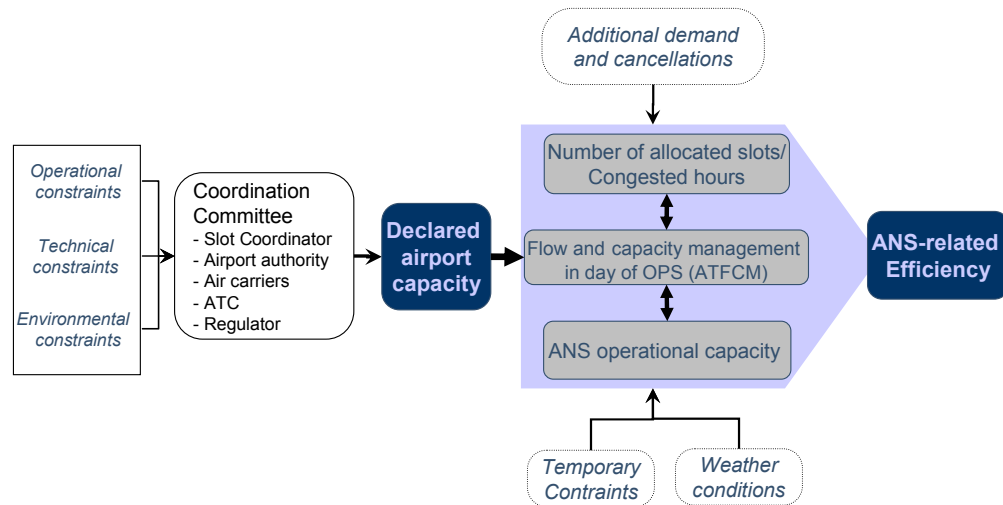
- 8.3.1 At coordinated and facilitated airports, the airport capacity is declared in advance of each IATA season to avoid frequent and significant excess in demand, which would generate poor quality of service. The airport declared capacity represents an agreed compromise between the maximisation of airport infrastructure utilisation and the quality of service, considered as locally acceptable (level of acceptable delay), for a given set of constraints (e.g. environmental). This trade-off is usually agreed between the airport managing body, the airlines operating at the airport and the local ATC provider, during the airport capacity declaration process.
- 8.3.2 After the airport capacity declaration, the airport slots are assigned to airlines. The airport slot allocation is a continuous process which goes from months before the day of operations until the day before operations, when the flight schedule list is completed. The airport slot allocation process has the objective of capping the demand at the level of the airport declared capacity.
- 8.3.3 Notwithstanding the airport capacity planning process, there will be periods when capacity drops and/or actual demand exceeds capacity during the day of operations. Adverse weather, temporary failures or unavailability of services can produce temporary capacity shortfalls. Demand bunching can occur as well.
- 8.3.4 On the day of operations, the level of ANS-related efficiency is the result of the demand versus capacity and of ANS' ability to manage such balance while providing minimal penalties to users. Figure 8-7 illustrates three typical situations which could occur on the day of operations.



**Figure 8-7: Capacity Demand balancing in days of operations**

- 8.3.5 When the operational capacity is at the level of the demand, or higher (see Figure 8-7, case 1), ANS should provide a service at the level of ANS efficiency as planned in the scheduling phase. When operational capacity is lower than demand (case 2 and 3), the

result, in terms of ANS-related efficiency, depends on ANS ability to reduce penalties to users while governing the imbalance. Usually ANS at airports provides an operational capacity slightly higher than the expected demand to cover traffic fluctuations.



**Figure 8-8: Factors affecting ANS-related Efficiency**

8.3.6 The main factors affecting ANS-related efficiency, see Figure 8-8, are as follows:

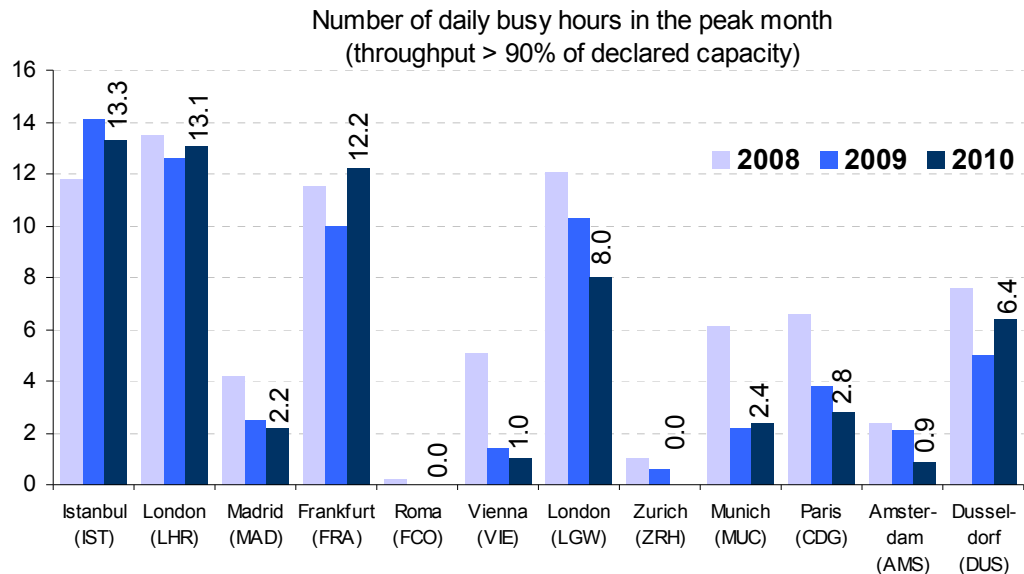
- the number of congested hours on the day of operations and day-to-day changes in the operational environment, affecting capacity and/or demand;
- the weather conditions and the number of “bad” weather days in a season;
- the level of ANS’ operational capacity: its ability to meet the airport capacity declaration in optimal operating conditions, and ability to resist adverse weather conditions;
- the ANS’ ability to manage flow and capacity, whilst reducing the impact of capacity-demand imbalances, whenever and for whatever reasons they occur; and,
- the noise management strategy at the airport and its impact on the use of runways and surrounding airspace (see also aircraft noise at airports in Chapter 9).

### CONGESTED HOURS

8.3.7 The degree of congestion at an airport reflects the ability of ANS to handle degraded situations and to recover performance, once a degraded situation has ended. If an airport has many congested hours, it is crucial to maintain high throughput, irrespective of weather conditions, in order to avoid knock-on effects throughout the day.

8.3.8 Congested traffic hours are measured by counting the hours during which traffic handled was at least 90% of the declared capacity. This measure gives an indication of the intensity of operations in the daily activity. It does not provide information about the saturation of an airport from a scheduling viewpoint.

8.3.9 Figure 8-9 shows the number of daily congested hours at the selected airports. The three airports with the highest number of congested hours (IST, LHR, FRA) are also among the most penalising airports in terms of ANS efficiency performance (see Figure 8-2).



Source: CFMU, Slot Coordination; LSSIP

**Figure 8-9: Global throughput over 90% of the declared capacity at Top 12 airports**

8.3.10 In 2010, all 10 airports (excluding Zurich (ZRH) and Rome (FCO)) have some congested hours each day, although traffic has been reducing since 2009. It should be noted that this happens in spite of demand having been already strategically capped at those airports not to exceed the airport declared capacity. Considering that significant airport capacity increases (new runways, new terminals, etc.) require a long lead time before implementation, the lack of airport capacity is already a serious constraint [Ref. 43].

#### WEATHER CONDITIONS

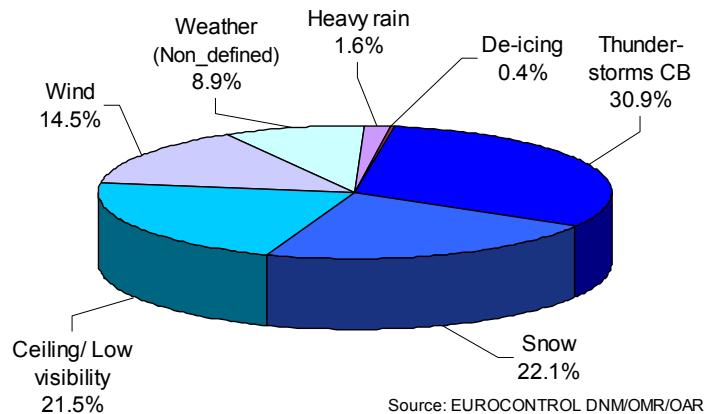
8.3.11 The main weather conditions which could affect airport and/or ANS performance are: poor visibility, freezing conditions, strong winds and convective weather.

8.3.12 There is generally no immediate relationship between the weather conditions and the ANS/ airport performance, as the real impact of weather conditions on airports depends on additional factors, such as:

- the airport traffic levels and the number of congested hours;
- the ANS and airport equipment to mitigate adverse weather;
- the exposure of given runway systems to particular wind conditions;
- the negative interaction between noise constraints and weather; and,
- the ANS flow management strategy to cope with airport capacity drops.

There is however a statistically significant relationship between airport capacity and weather as indicated in Figure 8-13.

8.3.13 Figure 8-10 shows a breakdown of weather-related ATFM delays by type of delay to illustrate the impact of weather on ATFM delays in Europe in 2010. At system level, thunderstorms had the highest impact in terms of ATFM delays in 2010, followed by snow, poor visibility and wind.



**Figure 8-10: Impact of weather phenomena on ATFM delays**

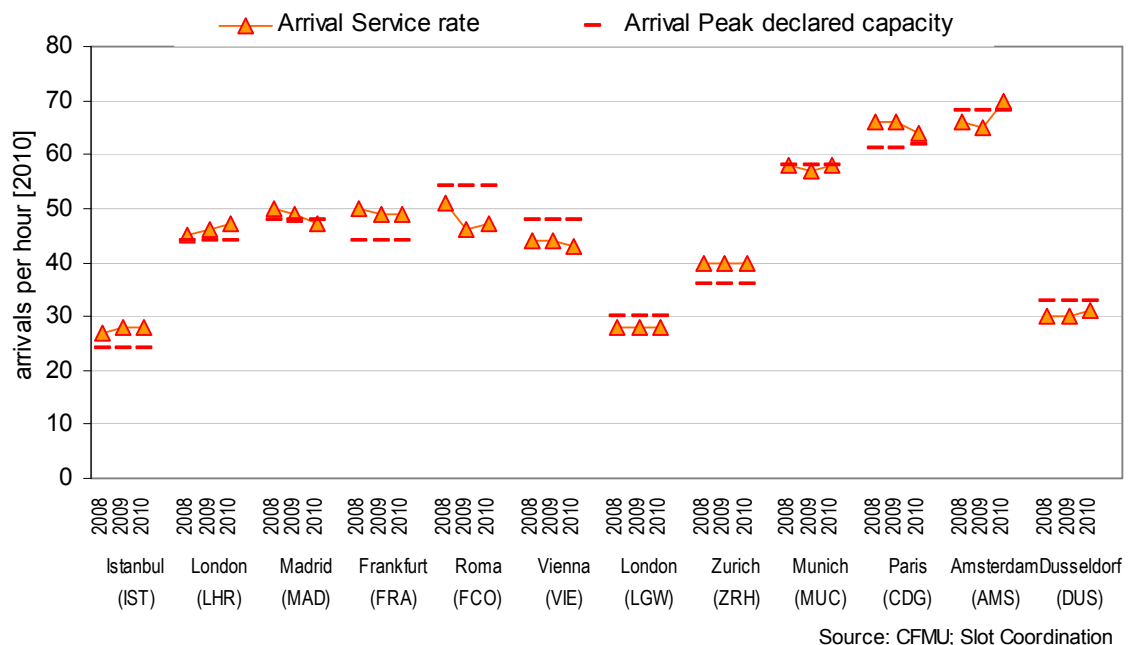
8.3.14 ANS operational capacity in adverse weather conditions is analysed in §8.3.26 onward.

#### ANS OPERATIONAL CAPACITY IN GOOD OPERATING CONDITIONS

8.3.15 The ANS operational capacity is assessed using the peak service rate (i.e. peak throughput) which is an imperfect measure for ANS operational capacity when it is lower than the peak airport declared capacity. In this case, it is necessary to determine whether a variation in peak service rate is driven by a change in demand or by a change in operational capacity.

8.3.16 Figure 8-11 and Figure 8-12 show the peak declared and peak service rate for arrivals and departures respectively.

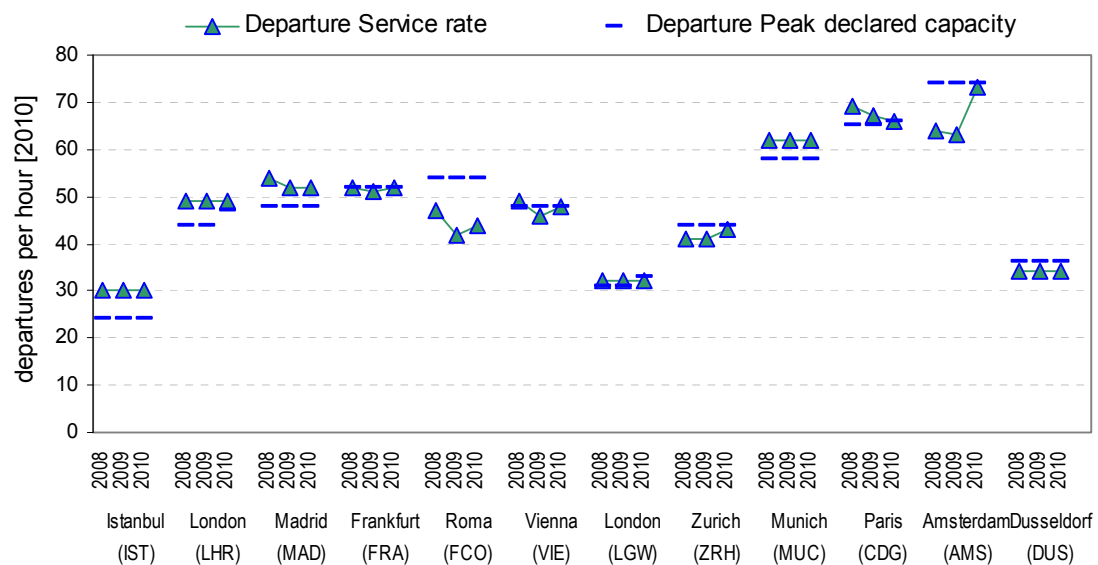
8.3.17 For arrivals (Figure 8-11), the peak declared capacity did not change at 11 airports between 2008 and 2010; capacity at Paris (CDG) was increased by one unit.



**Figure 8-11: Arrival peak declared capacity and service rate [2010]**

8.3.18 It is worth noting that a number of airports (IST, LHR, FRA, LGW, ZRH, MUC, CDG, and AMS) could operate above the peak arrival declared capacity when demand exists.

- 8.3.19 Madrid (MAD) and Vienna (VIE) tend to constrain the traffic below the declared capacity using ATFM regulations, during days of good operating conditions.
- 8.3.20 At Rome (FCO), the peak arrival throughput is below declared capacity simply due to changes in the demand and not due to operational capacity constraining the demand.
- 8.3.21 In Figure 8-12, the peak departure declared capacity did not change at 11 airports between 2008 and 2010: Paris (CDG) increased the capacity by one unit.
- 8.3.22 A number of airports (IST, LHR, FRA, MAD, LGW, VIE, ZRH, MUC, CDG, AMS) were able to operate above the peak departure declared capacity when demand exists.



Source: CFMU, Slot Coordination

**Figure 8-12: Departure peak declared capacity and service rate [2010]**

- 8.3.23 The change from 2009 to 2010 in Amsterdam (AMS) is related to changes in traffic distribution.
- 8.3.24 The departure peak service rate at Madrid (MAD) decreased between 2009 and 2010, accompanied by an increase in taxi-out additional times.
- 8.3.25 Although the peak throughput remains significantly below the peak declared capacity, the taxi-out additional time at Rome (FCO) is considerably high (above 6 minutes). The situation is expected to improve in 2012 or earlier due to CDM phase I implementation and/or other initiatives.

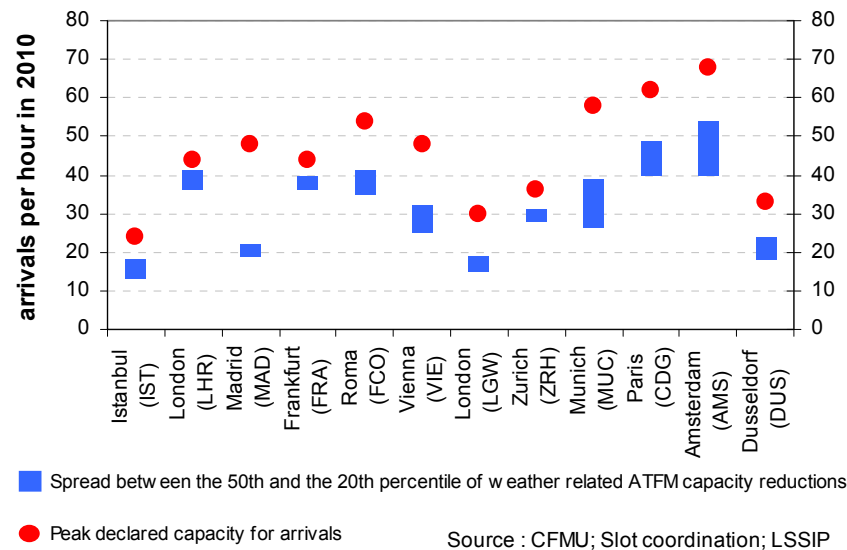
#### ANS OPERATIONAL CAPACITY IN ADVERSE WEATHER CONDITIONS

- 8.3.26 The arrival and departure airport capacity drops in adverse weather conditions. ANS is responsible for organising the arrival/departure sequences in order to maximise the use of the available airport capacity while minimising penalties for users.
- 8.3.27 Arrival capacity reductions are driven by strong winds, low visibility, runway friction reduction caused by precipitations or ice, and convective weather. These conditions can increase the landing and take-off time intervals between flights, generating longer traffic queues, delays, and ASMA additional times.
- 8.3.28 Depending on the severity of such weather conditions and on the measures taken for mitigating the impact of adverse weather, there could be significant drops in operational



capacity requiring the application of ATFM regulations.

8.3.29 Figure 8-13 shows the spread of weather-related ATFM restrictions for arrivals at the 12 airports, as well as peak declared capacity.



**Figure 8-13: Arrival operational capacity reduction due to adverse weather [2010]**

8.3.30 Frequent and accurate meteorological forecasts, information on runway friction and coordination with stand/gate allocation units are important for ANS to optimise arrivals.

8.3.31 Although less influenced by strong winds and visibility, the departure capacity can be heavily influenced by freezing conditions (snow, ice, high humidity in low temperatures). A close co-operation between ANS, de-icing companies and airport maintenance teams is important to mitigate the impact of freezing conditions.

8.3.32 An effective airport CDM process could enable ANS to access the relevant information for both arrivals and departures in a timely manner [Ref. 44].

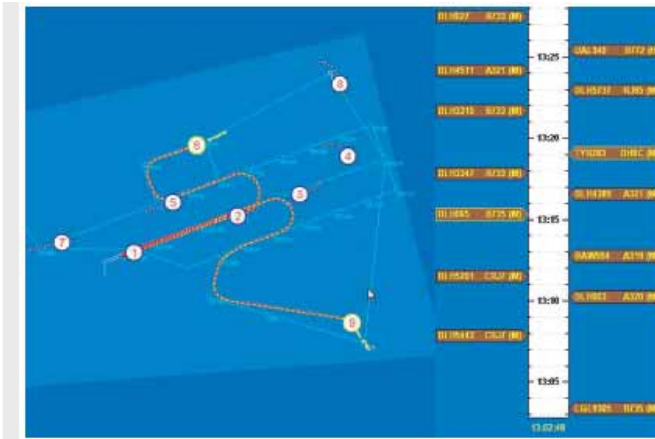
#### EFFICIENCY OF FLOW MANAGEMENT AND SEQUENCING AT AIRPORTS

8.3.33 Flow management and sequencing are ANS functions related to the management of capacity-demand imbalances.

8.3.34 The main elements of Air Traffic Flow and Capacity Management (ATFCM) are the CFMU in Brussels and the secondary ATFCM units at each ACC (FMPs). ATFCM imposes delays at the departure stand whenever the arrival demand could exceed the handling capacity at the destination airport.

8.3.35 The sequencing function at airports can include:

- the arrival management function (AMAN) (procedures, tools, etc.) to handle arrival flights in the surrounding airspace of the airport; AMAN manages the arrival queuing and the ASMA additional times in order to balance the demand with the availability of runway capacity at a given time in the day of operations; and,
- Collaborative Decision Making (CDM) and the departure management (DMAN) functions manage the departure queuing, the ATC pre-departure delays and the taxi-out additional times in order to balance the demand with the availability of runway capacity at a given time in the day of operations.



### **Arrival Management Function (AMAN)**

Controllers managing the inbound traffic perform the following tasks:

1. Build an arrival sequence.
2. Assign an arrival time at the runway threshold (and other significant waypoints) to each aircraft in the sequence.
3. Predict a 4D trajectory (including spacing and holding times) for each aircraft which implements the assigned landing time.
4. Transform the trajectory into appropriate guidance instructions which are transmitted to the pilot via voice or data link.

8.3.36 The ability of ANS to balance capacity with demand depends on three main factors:

- the selected strategy for maximising the use of available airport capacity while minimising penalties for users. The appropriate mix between delays at the stand (cheaper and less polluting) and additional times in the air or in the taxiway (more expensive and more polluting, but more responsive to changes) has to be selected;
- the precision of the intervention (i.e. only applying restrictions to the lowest possible number of aircraft and shortest period necessary to reduce the imbalance). The precision of the intervention is not measured in this report; and,
- the impact of the network on airport operations.

8.3.37 In Figure 8-3, it can be noted that arrival ATFM delays are usually only used during unfavourable weather conditions with the exception of Istanbul (IST), Madrid (MAD), and Vienna (VIE). In the other eight airports, during good weather conditions, the ASMA additional times are predominantly used to handle the capacity-demand balancing. In normal operating conditions, arrival traffic should be managed without imposing ATFM regulations at the departure airport.

8.3.38 During degraded operating conditions, it is necessary to strike a reasonable balance between airport ATFM delays incurred at the departure airport and ASMA additional times incurred in the terminal area. Although airport ATFM delays are regularly monitored by EUROCONTROL, ASMA additional times are monitored neither by EUROCONTROL nor by most of the ANS units concerned. Information on transit time in terminal areas as well as airport ATFM delays is required for optimised arrival flow management.

8.3.39 Finally, in Figure 8-4, it can be noted that European airports impose different levels of ASMA additional times in managing the arrival sequence. One question to be addressed is: in normal operating conditions, what is the optimal level of ASMA additional time for optimising the use of airport arrival capacity?

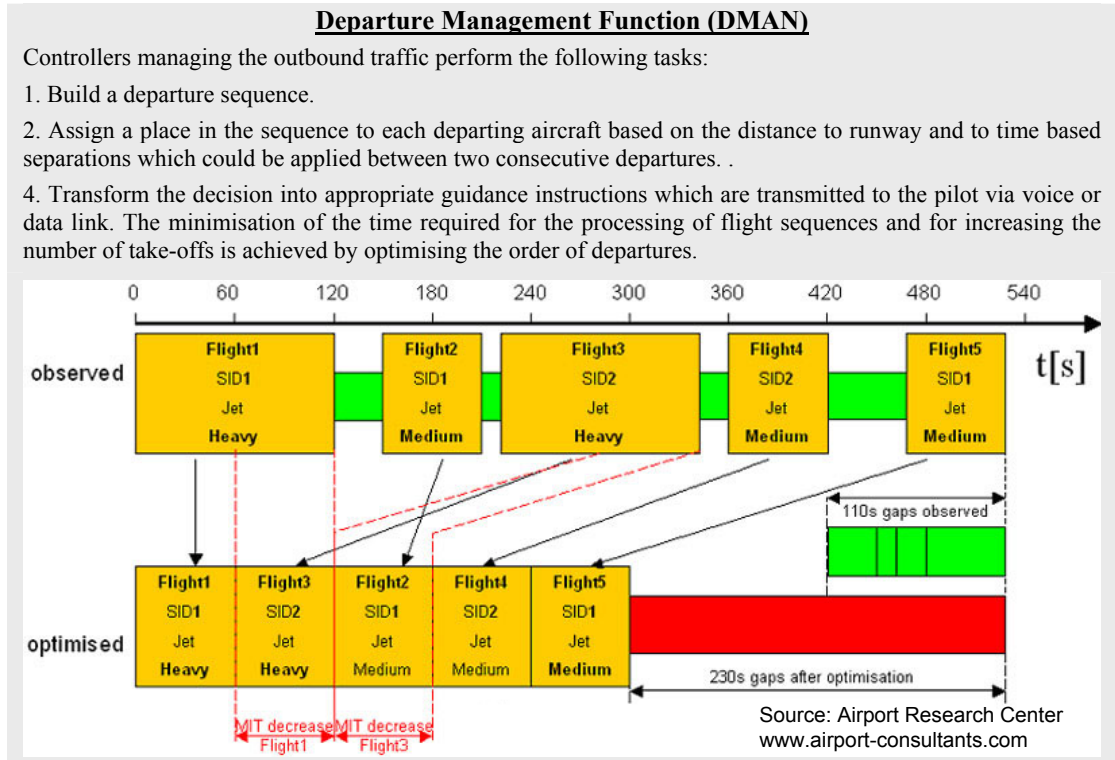
8.3.40 The availability of tools, procedures and airspace design solutions could also influence the level of ASMA additional times. Recently, EUROCONTROL has reviewed the availability of arrival management technology across European airports [Ref. 45]. Most major airports are equipped with such a tool, but others such as, inter alia, Madrid (MAD), Rome (FCO), Barcelona (BCN) and Istanbul (IST) are not equipped yet.

8.3.41 The full and coordinated exploitation of the AMAN tool would be very useful at congested airports.

8.3.42 The use of AMAN varies somewhat across European ACCs/APPs where it is available and there are clear indications that the potentialities of the AMAN tool are not exploited to the maximum extent. Moreover, the use of AMAN is generally limited to TMA/CTR

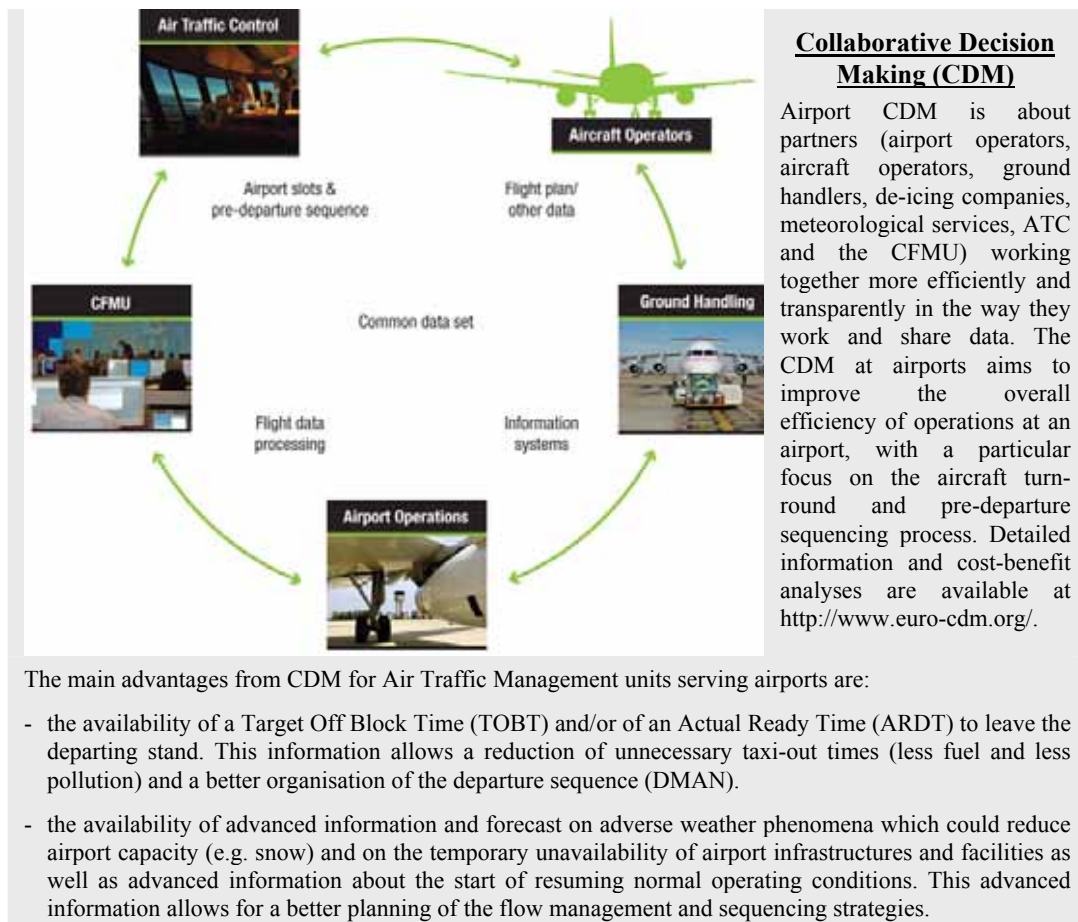
airspace and desirably should extend further away through appropriate coordination with upstream ATC sectors or units.

- 8.3.43 Another constraint to ANS performance during strong wind conditions is the fact that separations standards between arrival flights are expressed in distance rather than time. This has been an R&D item for more than 10 years, but no useful solutions have yet been introduced in operations.



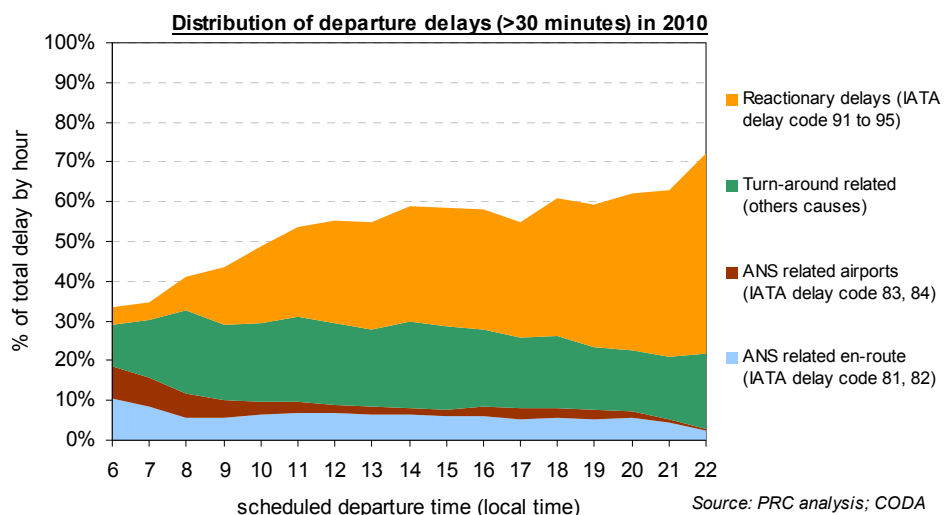
- 8.3.44 With regard to the management of the departure flow, analysing both Figure 8-5 and Figure 8-6, it can be noted that in Munich and Zurich, the level of taxi-out additional times is relatively low and the ratio between ATC pre-departure delays and taxi-out additional times is rather stable through time (between 2008 and 2010). This is not the case in Istanbul (IST), London (LHR), Madrid (MAD), Rome (FCO), and London (LGW), where taxi-out additional times are rather high, ATC pre-departure delays rather low and the ratio between ATC pre-departure delays and taxi-out additional time rather unstable.

- 8.3.45 The reason may be that Munich and Zurich apply CDM/DMAN procedures, while other above-mentioned airports have not or incompletely implemented them.



## REACTIONARY DELAYS

8.3.46 Reactionary delays build up from early morning until late evening at European airports (see Figure 8-14). In daily operations, there is no common awareness across aviation stakeholders of the build up of reactionary delay at network level.



**Figure 8-14: The building up of reactionary delays in daily operations**

8.3.47 It would be worth investigating how ANS could contribute in reducing reactionary delays and whether in the long run the situation could be improved by changing the current ATFM priority rule from “First planned, first served (FPFS)” into “First scheduled, first served (FSFS)”.

## 8.4 Improving ANS-related performance at airports

8.4.1 ANS-related performance at airports could be improved through:

- the enhancement of local enablers; and,
- an enhanced relationship between airport and network operations.

### LOCAL INTERVENTIONS TO IMPROVE ANS-RELATED PERFORMANCE

ENHANCEMENT	IMPROVED PERFORMANCE
Airport Collaborative Decision Making (A-CDM) and Departure Management (DMAN).	One of the most valuable outputs of Airport CDM is an accurate target off-block sequence which can be used by ATC to organise an efficient departure sequence. Start-up clearances can therefore be issued by ATC according the departure sequence and the queue size can be limited to the strictly necessary to maximise runway throughput, being the excess demand held at the stand (as opposed to taking the delay in the queue with the engines running).
Use of enhanced meteorological and climatological information in the operational capacity and demand balancing processes to improve the overall ANS performance in foreseen and unforeseen unfavourable weather conditions.  This includes the use of information on the likelihood and confidence (uncertainty) of weather phenomena to occur, in support of true knowledge guided decisions. Best practices, supported by clear business benefits of the users exist both in Amsterdam (AMS) and in Paris (CDG).	Sharing information on meteorological phenomena including information on the uncertainty in time and space, in addition to the traditional deterministic type of meteorological products used by decision makers today, add value to CDM processes and AMAN/DMAN type of applications by quantifying real uncertainties, potential perceptions and expectations and threats with respect to the overall ANS efficiency in foreseen and unforeseen (adverse) weather and moreover to enhance the precision of flow and capacity management actions and as such reducing penalties for users during capacity drops
Use of Arrival Manager (AMAN): time based separations during strong winds and the integration of meteorological information into arrival operations.	Arrival ATFM delays and ASMA additional times could be reduced during strong or unfavourable winds from an overall arrival management perspective.

**Figure 8-15: Enhancing local enablers to improve ANS performance at airports**

### THE RELATIONSHIP BETWEEN THE AIRPORT AND THE NETWORK FUNCTIONS

8.4.2 It is widely recognised that there could be significant improvements in ANS performance, if the relationship between the network and the airport was enhanced and awareness of the traffic/capacity situation was shared at network and local levels.

8.4.3 Common awareness of performance in daily operations is rather limited (see Figure 8-16). This creates misperceptions and potential misunderstandings between aviation stakeholders.

Data sets and indicators necessary for common awareness	ANS Network	Airports
Meteorological conditions	Not monitored, but information is available.	Monitored
ASMA additional times or similar indicators	Information not available	Monitored at some European airports (DUS, FRA, LHR, LGW, MUC)
Taxi-out additional times	Information not available	Monitored at some European airports (DUS, CDG, LHR, LGW, MUC)
TOBT or RDY information	Only available for MUC	Available at a number of European airports (BRU, CDG, FCO, MUC, ZRH, etc.)
Information on Actual In Block and Off Block Times	Information not available	Available at all airports

Information on actual, expected and minimum turn around times	Information not available	Available at all airports
Propagation of reactionary delays	Information not available	Limited information available

**Figure 8-16: Current awareness of the status of performance in daily operations**

8.4.4 The sharing of information between the Network functions and the airport will provide the following benefits:

- an improved traffic picture (actual and predicted traffic) at all nodes of the network including airports;
- a common awareness where the network problems are located and which nodes of the network are impacted;
- the avoidance of misperceptions on the status of performance and associated misunderstandings across aviation stakeholders.

## 8.5 ATFM slot adherence at airports

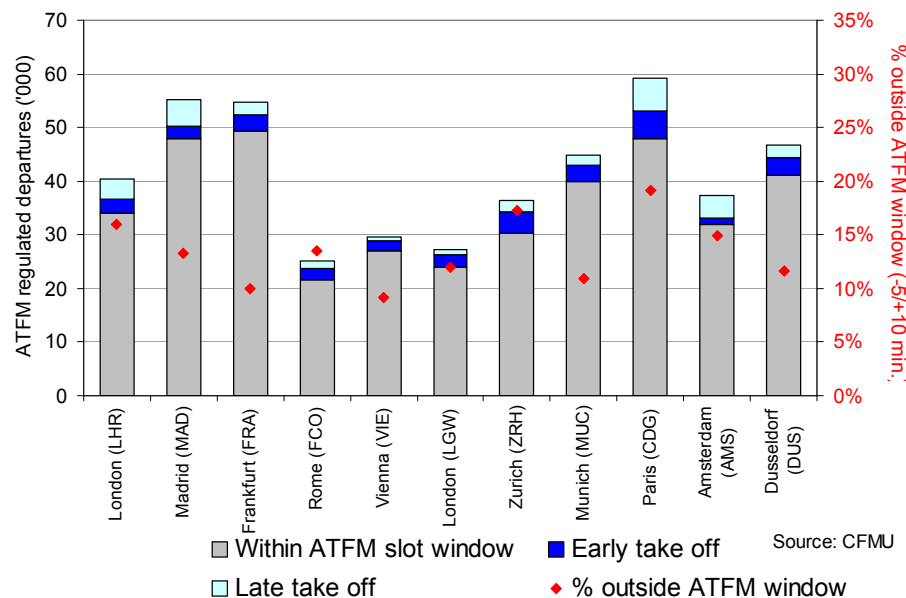
8.5.1 Regulation 255/2010 [Ref. 46] is expected to have a positive impact on ATFM slot adherence, which is addressed directly in its Article 11. At airports where the share of take-offs outside the ATFM slot window is 20% or higher, the respective ATS units have to provide relevant information of non-compliance and the actions taken to ensure adherence to ATFM slots.

### ATFM slot adherence

ATFM slot adherence measures the share of take-offs outside the allocated ATFM window. An ATFM slot tolerance window (-5min +10 min) is available to ATC to organise the departure sequencing.

ATC at the departure airport has a joint responsibility with aircraft operators to depart within the allocated ATFM window in order to avoid over-deliveries.

8.5.2 Figure 8-17 shows the proportion of ATFM regulated flights departing outside the ATFM window at 11 airports during 2010. Aggregate trends are shown in Figure 6-3.



**Figure 8-17: ATFM slot adherence at airports [2010]**

8.5.3 The ability to control adherence to ATFM slots is high in Munich where A-CDM procedures are applied. However, some airports without A-CDM procedures (e.g. Rome FCO) also have good performance with respect to this indicator.



## 8.6 Conclusions

- 8.6.1 Congestion remains an issue at several major European airports, notwithstanding: (i) the traffic downturn in 2009 and (ii) capping of demand through the airport co-ordination process.
- 8.6.2 In view of the long lead time required to increase airport capacity (new runways, new terminals, etc.) significant problems can be expected when traffic grows.
- 8.6.3 The airport arrival ATFM delays increased by +30% compared to 2009 (1.8 minutes per arrival). The terminal area transit time (ASMA) increased by +8% (2.8 additional minutes per arrival).
- 8.6.4 Departure delays attributable to local ATC constraints remained stable, but taxi-out additional times increased by 0.6 minutes. This is a negative trend.
- 8.6.5 Istanbul (IST), London Heathrow (LHR) and Gatwick (LGW), Madrid (MAD), and Rome (FCO) generated high taxi-out additional times (+6 to +10 minutes). CDM/DMAN can contribute to a more efficient management of the departure flow, and its implementation should be considered by these airports.
- 8.6.6 Arrival ATFM delays are monitored by EUROCONTROL, but the other above-mentioned TMA/airport efficiency KPIs are not. Active monitoring and management of those performance indicators, both by the Network Management function and local ATC units could bring significant benefits.
- 8.6.7 Reactionary delays amount to 46% of all air transport delays. The propagation of delays through the network and their potential mitigation by the Network functions and the revision of the current ATFM priority rule would be worth investigating.
- 8.6.8 Significant improvements in ANS performance could be achieved by enhancing the relationship between the Network functions and airports.
- 8.6.9 The following measures could be taken to mitigate the impact of adverse weather conditions:
  - provision of early information on the capacity of airport/handling infrastructures (e.g. de-icing); status of the airport movement area; and enhanced meteorological forecasts, combined with effective CDM processes, would help ANS to exercise its role of managing traffic at the airport; and,
  - improved management of arrivals in strong wind conditions (weather information input in arrival manager tools and introduction of time-based separations).



# Chapter 9: Environmental Impact of ANS

KEY POINTS	KEY DATA 2010		
1. Emissions from aviation account for approximately 3.5% of total CO <sub>2</sub> emissions in Europe. The part that can be influenced by ANS contribution is limited to 0.2% of total emissions.	IFR Flights controlled <sup>53</sup>	9.5 M	+0.8%
	Tot. CO <sub>2</sub> emissions from aviation within Europe	≈ 138Mt	+3.9%
	Avg. fuel burn per flight in European airspace	≈ 4.7t	+3.0%
	Total ANS actionable CO <sub>2</sub> emission	≈ 8.6Mt	+6.8%
	ANS-related fuel efficiency	≈ 93.8%	-0.2%
2. ANS-related fuel efficiency is already high (≈94% in 2010). Further improvement can be achieved in particular by improving the route network and by better managing the flow to/from main airports. Improvements made in 2010 were however cancelled-out by the impact of the ash cloud and ATC industrial tensions in France and Spain.	CO <sub>2</sub> emission actionable by ANS by flight phase		
	Horizontal flight phase	≈ 5.1Mt	+5.8%
	ASMA inefficiencies	≈ 1.7Mt	+11.3%
	Taxi out inefficiencies	≈ 1.0Mt	+9.6%
3. Noise management at airports is an important issue and a well balanced and forward looking strategy is required by Airport Operator, ANSP, CAA and the local land use planning authorities to reduce noise exposure and the number of inhabitants affected by noise while optimising the use of airport capacity.			

## 9.1 Introduction

- 9.1.1 Sustainable development is an increasingly important political, economic and societal issue and the aviation industry has a responsibility to minimise its global and local impact on the environment. This chapter addresses the role of ANS in the reduction of aviation's environmental impact, which should be seen as an evolutionary rather than a revolutionary process.
- 9.1.2 The first part of this chapter focuses on the global impact and evaluates the ANS contribution towards minimising the impact of aviation on climate (Section 9.2 to 9.5). The second part of this chapter (Section 9.6 onwards) looks at local air quality and noise at major airports.

## 9.2 Reducing aviation's impact on climate

- 9.2.1 Climate relevant emissions from aviation include carbon dioxide (CO<sub>2</sub>) contrails and cirrus clouds (H<sub>2</sub>O), oxides of nitrogen (NO<sub>x</sub>) oxides of sulphur (SO<sub>x</sub>) and soot.
- 9.2.2 CO<sub>2</sub> can remain in the atmosphere for over 100 years and is considered to be the most important greenhouse gas (GHG) with the largest cumulative impact on climate.
- 9.2.3 Contrails (short for "condensation trails") are the visible trails of condensed water vapour (H<sub>2</sub>O) made by the exhaust of aircraft engines. Depending on atmospheric conditions, contrails may be visible for a few seconds or minutes, or may persist for some hours. The climate impact of cirrus clouds and contrails depends not only on traffic density but also on weather, temperature and ground surface reflection.
- 9.2.4 According to the European Environmental Agency (EEA), transport accounts for around a quarter of total CO<sub>2</sub> emissions<sup>54</sup>. Aviation's relative share accounts for approximately 3.5% of total anthropogenic CO<sub>2</sub> emissions in Europe<sup>55</sup> and is therefore comparatively

<sup>53</sup> ESRA 2008 area (see Glossary).

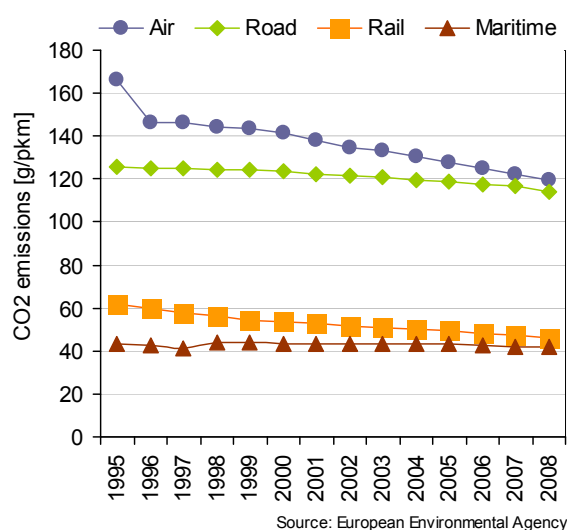
<sup>54</sup> Ideally the evaluation of CO<sub>2</sub> emissions by sector should not be based on direct fuel burn but should also consider emissions related to power production, building of transport infrastructure etc.

<sup>55</sup> The Intergovernmental Panel on Climate Change (IPCC) (2007) estimates that international aviation contributes about 3% to anthropogenic global warming.

small. Its evolution will be partly driven by traffic growth, technological improvements (aerodynamic and engines) and use of alternative energy sources, but also by the long lead time necessary to take the full benefit of these improvements (the lifespan of an aircraft is typically 30 years).

9.2.5 Although the aviation share of total CO<sub>2</sub> emissions is still comparatively small, in view of the forecast traffic growth and the environmental and economic benefits, the aviation industry has a responsibility to minimise its impact on climate by further improving aviation efficiency.

9.2.6 The amount of CO<sub>2</sub> emitted per passenger km for different modes of transport is largely determined by the type of vehicle (aircraft, train, and car), vehicle utilisation (load factor) and driving characteristics (speed, distances).

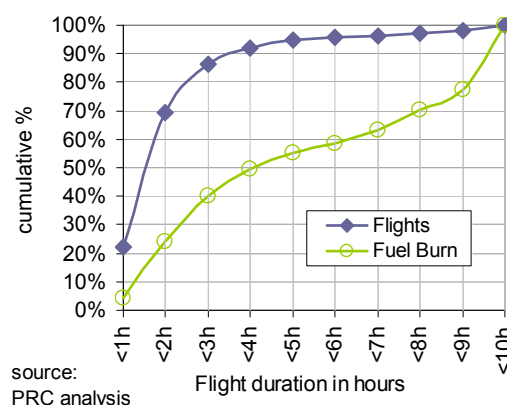


**Figure 9-1: CO<sub>2</sub> emissions per mode of transport in Europe**

9.2.7 Figure 9-1 shows a continuous reduction of CO<sub>2</sub> emissions per passenger km from aviation in Europe reaching a level close to road transport in 2008. Aviation CO<sub>2</sub> efficiency and the contribution of ANS towards reducing CO<sub>2</sub> emissions is evaluated in more detail in section 9.4 of this chapter.

9.2.8 Figure 9-2 shows the number of flights<sup>56</sup> and corresponding fuel burn for the full flight distance by flight time in 2010.

9.2.9 Almost one quarter of flights are less than 1 hour and account for only ≈4% of total fuel burn. The remaining ≈96% of the fuel burn originates from flights longer than one hour, for which the potential of substitution with alternative modes of transport is limited in practice<sup>57</sup>.



**Figure 9-2: Fuel burn by duration of flight**

### 9.3 Aviation related environmental policy and targets

9.3.1 After almost a decade of deadlock on how to address emissions from international aviation, ICAO Contracting States made the first global governmental agreement to commit the aviation sector to reduce greenhouse emissions from international aviation at the ICAO 37<sup>th</sup> Assembly in October 2010.

<sup>56</sup> Only departing flights are considered to avoid double-counting of flights within Europe and to allow global consolidation of such statistics. Similar statistics would be obtained for arrival flights. Overflights are nearly negligible (~0.5% of flights).

<sup>57</sup> The improvement of fuel efficiency on long haul flights requires wider cooperative agreements between regions (see also AIRE initiative in Section 9.5).

9.3.2 The ICAO resolution was presented at the UN climate talks (UNFCCC COP 16) in December 2010 but no reference was made to aviation in the final COP 16 text. The ICAO resolution contains a number of noteworthy elements:

- a global goal of 2 % annual fuel efficiency improvement up to the year 2050, supplemented with further exploration of the feasibility of more ambitious medium and long-term goals, including carbon-neutral growth (CNG) and emissions reduction of the sector;
- development of a CO<sub>2</sub> certification standard for aircraft engines by 2013 and facilitation of operational improvements to further reduce aviation emissions;
- development of a global framework for market-based measures (MBM) in international aviation by the next Assembly in 2013;
- further elaboration on measures to assist developing States and to facilitate access to financial resources, technology transfer and capacity building; and,
- submission of State action plan to ICAO by June 2012, outlining their policies and actions, and annual reporting of data to ICAO on their aviation fuel consumption.

9.3.3 The Flightpath 2050<sup>58</sup> goals for 2050 [Ref. 47] envisage technologies and procedures available to enable (relative to the capabilities of a typical new aircraft in 2000):

- a 75% reduction in CO<sub>2</sub> emissions per passenger kilometre to support the global aviation sector goals (Carbon-neutral growth starting 2020 and a 50% overall CO<sub>2</sub> emission reduction by 2050);
- a 90% reduction in NO<sub>x</sub> emissions;
- a 65% reduction of the perceived noise emission of flying aircraft; and,
- emission free aircraft movements when taxiing.

#### ENVIRONMENTAL POLICY – THE EUROPEAN CONTEXT

9.3.4 At European level, the two most relevant policy measures with regard to mitigating the aviation related impact on the environment are the EU Emission Trading Scheme (ETS) and the Single European Sky (SES).

9.3.5 To cap the aviation sector's CO<sub>2</sub> emissions, the EU decided to include it in the European Union Emission Trading Scheme (EU ETS), which was originally limited to stationary sources of CO<sub>2</sub>. This makes aviation the first, and thus far the only, transport mode included in the EU ETS. It will require the aviation sector to either realise CO<sub>2</sub> emission reductions or to buy allowances on the market thus contributing to the reduction of emissions from other sectors.

9.3.6 It is interesting to point out that the EU ETS will not only affect European airlines, but all aircraft arriving or departing from EU airports.

9.3.7 For the 1<sup>st</sup> trading period in which aviation is included (starting in 2012), the CO<sub>2</sub> allowance is set to 97% of average annual aviation emissions during the years 2004–2006. For the 2<sup>nd</sup> trading period (2013–2020), the limit will be set to 95% of the baseline.

9.3.8 For the period 2013–2020, 82% of the allowances will be allocated free of charge to aircraft operators and

#### **EU ETS and Aviation**

According to Directive 2003/87/EC [Ref. 48] and subsequent amendments, aircraft operators will be obliged to surrender “allowances” for virtually all commercial flights with a take off weight of 5.7t or above, landing at and departing from any airport in the EU as from 2012. Domestic aviation will be subject to the same rules as international air traffic.

Aircraft operators with a relatively low number of flights have been exempted

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58 Flightpath 2050 continues the work that the Advisory Council for Aeronautics Research in Europe (ACARE) has been doing since 2001 beyond 2020 to 2050.

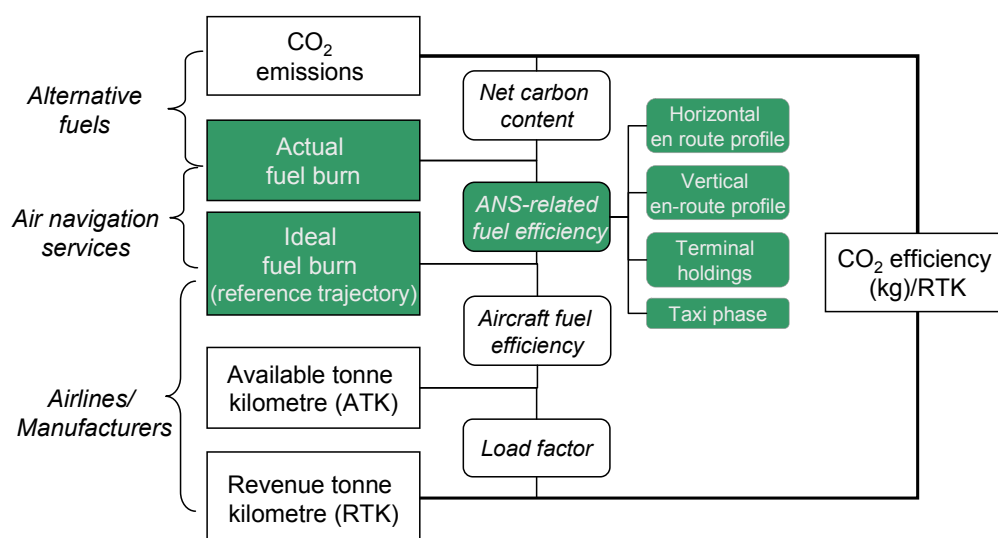
15% of the CO<sup>2</sup> allowances are allocated by auctioning. The remaining 3% will be allocated to a special reserve for later distribution to fast growing airlines and new entrants into the market.

to avoid excessive administrative cost burden. The so-called “de minimis” clause excludes operators with fewer than 243 flights per 4-months period for three consecutive 4 months periods was added to the Directive.

- 9.3.9 In addition to the EU ETS, the SES performance scheme (see Chapter 2) and related initiatives such as the Flexible Use of Airspace (FUA) Concept, the creation of Functional Airspace Blocks (FABs) to reduce the level of fragmentation in Europe, and in due course SESAR are expected to drive flight efficiency and capacity improvements with resulting positive effects on fuel burn and the environment.

## 9.4 Aviation CO<sub>2</sub> efficiency

- 9.4.1 Figure 9-3, provides a conceptual framework for the analysis of aviation CO<sub>2</sub> efficiency. The contribution of aviation is the product of four factors (net carbon content, ANS-related fuel efficiency, aircraft fuel efficiency and load factor), which correspond to different accountabilities and performance improvement options.



**Figure 9-3: Factors affecting aviation CO<sub>2</sub> efficiency**

- 9.4.2 Aviation CO<sub>2</sub> efficiency is measured in kilograms of CO<sub>2</sub> per Revenue Tonne Kilometre (RTK), or similar measure of commercial aviation output.

- 9.4.3 Alternative (non-fossil) fuels are therefore a potentially powerful way to decouple aviation emissions growth from air traffic growth, but much research, development, investment and time are still needed before any significant deployment can take place.

### Net carbon fuel content

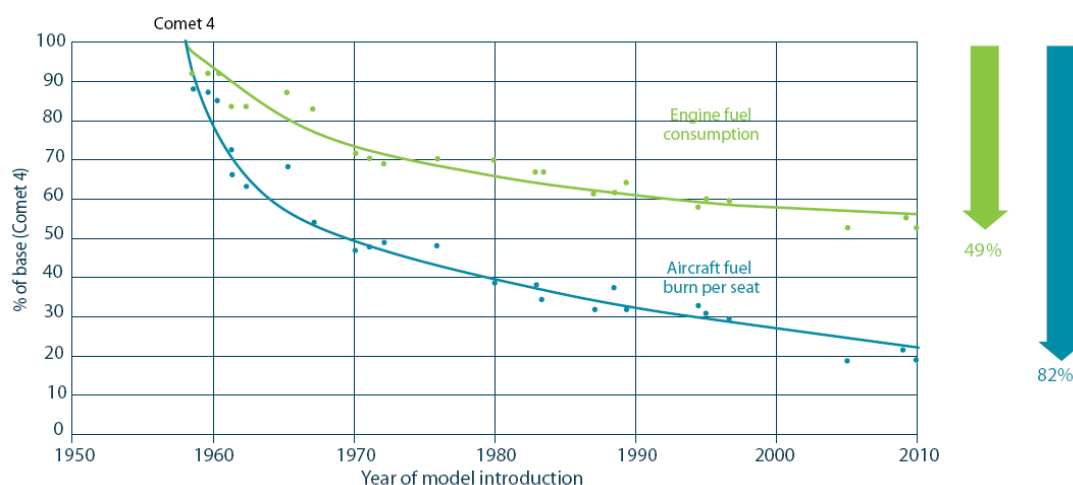
The net carbon content of fuel, defined as the ratio of net kilogram of CO<sub>2</sub> per kilogram of fuel. For kerosene, this ratio is 3.15 [Ref. 49]. The net carbon content can be significantly reduced with bio-fuels, produced from bio-materials. This ratio could even be reduced to zero if hydrogen can be used as aviation fuel and produced carbon-free.

- 9.4.4 Aircraft fuel efficiency is defined as fuel burn on the shortest trajectory per Available Tonne-Kilometre (ATK) or alternative measure of air transport capacity. It is under airlines’ and manufacturers’ influence and can be improved by fleet renewal with more efficient aircraft, advances in airframe and engine technology, and optimised use of aircraft (speed, stage length, etc).

- 9.4.5 Figure 9-4 shows the significant efficiency improvement between 1960 and 2010 in terms of engine fuel consumption (-49%) and aircraft fuel burn per seat (-82%).

9.4.6 The third improvement area relates to aircraft load factors, defined as the ratio between used capacity (RTK or RPK) and offered capacity (ATK or ASK).

9.4.7 Average load factors have increased over the past years and are already relatively high (in the 75-80% range) and there is limited room for improvement there.



Source: ICAO Environmental Report, 2010

**Figure 9-4: Aircraft fuel efficiency gains**

9.4.8 According to the European Environmental Agency, the combined effect of improvements in aircraft technology and increased load factors has resulted in a decrease in specific CO<sub>2</sub> emissions of air passenger transport by 28% between 1995 and 2008 [Ref. 50]. But because air transport demand has grown faster than efficiency improvements the total emissions are still growing. This is true for all transport modes, with the road sector taking the main share.

9.4.9 Figure 9-5 provides a summary of the four main areas for the improvement of aviation CO<sub>2</sub> efficiency and an estimation of the possible scope for improvement.

	Main areas of improvement	Actionable by	Potential improvement
Alternative fuels	• Net carbon content of fuel	Industry/ aircraft manufacturers/ airlines	High benefits in the medium-long term ( <i>increasing yield with increasing traffic levels</i> )
ANS-related fuel efficiency	• Optimisation of 4-D trajectory	ANS	Limited ( <i>decreasing yields with increasing traffic levels - congestion</i> )
Aircraft fuel efficiency	• Fleet renewal • Aircraft design and use	Aircraft manufacturers/ airlines	Significant over time
Load factor	• Aircraft utilisation	Airlines	Limited/ moderate as load factors are already very high (~80%)

**Figure 9-5: Factors contributing to aviation CO<sub>2</sub> efficiency**

9.4.10 The main contribution to the reduction of aviation CO<sub>2</sub> emissions is expected to come from fleet renewal, technology developments and low carbon fuels.

#### ANS CONTRIBUTION TOWARDS AVIATION CO<sub>2</sub> EFFICIENCY

9.4.11 ANS contribution is closely related to operational performance which is largely driven by inefficiencies in the four dimensional trajectory and associated fuel burn (and emissions). There is a close link between reducing GHG emissions and airspace user requirements to

minimise fuel burn<sup>59</sup>. En-route ANS operational performance is addressed in more detail in Chapter 7 and ANS at airports is analysed in Chapter 8.

- 9.4.12 Figure 9-6 provides an overview of total aviation emissions within European airspace in 2010. Total aviation related CO<sub>2</sub> emissions<sup>60</sup> are estimated to be 138 million tons in 2010 which represents an increase of 3.9% compared to 2009.

2010	Intra-European Flights	Intercontinental flights From/ To Europe		TOTAL
		Within Europe	Outside Europe	Within Europe
	a	b	c	a+b
Number of flights	7.6 M	1.8 M		9.5 M
Average number of seats	127	219		155
Average Max. Take Off Weight	64 t	195 t		94 t
Average Distance flown	913 km	1 684 km	2 945 km	1 063 km
Average flight time	81 min	124 min	201 min	89 min
Fuel per flight (including taxi)	3.2 t	10.7 t	21.8 t	4.7 t
Total Fuel	24 Mt	20 Mt	40 Mt	44 Mt
CO <sub>2</sub> (3.15kg/ kg of fuel)	76 Mt	62 Mt	126 Mt	138 Mt
%	55%	45%		100%

**Figure 9-6: Aviation emissions within European airspace in 2010**

- 9.4.13 Figure 9-7 summarises the current best estimate of ANS operational efficiency. The share of ANS actionable CO<sub>2</sub> emission reductions relates to a theoretical optimum (distance and time) from a single flight perspective which are - due to inherent necessary (safety) or desired (noise, capacity, cost) limitations - not achievable at system level and therefore cannot be reduced to zero.

2010	Fuel/ flight	Fuel Total	CO <sub>2</sub> total	%
Aviation emissions within European airspace	4.7 t	44Mt	138Mt	
Actionable by ATM				
- Horizontal flight path	172 kg	1.6Mt	5.1Mt	3.7%
- Vertical flight profile (see footnote 61)	25 kg	0.2Mt	0.7Mt	0.5%
- Airborne (ASMA) delays	56 kg	0.5Mt	1.7Mt	1.2%
- Taxi-out delays	34 kg	0.3Mt	1.0Mt	0.7%
<b>Total</b>	<b>288 kg</b>	<b>2.7Mt</b>	<b>8.6Mt</b>	<b>6.2%</b>

**Figure 9-7: Share of CO<sub>2</sub> emissions actionable by ANS in 2010**<sup>61</sup>

- 9.4.14 The estimate contains inevitably margins of uncertainty. For instance, while the great circle distance used for the calculation of the inefficiencies in the horizontal flight path is the shortest route, it may not always correspond to the user preferred profile which also considers factors such as wind or operation cost or the profile with the least impact on the climate<sup>62</sup>.
- 9.4.15 Average ANS-related fuel efficiency in Europe is estimated to be around ≈ 94% which means that ANS contribution towards improving aviation CO<sub>2</sub> efficiency is limited to

<sup>59</sup> The emissions of CO<sub>2</sub> are directly proportional to fuel consumption (3.15 kg CO<sub>2</sub> /kg fuel)

<sup>60</sup> Please note that the analysis scope in Figure 9-6 differs from the EU ETS as only the part flown within EUROCONTROL airspace is considered for the ANS efficiency calculation.

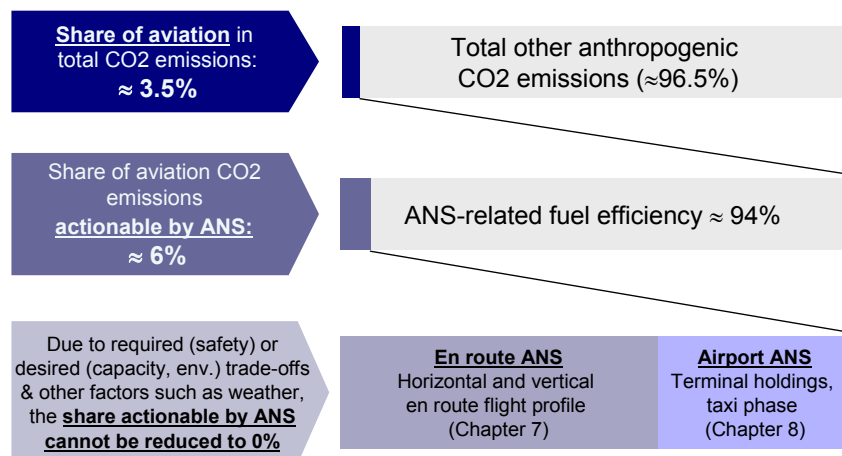
<sup>61</sup> The table shows fuel per flight for airborne and taxi delays. The average per arrival or departure is higher as not all flights take off or land in Europe. Fuel burn for the vertical profile is an estimate from a previous study [Ref. 36].

<sup>62</sup> Recent research shows that if the effects of cirrus clouds are taken into account, a climate optimised route might not always be the shortest route.



some 6% of the total aviation related fuel burn and associated CO<sub>2</sub> emissions<sup>63</sup> (see Figure 9-8). This corresponds to approximately 0.2% of total CO<sub>2</sub> emissions in Europe (6% x 3.5% ≈ 0.2%).

- 9.4.16 The horizontal en-route flight path is the main component (≈ 3.7%), followed by airborne delays in the terminal area (ASMA additional time) which are estimated to be around ≈ 1.2%. The horizontal en-route flight path is addressed in more detail in the flight efficiency section in Chapter 7 and ANS-related inefficiencies at airports (taxi-out delays, terminal (ASMA) delays) are addressed in more detail in Chapter 8.



**Figure 9-8: Estimated ANS contribution towards reducing CO<sub>2</sub> emissions [2010]**

- 9.4.17 Although the ANS contribution towards reducing CO<sub>2</sub> emissions is limited, there is scope for improvement and the next section will introduce a range of initiatives aimed at achieving ANS-related fuel efficiency improvements in the short and medium term.

## 9.5 Improving ANS-related fuel efficiency

- 9.5.1 Figure 9-7 suggests that there is scope for efficiency improvements (i.e. compared to idle or optimum) but also in the way inefficiencies are distributed along the flight trajectory (e.g. where delays are taken). One of the major challenges for improving ANS-related fuel efficiency will be the improvement of aviation's environmental performance in the face of continuous traffic growth.

- 9.5.2 A number of European programmes and initiatives such as SESAR and the European flight efficiency plan, but also wider cooperative agreements such as AIRE, aim at exploring ways to reduce environmental impact while improving operational efficiency.

- 9.5.3 Figure 9-9 provides an overview of areas where ANS has a role to improve aviation's CO<sub>2</sub> fuel efficiency. It relates to some extent also to initiatives which also have a positive impact on local air quality and noise at airports (see next section).

- 9.5.4 A large part of ANS-related inefficiencies are

### **Related programmes and initiatives**

As a short term measure in response to the high jet fuel price in 2008, EUROCONTROL, IATA and CANSO developed the **European flight efficiency plan** [Ref. 37] with the goal to drive immediate efficiency improvements.

The **European Joint Industry CDA Action Plan** is a joint initiative of EUROCONTROL, IATA, CANSO and ACI with the goal to roll-out CDA at up to 100 and more ECAC airports and to a minimum of 50 airports by the end of 2013.

**SESAR** - the Single European Sky ATM Research programme aims at providing the next generation of ATM/CNS systems - is targeting significant benefits in terms of efficiency gains by maturing new ATM technologies and procedures, including reducing the environmental impact by 10%.

The **Atlantic Interoperability Initiative** to

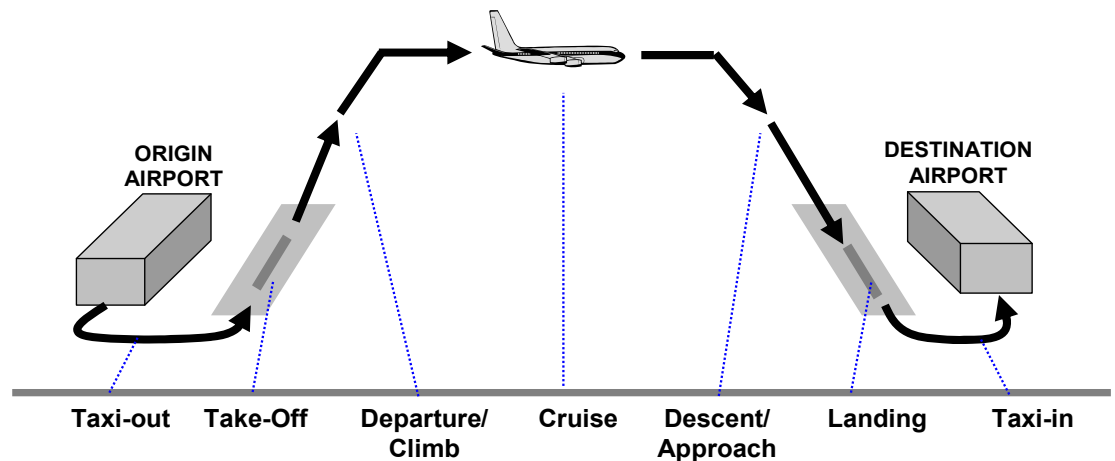
63 CANSO estimates ANS-related fuel efficiency between 92-94% in its report "ATM Global Environment Efficiency Goals for 2050", CANSO, December 2008.



the result of inefficiencies in the route network design and imbalances between demand and available capacity, coupled with the need to provide sequencing and safe separation (i.e. distribution of the delay between air and ground).

**Reduce Emissions (AIRE)** is part of SESAR and NextGen joint efforts to reduce environmental impact. AIRE aims to improve energy efficiency, lower aircraft noise, enhance ATM interoperability through the acceleration of the development and implementation of environmentally friendly procedures for all phases of flight (gate-to-gate).

9.5.5 While ANS is not always the root cause of those inefficiencies (weather, airport scheduling, noise restrictions, etc.), the way the inefficiencies are managed and distributed along the various phases of flight has clearly an impact on the environment in terms of greenhouse gas emissions and noise, on airspace users in terms of fuel burn and on the air transport system in terms of capacity utilisation.



Integrated 4-D gate to gate trajectory management (lateral, vertical, time and speed)		
ANS performance at airports	ANS en-route performance	ANS performance at airports
<ul style="list-style-type: none"> <li>Optimise push back time sequencing</li> <li>Optimum taxi routing (distance &amp; time);</li> </ul>	<ul style="list-style-type: none"> <li>Improved route network design &amp; support of free route initiatives;</li> <li>Improved airspace utilisation (civil military, additional CDRs, better flight planning)</li> <li>reduce RADs</li> </ul>	<ul style="list-style-type: none"> <li>Reduction of terminal holdings (ASMA times);</li> <li>Optimum taxi routing (distance &amp; time);</li> <li>Support to fuel efficient descent trajectory;</li> </ul>
Related projects/initiative		
<ul style="list-style-type: none"> <li>Departure manager (DMAN)</li> <li>Airport Collaborative Decision Making (CDM)</li> </ul>	<ul style="list-style-type: none"> <li>Flexible use of airspace (FUA)</li> <li>ATS Route network (V7)</li> </ul>	<ul style="list-style-type: none"> <li>Continuous descent operation (CDO);</li> <li>Arrival manager (AMAN)</li> </ul>

**Figure 9-9: Overview of ANS-related initiatives towards improved fuel efficiency**

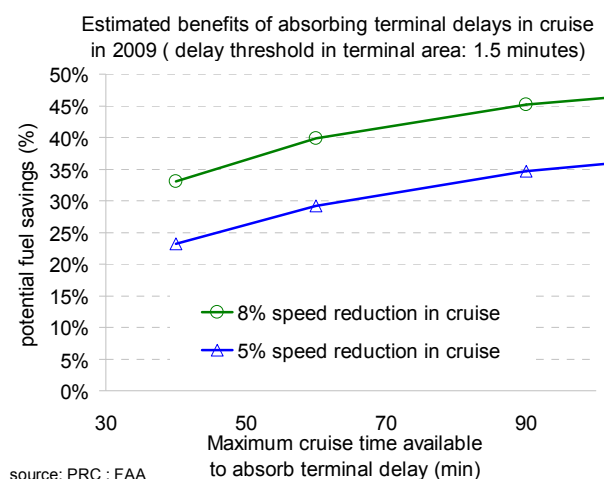
9.5.6 A number of ongoing ANS-related initiatives already target the improvement of fuel efficiency in the various phases of flight:

- Airport CDM helps reducing fuel burn in the taxi out phase by optimising the departure queue. Aircraft are sequenced by managing the push-back times at the gate in order to minimise the departure queue, aircraft taxi times, and fuel burn to a necessary minimum;
- Arrival managers can contribute to reduce holding time by starting the sequencing of the arrival queue already in the en-route phase (speed reduction) and enable sequencing techniques such as “point merge”;
- Continuous Descent Operations (CDO) are being formally offered at some stage of the day at 40 airports and 10 airports have implementation trials in progress; and,
- Route network design has also continued improving this year, although part of the improvements this year have been cancelled as a result of ATC industrial action (and the ash volcanic cloud) which forced airspace users to circumnavigate closed airspace.

- 9.5.7 While those initiatives are worth pursuing and should be further encouraged, care must be taken to avoid that savings made in terms of time and fuel in one flight phase are not offset by increased fuel burn or additional (and potentially less fuel efficient) times in subsequent flight phases.
- 9.5.8 For instance, keeping an aircraft on the ground (engines off) may result in a higher overall fuel burn if aircraft fly at a higher speed after take off to recover part of an ATFM delay experienced at the origin airport. Similarly continuous descent operations (CDO) – if not properly managed – can paradoxically result in higher fuel burn than without CDO.
- 9.5.9 Furthermore there are trade offs to be considered. The frequent use of queuing (airborne & taxi out) to maximise runway throughput at airports (see also Chapter 8) has a not negligible detrimental effect for the environment and needs to be reduced to a necessary minimum.
- 9.5.10 A recent study [Ref. 51] aimed at estimating the potential savings of absorbing additional time in the terminal areas through the application of speed control in cruise suggests significant potential for fuel savings.

9.5.11 Figure 9-10 depicts the estimated fuel savings as a function of available cruise time for the absorption of terminal delay through speed reduction of 5% and 8% in cruise.

9.5.12 Given the need to maintain pressure on the airport combined with current navigational accuracy to achieve desired arrival times, fuel curves were calculated for a threshold of 1.5 minutes of delay remaining in the terminal area.



**Figure 9-10: Potential fuel savings through speed reductions**

- 9.5.13 With a conservative assumption of a 5% speed reduction in cruise, the study estimates that up to 35% of the excess fuel burn on descent could be reduced through better combined ATM and airline procedures.
- 9.5.14 There is a need for a more integrated approach which combines and coordinates different flow management techniques (ground delays, speed control, etc.) along the entire 4-D flight trajectory to reduce fuel burn, emissions, and delays while maximising the utilisation of available en-route and airport capacity. Technology available aboard modern aircraft assist flight crews in the selection of speed/altitude commands that provide the best flight efficiency for a given set of airline and air traffic constraints.
- 9.5.15 Making use of those technologies to support trajectory based operations is one of the main element of the future concept being developed by the SESAR project in Europe and NextGen in the US.

## 9.6 Reducing aviation's environmental impact at/around airports

- 9.6.1 Noise and local air quality are the most important local factors from an environmental viewpoint for local communities and airports alike, and in recent years a number of EC directives addressing noise and local air quality have been adopted.
- 9.6.2 Establishing environmental restrictions at airports can have an impact on aircraft mix (engine types, etc.), queuing strategy (at the stand or nearby the runway) and trajectories (route design) in the vicinity of the airport.
- 9.6.3 Environmental restrictions can however also lead to capacity constraints at airports and hence lead to congestion, holdings and additional fuel burn at already constrained airports. There might even be trade-offs between environmental restrictions. For instance, a change in the flight path to minimise noise exposure on the ground could lead to longer routes and thus reduced flight efficiency and increased emissions.

### LOCAL AIR QUALITY (LAQ)

- 9.6.4 Local Air Quality (LAQ) is an increasingly important issue at airports. While there is no specific EU LAQ legislation in relation to aviation, the EC Directive 2008/50/EC [Ref. 52] on ambient air quality and cleaner air for Europe sets clear standards and requires Member States to stay within set limits for these pollutants.
- 9.6.5 Pollutants released into the atmosphere by activities affect local air quality. Nitrogen oxides (NO<sub>x</sub>) are regarded to be the most significant pollutant. At airports, the emission inventory can be broadly divided into three categories:
- passenger and staff travel to/from the airport (by car, bus, train);
  - airport infrastructure and aircraft handling (auxiliary power units (APUs), airside vehicles, stationary power plants, construction, etc) within the airport perimeter; and,
  - emissions from aircraft during landing and take off<sup>64</sup> but also when aircraft taxi (engine technology and operational efficiency).
- 9.6.6 Local initiatives at airports aimed at improving local air quality usually consist of a mix of measures including low emission airside vehicle fleet, NO<sub>x</sub> related landing charges, staff travel, use of fixed ground power instead of APUs, and improved efficiency of operations. Additionally to the positive impact on local air quality, those initiatives also contribute to a smaller extent towards reducing the impact of aviation on climate.
- 9.6.7 The direct contribution of emissions at airports to overall emissions in the vicinity an airport depends on the emission sources surrounding the airport. According to ICAO, for a typical urban environment, airport emissions represent approximately 10% of total regional emissions in the vicinity of airports but the percentage is higher in more rural environments. Emissions from aircraft are estimated to contribute between 70-80% of total airport NO<sub>x</sub> emissions [Ref. 53].

#### Local air quality:

Local air quality LAQ is concerned with potential health effects of air pollution. Aircraft, road vehicles and other sources such as power plants at and around airports emit a number of pollutants, particularly Nitrogen Oxides (NO<sub>x</sub>) and Particulate Matter (PM<sub>10</sub>) which impact on human health.

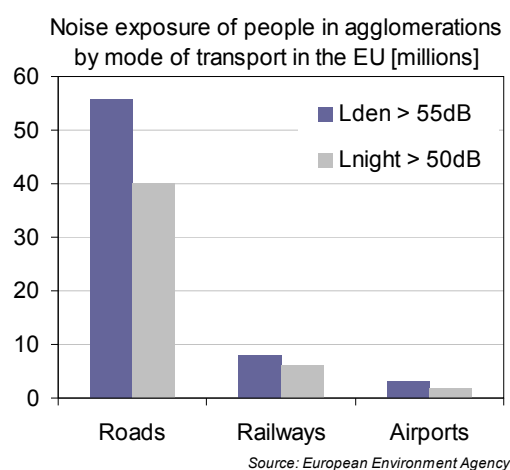
From a local air quality point of view, NO<sub>x</sub> is generally considered to be the most significant pollutant. It is a by-product of combustion of hydrocarbon fuels in air at high temperatures and pressures.

64 The potential adverse effects of pollutants released within an aircraft's landing and take-off cycle (LOT). The standard LOT cycle is considered by ICAO to be up to 3000 feet or 915 metres above ground level.

- 9.6.8 **LAQ emissions from aircraft at the source:** Aircraft technology has become significantly cleaner over the past years and the trend is likely to continue [Ref. 47].
- 9.6.9 ICAO's Committee on Aviation Environmental Protection (CAEP) frequently revises aircraft technical design standards to reflect technological progress. CAEP/6 came into force in 2008 and introduces engine NOx emission standards which are 12% lower than in CAEP/4.
- 9.6.10 **Operational opportunities to reduce LAQ Emissions from aircraft:** The ANS contribution towards improving local air quality is mainly related to operational performance and associated fuel burn during take off and landing and in the taxi phase. For instance, improved taxi efficiency through A-CDM not only reduces fuel burn but also has a positive impact on local air quality (see also Chapter 8).
- 9.6.11 There are a number of ANS-related initiatives and projects addressing the improvement of local air quality. The EUROCONTROL Airport Local Air Quality Studies (ALAQS) promote best practice methods and tools for airport LAQ analysis and interdependency analysis between noise and emissions.

#### AIRCRAFT NOISE AT AIRPORTS

- 9.6.12 Airports strive to balance the need to increase capacity in order to accommodate future traffic growth with the need to manage aircraft noise and negative effects on the population in the airport vicinity.
- 9.6.13 While the degree of perceived annoyance for a given noise level varies by culture, social circumstances and individual disposition, noise above a certain level<sup>65</sup> has undoubtedly adverse impacts on people's health, quality of life and on other factors such as housing values and the learning acuity of students in affected schools.
- 9.6.14 The total number of passengers in 2008 transported by air in the EU27 was 798 million [Ref. 54] whereas the number of people exposed to noise ( $L_{den} > 55\text{dB}$ ) from 71 major airports was about 2.5 million [Ref. 55].
- 9.6.15 Although the number of people affected by noise from railways and airports is much lower than from road traffic [Ref. 55], it is interesting to note that there is a higher sensitivity towards aircraft noise which is perceived to be "louder" than noise from other modes of transport.



**Figure 9-11: Noise exposure by mode of transport in the European Union**

65 According to World Health Organization average night noise level  $L_{night} > 55\text{dB}$  is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence that the risk of cardiovascular disease increases.

9.6.16 Noise restrictions are usually imposed on airports by Governments or local Planning Authorities and the level of compliance is monitored at local level. Noise management strategy and its implementation are usually under the responsibility of the airport operator, but each operational stakeholder at airport has a role to play in reducing noise. It should be noted that there are trade-offs which need to be considered when noise restrictions are put in place at airports.

9.6.17 Figure 9-12 shows the four elements of the ICAO “balanced approach”. The number of people exposed to noise emissions from aircraft is the result of (1) land use planning and management, (2) noise at source, (3) noise abatement operational procedures (NAOPs), and (4) aircraft operating restrictions.

#### EC directives on noise

Two EC noise Directives of particular importance to aviation were implemented in Europe. The first Directive (2002/30/EC [Ref. 56]) based on the ICAO ‘Balanced Approach’, specifies the overall approach to airport noise management in Europe.

The second EC Directive (2002/49/EC [Ref. 57]) provides guidance for Member States on the assessment and management of environmental noise using harmonised noise metrics and subsequent publishing of noise management plans. It requires competent authorities in Member States to draw up “strategic noise maps” (i.e. noise contours) for major roads, railways, airports<sup>66</sup> and agglomerations, using harmonised noise indicators and to draw up action plans to reduce noise where necessary.

Additionally, a further EC Directive (2006/93 EC [Ref. 58]) requires Member States to ensure that all civil subsonic jet aeroplanes operating from airports situated in their territory comply with the standards specified in Part II, Chapter 3, Volume 1 of Annex 16 ICAO

9.6.18 In Europe, accountability for noise management is generally given to airport operators under rule making and supervision of national authorities; accountability for land use planning is given to local authorities, based on land use policies developed at higher levels. ANS have an essential role in support of noise management by the airport operator.

9.6.19 Figure 9-12 presents the four main measures to reduce exposure of the population to aircraft noise, related time-scales, organisation in charge, potential improvements and enablers.

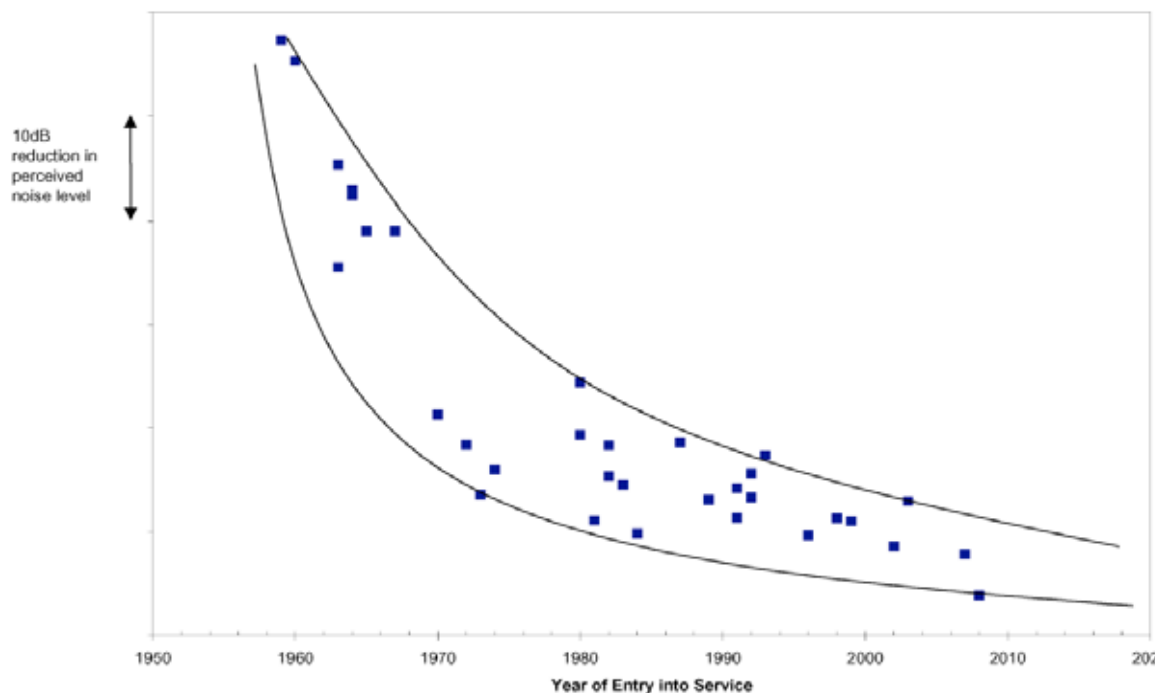
	Time scale	Actionable by	Potential improvement	Enablers
Land use planning	Long term (10 -20 years)	Local authorities	Substantial benefits in the long term	Land use policy
Reduction of noise at source		Industry/ aircraft manufacturers/ airlines	Significant over time ( <i>increasing yield with increasing number of new aircraft</i> )	Technology & fleet renewal
Noise abatement operational procedures	Short to medium term (1-3 years)	CAA / ANSP	Moderate – subject to trade offs with flight efficiency(and hence emissions), delays and runway capacity ( <i>decreasing yields with increasing traffic levels</i> ) - congestion)	ANS & airline performance
Aircraft operational restrictions	Short term (6-12 months)	CAA/ airport operator/ ANSP	Typically moderate – trade off with airport revenues.	Regulatory

**Figure 9-12: Main measures to reduce noise exposure around airports**

9.6.20 **Reduction of noise at the source** relates to aircraft and engine standards and is mainly in the domain of aircraft manufacturers. A review of the Implementation of Directive 2002/49/EC on Environmental Noise, (Task 2, May 2010) [Ref. 59] concluded that noise reductions at source (as in the 1990s) with a similar order of magnitude are not likely to occur in the near future.

66 “Applicable to ‘major airports’ shall mean a civil airport, designated by the Member State, which has more than 50 000 movements per year (a movement being a take-off or a landing), excluding those purely for training purposes on light aircraft”;

- 9.6.21 Nonetheless, there is still room for improvement. For new generation aircraft e.g. A380-800, the 85 dB footprint (3.74km<sup>2</sup>) is by 46 % smaller than the one for B747-400 aircraft (6.97km<sup>2</sup>). According to Boeing, the noise footprint of the 787 is more than 60 percent smaller than those of today's similarly sized airplanes. Manufacturers of smaller aircraft also have ambitious plans to produce quieter aircraft. Bombardier claims that the future generation of C-Series family will be 4 times quieter than current similar size of aircraft.
- 9.6.22 In this context, it is interesting to note the ambitious goal of the Clean Sky initiative for 2020 which is the reduction of external noise by 50% compared to 2000 levels through an improvement of aircraft and engine technology.
- 9.6.23 It is worth pointing out that - due to the long life cycle of aircraft - it takes some lead time to fully realise the benefits of technical progress. This is largely linked to airline fleet renewal and resulting positive effects on noise emissions.

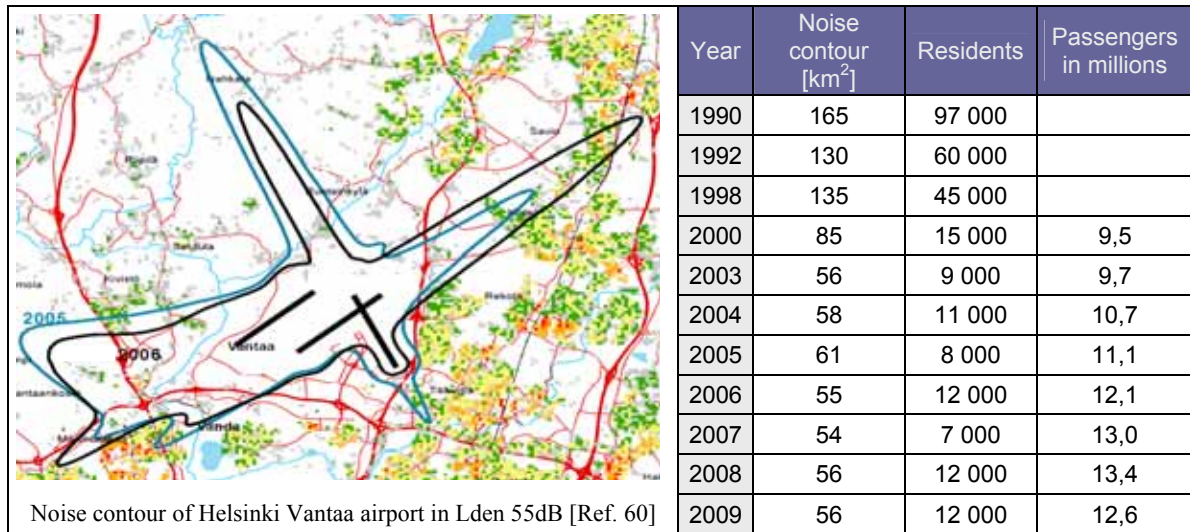


Source: UK CAA

**Figure 9-13: Reductions in perceived noise levels by aircraft type**

- 9.6.24 **Land use planning and management** is one of the main elements of the ICAO “balanced approach”. Local and regional authorities are typically responsible for the land use planning (land use zones at and around airport). The main target is to properly plan residential development in combination with strategic noise-maps, so that if there is shrinkage of the noise contour, the population inside the remaining contour does not increase.





**Figure 9-14: Noise contour and exposure at Helsinki airport**

9.6.25 Figure 9-14 illustrates the changes in noise exposure at Helsinki Vantaa airport. The noise contour (in Lden<sup>67</sup> 55dB) and the number of people exposed to aircraft noise could be reduced considerably while traffic continued to grow during the same time, however it can also be observed that noise contours have not changed substantially since 2003, hence the achievement of the Clean Sky Initiative for 2020 (see § 9.6.22) would be essential for further reducing the area exposed to noise.

9.6.26 The aim of **aircraft operating restrictions** is to limit noise exposure, especially during the night and ANS has a role in ensuring the adherence to those restrictions. So called “curfews” are arguably the most rigorous measures<sup>68</sup>. At Paris Orly airport for example, landings are forbidden between 23:30-06:19, and take-offs are forbidden between 23:20-05:59. Another measure which can be applied is a cap on movements, usually imposed for night movements, but there are already a number of airports which have also a cap on movements per season or per year in order not to exceed noise quota<sup>69</sup> e.g. Paris Orly, and Amsterdam Schiphol.

9.6.27 **Noise abatement operational procedures** (NAOPs) are the main area where ANS contributes to the reduction and/or reshaping the noise contour. Broadly these can be broken down into three categories:

- noise abatement flight procedures (i.e. Noise Abatement Departure Procedures (NADP), Minimum use of reverse thrust after landing)<sup>70</sup>;
- spatial management (i.e. noise preferred arrival and departure routes, flight track dispersion or concentration, noise preferential runways system); and
- ground management (i.e. APU management, taxi without all engines running).

67 L<sub>den</sub> (day-evening-night noise indicator) shall mean the noise indicator for overall annoyance.

68 Curfew – an airport curfew is a global or aircraft-specific partial operating restriction that prohibits take-off and/or landing during an identified time period. [ICAO Doc 9829].

69 Noise quota – noise quota (sometimes expressed as a “noise budget”) caps the total noise level from aircraft operations within a given area over or around the airport to some established total value over a given period of time (six months, a year, etc.) expressed in established noise energy over a period of time. [ICAO Doc 9829].

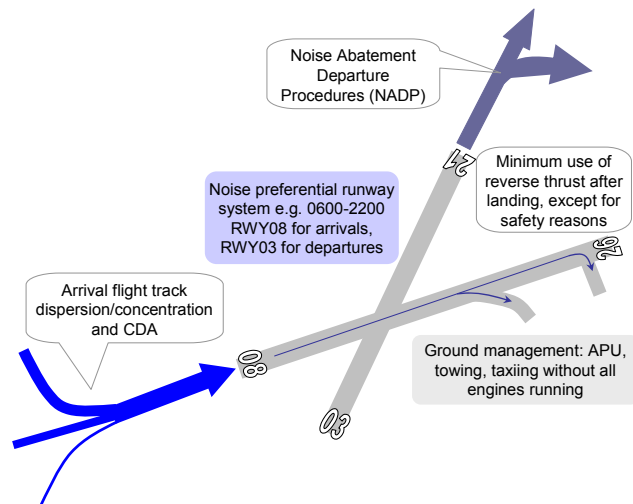
70 The use of Continuous Descent Approach (CDA) may also have a positive effect for noise reduction in a radius of 10-30 nm around the airport.



9.6.28 A review of noise abatement measures by ICAO [Ref. 61] reported a positive impact of NAOPs on an airport's noise contour.

9.6.29 It is however important to note that there are also trade offs in terms of airport capacity and flight efficiency.

9.6.30 The magnitude of the impact can vary from airport to airport and it also depends on the measure applied (see Figure 9-15).



**Figure 9-15: Example of NAOPs and their impact on ANS-related performance**

9.6.31 This is confirmed by results from the SOURDINE II Project [Ref. 62] which found that the application of Noise Abatement Approach Procedures (NAAP) can have a negative effect on capacity (see Figure 9-16).

Airport	Baseline	NAAP II	NAAP III	NAAP IV	NAAP V
Madrid	78-80	70-72	70-72	68-70	72-74
Paris-CDG	81-83	80-82	80-82	x	80-81
Amsterdam	72-74	69-71	x	59-61	66-68
Naples	31-33	30-32	x	28-30	30-32

**Figure 9-16: Arrival capacity reductions due to Noise Abatement Approach Procedures**

9.6.32 The ANS contribution in defining, implementing and monitoring NAOPs includes:

- Airspace design departments will provide for procedure design;
- Operational and training units will prepare letters of agreement and will train ATCOs;
- Safety Management Units will prepare safety cases for NSA approval;
- ATCOs will instruct operations in accordance with approved NAOPs; and,
- Radar and flight plan data will be provided to the airport operator and/or NSA for monitoring the adherence of aircraft to NAOPs.

9.6.33 In this context it is also noteworthy to recall the SESAR long term environmental objectives:

- to improve the role of ATM in enforcing local environmental rules by ensuring that flight operations fully comply with aircraft type restrictions, night movement bans, noise routes, noise quotas, etc.
- to improve the management of noise emissions and their impacts through better flight paths, or optimised climb and descent solutions; and,
- to improve the role of ATM in developing environmental rules by assessing the ecological impact of ATM constraints, and, following this assessment, adopting the best alternative solutions from a European sustainability perspective.

9.6.34 Noise management at airports is an important issue, and a well-balanced and forward looking strategy is required to reduce noise exposure while optimising the use of airport capacity.

## 9.7 Conclusions

- 9.7.1 Emissions from aviation account for approximately 3.5% of total CO<sub>2</sub> emissions in Europe.
- 9.7.2 At its 37th Assembly in October 2010, ICAO achieved the adoption of the first global governmental agreement which commits the aviation sector to reducing its greenhouse emissions (-2% p.a. until 2020).
- 9.7.3 Although the main contribution to the reduction of aviation CO<sub>2</sub> emissions is expected to come from fleet renewal, technology developments and low carbon fuels, ANS has its role to play as well.
- 9.7.4 The ANS-related impact on climate change is closely linked to operational performance which is largely driven by inefficiencies in the 4D trajectory and associated fuel burn.
- 9.7.5 The PRC's estimate of ANS-related fuel efficiency of aviation in Europe is approximately 94%. ANS contribution towards improving aviation CO<sub>2</sub> efficiency is therefore limited to some 6% of the total aviation-related fuel burn and associated CO<sub>2</sub> emissions ( $\approx 0.2\%$  of total emissions).
- 9.7.6 Although limited by safety requirements and additional constraints (noise, capacity, cost, etc.), there is scope for improvements in ANS efficiency (closer to optimal flight profile) and also in optimising the distribution of delays along the trajectory (e.g. ground vs. air, reduced speed vs. holding).
- 9.7.7 Of the estimated 6.2% ANS-related fuel inefficiency, the horizontal en-route flight path holds the highest potential for ANS-related improvements ( $\approx 3.7\%$ ), followed by terminal transit ( $\approx 1.2\%$ ), and inefficiencies in the taxi phase ( $\approx 0.7\%$ ).
- 9.7.8 One of the major challenges for improving ANS-related fuel efficiency will be the improvement of aviation's environmental performance in the face of continuous traffic growth. Maintaining or improving the same level of ANS service quality while absorbing projected demand, which is expected to double over the next 20 years, will be challenging.
- 9.7.9 Noise management at airports is an important issue. A well balanced and forward-looking strategy is required for the Airport Operator, ANSP, CAA and the local land use planning authorities to reduce noise exposure and the number of inhabitants affected by noise, while optimising the use of airport capacity.
- 9.7.10 While the main contribution is expected to come from measures with long lead times (land use planning, reduction of noise at source), ANS has an important role to play in the application of noise abatement operational procedures (NAOPs) which require also a well balanced assessment of resulting trade-offs with other KPAs such as airport capacity and flight efficiency.

# Chapter 10: Cost-effectiveness

KEY POINTS	KEY DATA	2009	vs. 08
<p>1. The unprecedented traffic downturn (-6.2% in terms of kilometres controlled) in 2009 combined with a slight increase in total en-route ANS provision costs in 2009 (+1.3%) resulted, despite the successful implementation of cost containment measures, in a significant increase of the en-route unit costs in 2009 (0.80€/km, +8.1% vs. 2008), thereby marking the end of a positive trend between 2003 and 2008.</p> <p>2. It is disappointing that despite the efforts made in 2009 to reduce en-route ANS costs compared to the plans (-2.2% which is equivalent to €130M), the total en-route ANS cost base increased by +1.3% in real terms compared to 2008. Furthermore, according to current State plans, the Pan-European target adopted by the PC for 2008-2010 is no longer achievable.</p> <p>3. Given short term rigidities to adjust costs downwards and unavoidable lead times, some of the measures that were implemented in 2009 may actually only have an impact on costs in 2010 and onwards. At system level, total en-route costs planned for 2010 were revised downwards by some €320M compared to November 2008 plans. It is important that these planned savings materialise so that, in future years, unit costs can return to the levels achieved before the economic downturn.</p> <p>4. According to the latest plans, en-route unit costs per km are expected to decrease by -2.8% per annum (p.a.) between 2009 and 2014 which is well below the improvements achieved between 2003 and 2008 (-3.3% p.a.). This is disappointing given the high expectations of significant improvements resulting from a coordinated implementation of SES II performance scheme.</p> <p>5. In 2009, terminal ANS unit costs increased by +10.5% in real terms compared to 2008 which was due to a significant decrease of IFR airport movements (-8.3%) coupled with an increase in terminal ANS costs (+1.3%). It is important to put in place a genuine monitoring of terminal ANS cost-effectiveness performance indicators for all European States. This monitoring will provide the necessary grounds for identifying performance improvement opportunities based on solid information.</p>	En-route ANS provision costs		
	Total en-route ANS provision costs (M€)	6 640	+1.3%
	Distance charged (M km)	8 302	-6.2%
	En-route ANS provision costs per km (€2009)	0.80	+8.1%
	Planned average annual growth rate of en-route unit costs per km between 2009-14 (Nov.2010 plans)		-2.8%
	Terminal ANS provision costs		
	Total terminal ANS provision costs (M€)	1 454	+1.3%
	IFR airport mvts. (M)	11.5	-8.3%
	Terminal ANS provision cost per IFR airport mvt. (€2009)	126	+10.5%
	Gate-to-gate ATM/CNS provision costs		
	Gate-to-gate ATM/CNS provision costs (M€ 2009)	7 585	+1.7%
	Composite flight-hours (M)	17.4	-7.0%
	Gate-to-gate ATM/CNS provision costs per composite flight-hour (€ 2009)	435	+9.3%

## 10.1 Introduction

10.1.1 This chapter analyses cost-effectiveness performance for the year 2009 (i.e. the latest year for which actual financial data are available). This chapter also shows how cost-effectiveness performance changed over time (2005-2009) and how it is planned to evolve between 2010 and 2014.

10.1.2 In 2009, total en-route and terminal ANS costs for the Pan-European system<sup>71</sup> amounted to some €8 630M, of which around 80% relate to the provision of en-route ANS and 20% relate to the provision of terminal ANS.

<sup>71</sup> In this chapter, the term “Pan-European system” refers to the States that were Members of EUROCONTROL on the 1st January 2009.

- 10.1.3 En-route ANS costs can be broken down into ATM/CNS, MET, EUROCONTROL and payment to regulatory and national authorities. The aggregation of the en-route cost and traffic data provided by States for the purposes of the EUROCONTROL Enlarged Committee for Route Charges allows computing the en-route cost-effectiveness KPI for the EUROCONTROL Area. The analysis on the en-route cost-effectiveness is presented in Sections 10.2-10.4.
- 10.1.4 Data on terminal ANS cost-efficiency (reported to the EC by EU Member States in accordance with Regulation (EC) N°1794/2006 (hereinafter the “charging scheme regulation”<sup>72</sup>) [Ref. 63]) are used in order to provide an assessment of terminal ANS cost-effectiveness, presented under Section 10.5.
- 10.1.5 Finally, for the purposes of benchmarking ANSPs’ performance and comparing like with like, the PRC is monitoring since 2001 a gate-to-gate cost-effectiveness KPI which focuses on ATM/CNS costs incurred by ANSPs. Highlights and findings from this analysis are reported in Section 10.6.

## 10.2 En-route cost-effectiveness analysis for EUROCONTROL Area

- 10.2.1 The en-route cost-effectiveness KPI is obtained by dividing the total real en-route ANS 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.

- 10.2.2 This indicator slightly differs from the cost-efficiency KPI defined in the Performance Scheme Regulation (No 691/2010, see Annex I, Section 1.4 [Ref. 8]) which is the ratio of en-route determined costs and service units. The concept of determined costs is fairly close to the total en-route ANS costs (i.e. national costs including ANSP, MET and NSA/CAA costs plus EUROCONTROL costs) which are analysed in this chapter. The main discrepancy between the indicator analysed in this chapter and the cost-efficiency KPI arises from the use of different output metrics. Indeed, as the service units included in the regulated cost-efficiency KPI take into account the chargeable distance, they also include a component relating to aircraft weight.

### **Cost-effectiveness KPI versus chargeable unit rates**

It should be noted that both the cost-effectiveness KPI differ from the unit rate that is charged to airspace users. Indeed, on top of en-route ANS costs, the latter also includes adjustments for the costs of exempted flights, for over/under recoveries arising from previous years and potential revenues that are used to reduce the chargeable cost-base. Furthermore, it should be noted that in this chapter for the purposes of measuring performance, the cost-effectiveness KPI is expressed in real terms. Therefore, changes in en-route unit costs per kilometre are not consistent with the changes in the nominal unit rates that are paid by airspace users.

- 10.2.3 For the purposes of this Report, the terms cost-effectiveness and cost-efficiency are considered to be synonymous and are used to define performance indicators based on the ratio costs per unit of output. A more detailed description of the various indicators relating to en-route, terminal and gate-to-gate cost-efficiency performance is provided in Annex VI of this report.
- 10.2.4 Figure 10-1 summarises the main relevant cost-effectiveness data and shows the changes in the en-route ANS costs per km and per SU between 2005 and 2014 for the EUROCONTROL Area<sup>73</sup>. The information provided in Figure 10-1 indicates that these two KPIs are highly correlated (0.98). Note that for consistency purposes with previous

<sup>72</sup> Amended by Commission Regulation (EU) N°1191/2010 of 16 December 2010.

<sup>73</sup> Note that the growth rates displayed in the last two columns of Figure 10-1 are computed for consistent samples of Member States for which a time series was available (i.e. 31 over the 2004-2009 period and 35 over the 2010-2014 period).

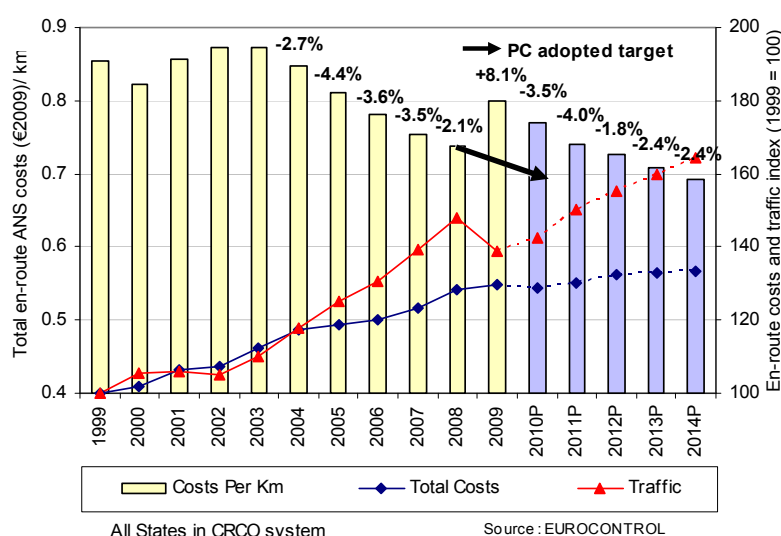
PRRs, the analysis provided in Sections 10.2 and 10.3 of this chapter focuses on the **en-route ANS costs per km**.

€2009 Prices	2005	2006	2007	2008	2009	2010P	2011P	2012P	2013P	2014P	09/05	14/09
Contracting States (Route Charges System)	31	31	31	34	35	35	35	35	35	35	31	35
Total en-route ANS costs (M€)	6 092	6 159	6 327	6 556	6 640	6 610	6 664	6 775	6 797	6 825	6%	3%
National costs (M€)	5 434	5 485	5 653	5 896	5 968	5 927	6 082	6 133	6 202	6 232	7%	4%
EUROCONTROL Maastricht (M€)	122	124	129	128	135	140	130	145	149	151	10%	12%
EUROCONTROL Agency (Parts I & IX) (M€)	536	550	545	532	538	543	452	496	445	442	0%	-19%
Total distance charged (M km)	7 472	7 823	8 321	8 851	8 302	8 532	8 984	9 294	9 558	9 835	6%	18%
En-route total service unit (M SU)	97	101	108	115	109	113	119	123	126	130	7%	19%
En-route real unit costs	(€2009/km)	0.82	0.79	0.76	0.74	0.80	0.77	0.74	0.73	0.71	0%	-13%
	(€2009/SU)	62.85	60.77	58.64	56.81	60.70	58.74	56.21	55.21	53.84	-1%	-14%

**Figure 10-1: Real en-route ANS cost-effectiveness KPI for EUROCONTROL Area<sup>74</sup> [€2009]**

10.2.5 After consecutive decreases between 2003 and 2008 (-3.3% p.a. over this period), the en-route unit costs per km significantly increased in 2009 (+8.1%) to reach €0.80 per km (see Figure 10-2). Given that its value was €0.82 per km in 2005, this means that between 2005 and 2009, real en-route unit costs remained fairly constant at European system level.

10.2.6 The significant increase in unit costs per km in 2009 at European system level (+8.1%, see Figure 10-2) results from the combination of a sharp decrease in traffic volumes (-6.2% in terms of kilometres controlled) and an increase of en-route ANS cost-bases (+1.3%). This reflects the economic downturn which has affected the aviation industry in 2009 with an unprecedented severity and the ANS industry's inability to adjust downwards its cost-base in a similar magnitude.



**Figure 10-2: Real en-route unit costs per km (KPI), total costs and traffic**

10.2.7 The Provisional Council (PC 28, November 2007) adopted its objectives for 2008, 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.” In other words, this would correspond to a reduction of the real en-route unit costs per km of -6% on the period 2008-2010 (see dark arrow in Figure 10-2 above). The information provided in Figure 10-2 indicates that unfortunately the

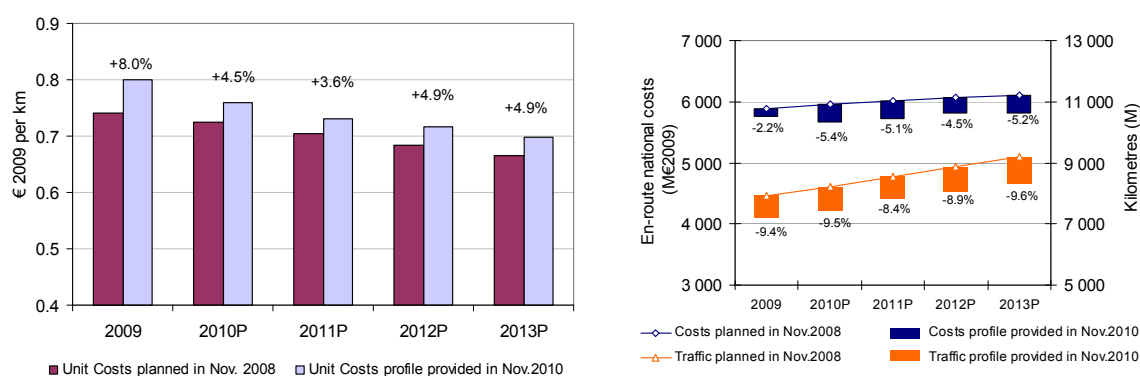
<sup>74</sup> In March 2011, the UK provided the PRC with a series of en-route costs for the period 2009-2014 based on the methodology for determined costs as defined in the Performance Scheme regulation (EU 691/2010). These figures are not directly comparable with the information provided by the UK for the years 2005-2008 for the purposes of the Enlarged Committee for Route Charges. As a result, although the impact of this reporting change is marginal at European system level, the en-route costs data reported in Figure 10-1 for the years 2009-2014 are not fully comparable with the data provided for the years 2005-2008.

Pan-European target adopted by the PC for 2008-2010 will not be met.

10.2.8 Figure 10-2 shows that after the increase in 2009, en-route unit costs per km are planned to continuously decrease until 2014 (i.e. an average reduction of -2.8% p.a. over the 2009-2014 period). As shown in Figure 10-2, the planned decrease in unit costs per km is mainly due to a forecast increase in traffic volumes (+3.4% p.a. between 2009 and 2014) while in the meantime en-route ANS costs are planned to slightly increase (+0.6% p.a.). In other words, Figure 10-2 indicates that between 2009 and 2014, the planned decrease in en-route unit costs per km (-2.8% p.a.) is less ambitious than the decrease achieved between 2003 and 2008 (i.e. -3.3% p.a.).

10.2.9 The planned improvement is rather disappointing given the high expectations that a coordinated implementation of the SES II performance scheme (Ref. Chapter 2) during this period should bring significant performance improvements. Following the significant traffic reduction in 2009 and the different tools provided by SES II, there is an opportunity to better match capacity and demand in the forthcoming years while at the same time improving cost-effectiveness performance.

10.2.10 Figure 10-3 below compares the plans in terms of en-route ANS costs and traffic prepared by the States in November 2008, i.e. before the impacts of the financial crisis and economic downturn were fully appreciated by the States/ANSPs, with the information provided for the purposes of the November 2010 session of the Enlarged Committee.



**Figure 10-3: Comparison of real en-route unit costs (data provided in Nov.'08 versus Nov.'10)<sup>75</sup>**

10.2.11 The chart displayed on the left-hand side of Figure 10-3 shows the percentage changes between the en-route unit costs per km planned in November 2008 and the information provided in November 2010. Compared to November 2008 plans, the en-route unit cost profile for 2010-2013 has been revised upwards by some 4-5%.

#### **Comparison of States' latest forward-looking data with previous years' plans**

The percentage values reported in Figure 10-3 show the difference between the unit costs, the traffic and the costs planned by the Member States in November 2008 for 2009 onwards with the latest forward-looking information provided in November 2010. These figures are therefore of a different nature than the information provided in Figure 10-2 above which shows the planned en-route unit costs based on States November 2010 data.

10.2.12 The difference between the two en-route unit costs profiles presented on the right-hand side of Figure 10-3 is mainly the result of:

<sup>75</sup> As highlighted in footnote 74, the UK provided the PRC with a revised series of en-route costs for the period 2009-2014. These figures are not directly comparable with the information provided by the UK for the purposes of the Enlarged Committee for Route Charges in November 2008. For this reason, in this chapter the UK has been excluded from Figure 10-3, Figure 10-5 and Figure 10-8.



- A significant downwards revision of traffic projected for 2010 onwards (some -9% - see orange bars on the right-hand side of Figure 10-3 - reflecting the impact of the economic downturn; while,
- The total en-route ANS cost-bases have been revised downwards by some 4-5% - see blue bars on the right-hand side of Figure 10-3.

10.2.13 The right-hand side of Figure 10-3 shows that 2009 actual en-route ANS costs are -2.2% lower than planned in November 2008 (see blue bars). Given that each percentage reduction of the en-route cost-base amounts to some €70M, the “savings” for the year 2009 compared to the plans are valued at some €130M for the European system. All else equal, this indicates that some cost-containment measures were actually implemented in 2009.

10.2.14 This result shows a certain degree of reactivity of the European ANS industry in response of the significant traffic decrease in 2009. However, it should be noted that the downwards revision of en-route ANS costs in 2009 compared to previous plans (-2.2%) was:

- of a much lower magnitude than for the traffic (-9.4% compared to the plans, see Figure 10-3); and,
- not sufficient to avoid a slight increase of the total en-route ANS cost base at European system level (+1.3% in 2009 in real terms).

10.2.15 However, it should be noted that given short term rigidities to adjust costs downwards and unavoidable lead time, some of the measures that were implemented in 2009 may only have an impact on costs in 2010 and onwards.

10.2.16 Figure 10-3 shows that the en-route ANS costs projected for 2010 have been revised downwards by -5.4%. If this materialises, the “savings” for the year 2010 would amount to some €320M for the European system compared to November 2008 plans. En-route cost-bases have also been revised downwards for 2011-2014 by some 4-5% per annum. This is a clear indication that the cost-containment measures implemented by several States are expected to also deliver substantial benefits in 2010 and onwards. It is important that the cost-containment measures planned for 2010 genuinely materialise so that in future years the European system unit costs can quickly converge towards levels achieved before the economic downturn (i.e. €0.74/km).

### 10.3 En-route ANS cost-effectiveness analysis at State level

10.3.1 The historic and planned changes in en-route unit costs per km at European system level (see Figure 10-2) masks contrasted levels and trends across EUROCONTROL Member States<sup>76</sup>, hence the importance of considering the State level view.

10.3.2 In April 2009, CANSO indicated that several European ANSPs would implement short-term and medium term cost-containment measures in order to reduce the impact of the economic downturn on airspace users. In May 2009, the European Commission requested its Member States to provide the list of the measures that would be implemented in 2009 and 2010. A majority of States/ANSPs disclosed this information for the purposes of the Enlarged Committee for Route Charges meeting held in June 2009.

10.3.3 This information is summarised in Figure 10-4 which distinguishes genuine structural ANSPs measures aimed at containing or reducing the cost-base (green columns) and

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<sup>76</sup> These unit costs reflect en-route charges passed on to the airspace users by the various States. These charges include costs relating to ATS and MET provision, regulators, and to EUROCONTROL.

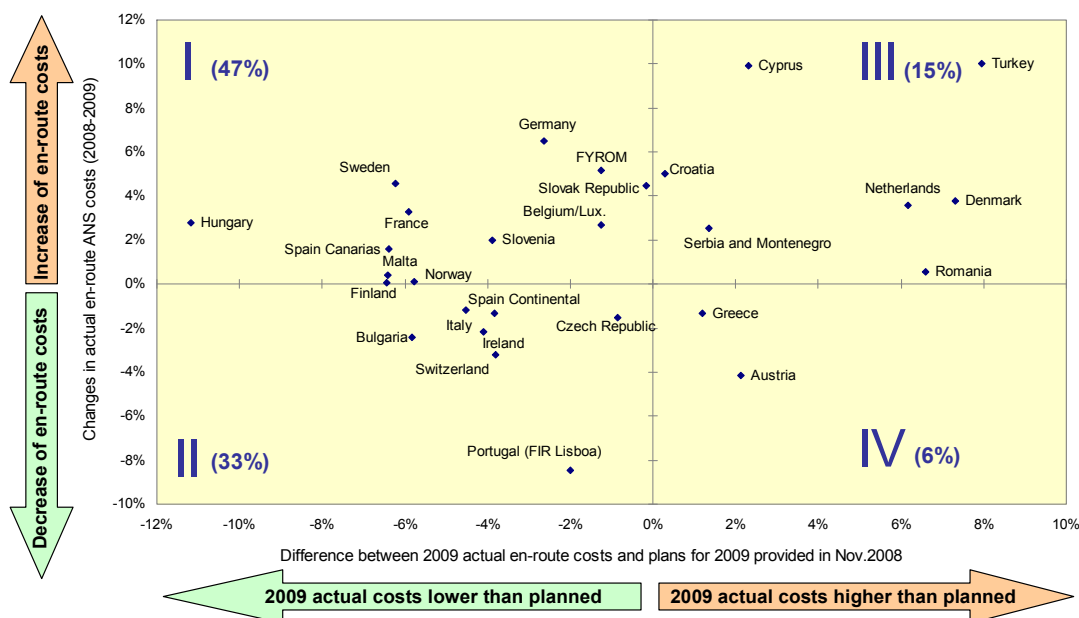
temporary measures from the State to reduce charges<sup>77</sup> (blue column).

Cross-subsidies and transfers	ATCO productivity	ATCO employment costs	Other operating costs	Capital-related costs
ANSP seeks additional revenue for inadequately funded services  State funds specific elements of the cost base  Use stabilisation fund or other reserves to smooth unit rate fluctuations  Reduced requirement for return on State-owned equity	Improved shift planning  Enhanced management of overtime	Enhanced management of overtime  Change pension scheme for new recruits  Increase retirement age	Review staffing needs for support functions  Pay freeze for top executives  Postpone recruitment  Curtail travel  Postpone training	Review property needs. Sell surplus assets.  Improved procurement processes  Extend life of technical systems  Review investment plan
<b>Across-the-board areas of improvement for ANSPs</b>				
Critical review of plans  Critical review of operational processes  Rationalise ACCs and other operational units			Seek improvements through cooperation (FABs)  Implement elements of SESAR  More rigorous budgetary control	

**Figure 10-4: List of main cost-containment measures**

10.3.4 Due to the variety of measures and to a lack of detailed information it is rather difficult to carry out an in depth analysis for each of the cost-containment measures listed in Figure 10-4 above. For this reason, the subsequent analysis of the cost-containment measures tends to focus on changes of States' en-route cost bases rather than on its specific components (such as ATCO productivity, ATCO employment costs, etc.).

10.3.5 In order to better understand whether EUROCONTROL Member States implemented cost-containment measures, Figure 10-5 shows the difference between actual 2009 en-route costs and the plans made in November 2008 for 2009 (see x-axis)<sup>78</sup>.



**Figure 10-5: Comparison of 2009 actual en-route ANS costs with Nov '08 plans**

10.3.6 Figure 10-5 also presents the changes in actual en-route ANS costs between 2008 and

<sup>77</sup> In addition to these cost-containment measures, there are also States that have postponed the collection of a part of the 2009 and 2010 charges to future years through the Route Charges adjustment mechanism (carry over of under/over recoveries). These will translate into under-recoveries to be borne by airspace users in future years.

<sup>78</sup> Note that Figure 10-5 does not comprise costs and traffic data relating to the UK (see footnote 74).

2009 (see y-axis). This information is useful to understand whether the implementation of cost-containment measures<sup>79</sup> in 2009 led to a reduction of the en-route cost-base compared to 2008.

10.3.7 It is important to analyse the information provided in Figure 10-5 in the light of the difference between the traffic planned for 2009 in November 2008 and the actual traffic in 2009. Indeed, larger traffic volumes than expected could lead to actual costs higher than planned in order to provide the adequate level of capacity.

10.3.8 Figure 10-6 indicates that in November 2008, a majority of States had not reflected in their plans the impact of the traffic downturn in 2009. Only five States planned for a negative traffic growth in 2009 (i.e. Austria, Bosnia and Herzegovina, Bulgaria, Germany, Romania and the UK).

10.3.9 Figure 10-6 also shows that for all the States, except Albania, Bulgaria, Bosnia and Herzegovina and Turkey, the actual 2009 traffic was lower than planned in November 2008.

10.3.10 It is noteworthy that in 2009, traffic increased for eight States: Albania (+9%), Bosnia and Herzegovina (+10%), Bulgaria (+2%), Croatia (+1%), Malta (+2%), Moldova (+11%), Serbia and Montenegro (+2%) and Turkey (+6%).

States	Actual traffic growth rate in 2009	Planned traffic growth rate for 2009 in Nov. 2008
Albania	9%	0%
Austria	-7%	-2%
Belgium/Lux.	-8%	2%
Bosnia-Herz.	10%	-7%
Bulgaria	2%	-2%
Croatia	1%	2%
Cyprus	-1%	3%
Czech Republic	-1%	5%
Denmark	-8%	4%
Finland	-6%	2%
France	-8%	1%
FYROM	-1%	5%
Germany	-8%	-1%
Greece	-2%	6%
Hungary	-3%	1%
Ireland	-8%	3%
Italy	-7%	2%
Malta	2%	5%
Moldova	11%	31%
Netherlands	-8%	1%
Norway	-5%	1%
Portugal (FIR Lisboa)	-7%	2%
Romania	-4%	-1%
Serbia and Montenegro	2%	15%
Slovak Republic	-1%	5%
Slovenia	-4%	2%
Spain Canarias	-14%	6%
Spain Continental	-9%	6%
Sweden	-11%	3%
Switzerland	-6%	2%
Turkey	6%	5%
United Kingdom	-11%	-3%

**Figure 10-6: Actual 2009 traffic compared to Nov. 2008 plans (km controlled)**

10.3.11 Figure 10-5 indicates that for 19 out of 31 States (representing some 80% of the European system total en-route costs), 2009 actual en-route costs are lower than planned in November 2008 (see Quadrants I and II). This indicates a certain degree of reactivity to the traffic shock experienced in 2009, and would suggest that these States implemented cost-containment measures in 2009.

10.3.12 For seven of these States, actual 2009 en-route costs are both lower than planned in November 2008 and lower than 2008 actual en-route costs (see Quadrant II). This is particularly the case for Portugal (FIR Lisboa). At face value, this indicates a higher degree of reactivity and more flexibility to adapt to the significant decrease in traffic volumes.

<sup>79</sup> Further details on the implementation of cost-containment measures are available in Section 10.6 (ANSP benchmarking) of this Report.

10.3.13 On the other hand, Figure 10-5 shows that for 12 States actual 2009 en-route costs are higher than planned in November 2008 (see Quadrants III and IV). For ten<sup>80</sup> of these States, actual 2009 en-route costs are both higher than planned in November 2008 and higher than 2008 actual costs (see Quadrant III).

10.3.14 Figure 10-5 also indicates that Austria and Greece could reduce their en-route cost-bases in 2009 despite the fact that actual en-route costs were higher than planned (see Quadrant IV).

10.3.15 The interpretation of the information provided in Figure 10-5 requires some caution since (a) some of the States classified in Quadrants III and IV may have implemented cost-containment measures that will generate savings from 2010 onwards, and (b) cost-containment measures expected to generate benefits in future years may have led to additional costs in 2009 (e.g. restructuring).

10.3.16 Because of their importance in the European system (65% of total costs) and for conciseness purposes, this section mainly focuses on the five largest States. More detailed analysis on the profile for en-route unit costs per km planned by smaller States is displayed in Annex VII. The top chart of Figure 10-7 displays the changes in real en-route unit costs for the five largest States<sup>81</sup> between 2007 and 2014 according to the information provided in November 2010 (blue line) and compare these figures with the unit costs profiles planned in November 2008 (red line).

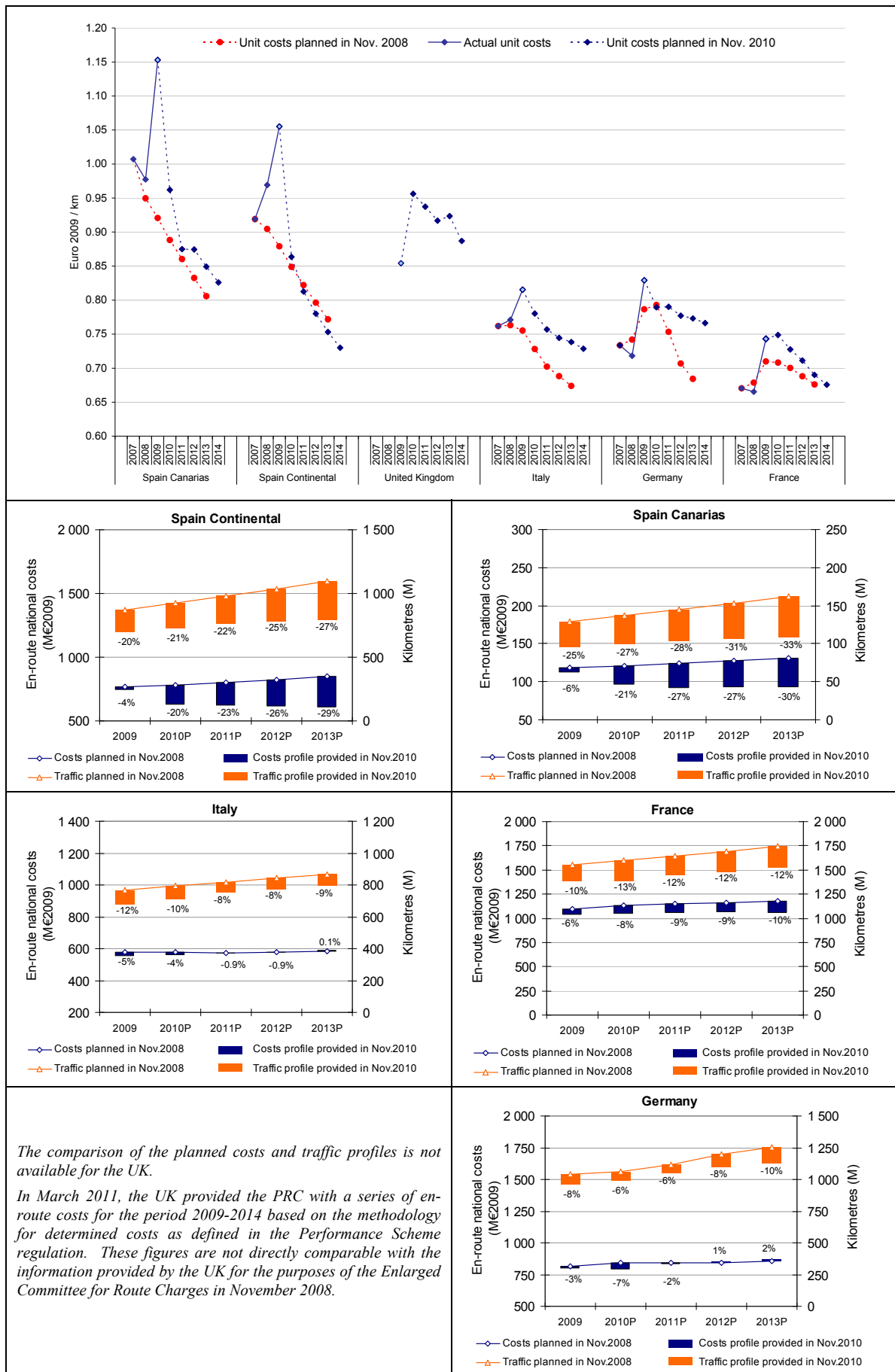
10.3.17 The bottom charts in Figure 10-7 compares, for each of the five largest States, the plans in terms of en-route costs and traffic prepared in November 2008 with the forward-looking information provided during the November 2010 session of the Enlarged Committee.

#### **Inflation and exchange rates**

Following the economic downturn, exchange rates have been extremely volatile in many European countries in 2008 and in 2009. As a result, time-series comparisons of unit costs can be affected by variations in exchange rates. To cancel this impact, in this Report the financial elements of performance are assessed, for each year, in national currency. Unit costs are then expressed in real terms using national inflation rates. Then, all national currencies are converted into Euro using the 2009 exchange rate. Therefore, the unit costs disclosed for any State in this Report differ from the figures provided in previous PRRs. For example, the **level** of the UK 2009 en-route unit costs in the top chart in Figure 10-7 is affected by the 23% depreciation of the £ compared to the € in 2007-2009. On the other hand, as explained above, the **trends** in unit costs provided in Figure 10-7 are not distorted by transient changes in exchange rates.

80 Moldova and Albania 2009 actual en-route costs were more than 10% higher than planned in November 2008. Similarly, Bosnia-Herzegovina en-route costs increased by +16% between 2008 and 2009. For this reason, these States could not be displayed in Figure 10-5.

81 Note that for the purpose of Route Charges, Spain has two different charging areas (Continental & Canarias).



**Figure 10-7: Changes in planned en-route costs and traffic for the five largest States [€2009]**

- 10.3.18 First, the top chart in Figure 10-7 indicates that there are significant differences in the 2009 level of actual unit costs across the five largest States which operate in similar operational and economic environments (i.e. from €1.15 for Spain Canarias to €0.74 for France). Note that levels of unit costs should be seen in the light of exogenous factors such as local economic and operational conditions, which considerably vary across States. This requires some caution when drawing conclusions in terms of economic efficiency. This being said, the level of en-route unit costs for Spain Canarias is not commensurate with its operational (i.e. airspace complexity) and economic (i.e. cost of living) environments.
- 10.3.19 Second, the top chart in Figure 10-7 shows that in 2009, real en-route unit costs significantly increased for all the five largest ANSPs following the significant decrease in traffic volumes. Figure 10-7 also indicates that the planned unit costs profile submitted in November 2010 significantly differs from the plans made in November 2008. It is therefore important to understand the drivers for these changes and to compare the costs and traffic data planned in November 2008 and in November 2010.
- 10.3.20 In the UK, the en-route ANSP (NERL) implemented a cost reduction programme on operating costs (reduction of some €50M) by end 2010 (equivalent to some 7% of NERL en-route annual cost-base). As a result, despite traffic volumes which were -10% lower than planned in November 2008 and a decrease in revenues (-4%), NERL could generate a profit of £41.1M in 2009/2010 which indicates that actual costs were lower than planned. This might be due to the incentive scheme which is part of the independent economic regulation regime under which NERL operates. Indeed, in the UK as the traffic risk is shared between the ANSP and airspace users, a decrease in traffic volumes directly result in a loss for the ANSP which will not be recovered from airspace users. There is therefore a direct incentive for the ANSP to reduce its costs to compensate the decrease in revenues arising from the fall in traffic.
- 10.3.21 The UK plans for a slow traffic recovery following the downturn in 2009, since between 2009 and 2014 traffic volumes are expected to increase by +11% (+2.2% p.a. compared to +3.4% p.a. for the European system). In the meantime, en-route costs are planned to significantly rise (+16%), with a sharp increase in 2010 (+8%). Therefore, en-route unit costs are planned to significantly increase by +12% between 2009 and 2010 and then to decrease by -1.9% p.a. until 2014. As a result, the UK en-route unit costs will be the highest among the five largest States in 2014 (i.e. €0.89/km, +31% compared to France 2014 unit costs).
- 10.3.22 In France, the cost-containment measures implemented by DSNA for 2009 were associated with a reduction in non-staff operating costs (€5M) and in capital related costs (€25M), together amounting to some 3% of the annual en-route cost-base. Figure 10-7 shows that France 2009 en-route cost-base is -6% lower than planned in November 2008 and that from 2010 onwards, en-route costs have been revised significantly downwards (i.e. 8-10%), mainly reflecting reductions in support staff costs and a State policy to replace only half of the retiring staff. As a result, France en-route unit costs are planned to decrease by -9% between 2009 and 2014 and be the lowest among the five largest States in 2014.
- 10.3.23 In 2010 a report from the French “Cour des Comptes” highlighted a certain number of performance issues during their audit of the French DGCA budget, in particular issues relating to the lower number of days and effective working hours of French ATCOs and to the roster scheme. As an effective step to address some of these issues, DSNA implemented a number of measures and in particular a clock-in clock-out system for ATCOs (June 2010).



10.3.24 In Spain, AENA implemented specific cost containment measures in 2009 which were expected to bring savings of some €37M (mostly relating to a greater flexibility in ATCO roster and shift planning, and a reduction of ATCO overtime hours). Figure 10-7 shows that Spain continental and Spain Canarias 2009 cost-bases are lower than planned in November 2008 (-4% and -6%, respectively).

10.3.25 Furthermore, the en-route costs forward-looking profile for the years 2010-2014 was revised significantly downwards (by around 20-30%). This reflects the expected impact on the Spanish cost-base of the specific law (Ley 9/2010) which was adopted in Spain on the 15 April 2010 in order to address performance issues in Aena and in particular the high level of ATCO employment costs and the lower productivity compared to other ANSPs. The main issues addressed by the law relate to the organisation of shifts and to the determination of staff working hours. In particular, ATCO contractual working hours will be adjusted to better match with the traffic demand and the number of ATCO overtime hours will be capped at 80 hours per year (i.e. well below the 500 overtime hours in 2009). These measures are expected to significantly reduce ATCO employment costs and to increase productivity in the future years.

10.3.26 According to the information provided by Spain in November 2010, en-route unit costs are planned to significantly decrease between 2009 and 2014 (i.e. -28% for Spain Canarias and -31% for Spain Continental). The law requires that the Spanish unit rate converges towards the average of the five largest States by 2013. The information provided in Figure 10-7 shows that Spain forward-looking projections are in line with this objective.

**Managing changes to improve performance**

The initiatives taken in France and in Spain show that cost-effectiveness improvements are achievable, in particular when there is a strong political and managerial commitment to address performance issues.

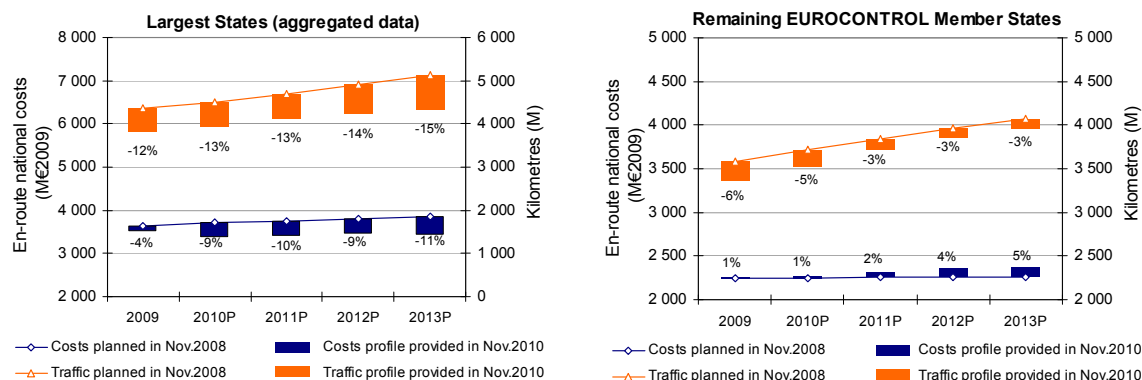
As suggested by the figures on ATFM delays for 2010 (see Chapter 7), there was a significant deterioration of the quality of service provided in France and Spain which was mainly related to tensions between ANSP management and staff.

10.3.27 In Italy a cost cutting programme was expected to generate savings amounting to some €30M in 2010 (some 5% of the annual en-route cost-base). Figure 10-7 shows that Italy 2009 en-route cost-base is -5% lower than planned in November 2008. Figure 10-7 also shows that further cost containment measures are planned for 2010 since the plans provided in November 2008 have been revised by -4%. En-route costs planned for the years 2011 to 2013 have also been revised downwards albeit from a smaller magnitude. As a result, Italy en-route unit costs are planned to decrease by -11% between 2009 and 2014. Furthermore, it should be noted that in 2009 Italy used its special reserve (“stabilisation fund”) to finance part of the en-route cost-base and to reduce the unit rate that has been charged to airspace users.

10.3.28 Germany: the objective of the cost-containment measures (mainly relating to operating expenses and depreciation costs) implemented by DFS in 2009 was to save some €35M (some 5% of the en-route annual cost-base). Figure 10-7 indicates that Germany 2009 en-route cost-base is -3% lower than planned in November 2008. Figure 10-7 also shows that in 2010, en-route costs have been revised downwards (-7%). On the other hand, en-route costs planned for the years 2012 and 2013 have been revised slightly upwards compared to November 2008 plans. Overall, Germany en-route unit costs are planned to decrease by -8% between 2009 and 2014 and to reach unit costs of €0.77 per kilometre by 2014 which is +13% higher than France.

10.3.29 The right-hand side of Figure 10-8 indicates that overall for the remaining 25 EUROCONTROL Member States, en-route costs forecasted in November 2008 for the

period 2009-2013 were revised **upwards** in November 2009 plans. This clearly contrasts with the **downwards** revision of en-route costs for the largest States<sup>82</sup> when these are aggregated (see the left-hand side of Figure 10-8). Figure 10-8 also shows that for the remaining EUROCONTROL Member States, 2009 costs have not been revised downwards compared to November 2008 plans although most of these States announced that they would implement cost-containment measures in 2009 and 2010.



**Figure 10-8: Changes in planned en-route costs and traffic for the largest States versus the remaining 25 States [€2009]**

10.3.30 Figure 10-5 above indicates that for six States (the Netherlands, Denmark, Romania, Turkey, Albania and Moldova) actual 2009 costs are more than +5% higher than planned in November 2008. It should be noted that some of these States announced in June 2009 that they would implement cost-containment measures.

- **The Netherlands:** several cost-containment measures were implemented by LVNL for the years 2009 and 2010 including the revision of the investment plan, the reduction of some operating expenses, the freeze of recruitment of non operational staff and a significant reduction in non operational staff number (-100 FTEs by December 2010). On the other hand, Figure 10-5 shows that the Netherlands 2009 en-route costs are 6% higher than planned in November 2008. The main driver for the higher 2009 costs is the inclusion in their en-route cost-base of a one-off exceptional cost relating to the staff reduction programme planned for 2009 and 2010 (i.e. total amount around €21M). If these exceptional costs were not taken into account, actual 2009 en-route costs would be lower than planned in November 2008. Furthermore, the en-route costs planned for the years 2010 onwards have been revised downwards.
- **Denmark:** although NAVIAIR implemented cost-containment measures such as the capping of staff and non-staff operating costs and the postponement of non-critical investment projects, the actual 2009 Danish en-route cost-base is +7% higher than planned in November 2008. Significantly higher depreciation costs compared to the plans are the main driver for the higher Danish cost-base. These higher depreciation costs are partly due to the implementation of new accounting standards in 2009 which led to a new principle of depreciation of fixed assets and a one-time depreciation.
- **Romania:** in June 2009, ROMATSA announced that it would implement cost-containment measures including the reorganisation of ACC operational units, the revision of the investment plan and to continue the staff reduction programme started in 2007 (-17% by end 2010). On the other hand, Figure 10-5 and Figure 10-6 show that Romania 2009 en-route costs are 7% higher than planned despite lower traffic volumes than expected. Higher staff and non-staff operating costs are the main driver for the higher Romanian cost-base compared to the plans. Furthermore, compared to November 2008 forward-looking data, the en-route costs planned for the years 2010 onwards have been

<sup>82</sup> The right-hand side chart in Figure 10-8 comprises costs and traffic data for France, Germany, Italy and Spain. UK costs and traffic data are not included (see footnote 74).

revised upwards.

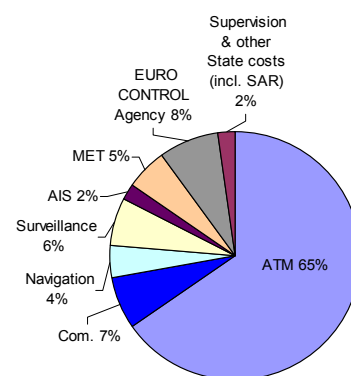
- Albania: in June 2009, NATA Albania announced that it would implement cost-containment measures mainly relating to the rationalisation of operating expenses. On the other hand, Figure 10-5 shows that Albania 2009 en-route costs are 19% higher than planned in November 2008. Higher staff and non-staff operating costs are the main driver for the higher Albania cost-base compared to the plans. However, this should be seen in the light of the fact that in Albania, the actual 2009 traffic (+9%) was much higher than planned (0%) as indicated in Figure 10-6. Compared to November 2008 plans, the en-route costs profile for the years 2010 onwards has been revised upwards. This mainly reflects the significant capital investment programme which is taking place in Albania in the context of the National Airspace Modernisation Program (NAMP).
- Moldova: in June 2009, MoldATSA announced that it would implement cost-containment measures mainly relating to the postponement of capital investment projects. On the other hand, Figure 10-5 shows that Moldova 2009 en-route costs are 20% higher than planned in November 2008. This should be seen in the light of the 11% traffic increase in 2009 in Moldova.
- Turkey did not implement specific cost-containment measures for the years 2009 and 2010. This is consistent with the information provided in Figure 10-5 which indicates that Turkey 2009 en-route costs are 8% higher than planned in November 2008. This should be seen in the light of the traffic increase in 2009 for Turkey (+6%). Furthermore, two main issues may contribute to further increase the Turkish cost-base in future years (1) the significant capital investment programme which is taking place in Turkey in the context of the Turkish ATC Modernisation Project (SMART project) and (2) the adoption of a law with a view to increase public servants salaries in Turkey.

10.3.31 It is important that all the States adequately contribute to the improvement of the European system cost-efficiency performance. A majority of them have already started to implement cost containment measures in 2009 and 2010. It is expected that these measures contribute to improve the European system cost-effectiveness performance in the forthcoming years.

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

10.4.1 In June 2010, Member States provided 2009 actual en-route costs data according to the EU regulation laying down a Common Charging Scheme for ANS (EC reg. 1794/2006) [Ref. 63].

10.4.2 ANS costs are broken down according to the components<sup>83</sup> indicated in Figure 10-9. Costs associated with the CNS infrastructure amount to 17% of the total cost-base, while 65% relates to ATM. Supervision and other State costs represent some 2% in 2009. Typically, these costs relate to States' regulatory and supervision functions (e.g. NSAs). It should be noted that the proportion of the different components of en-route ANS costs remained fairly constant between 2008 and 2009.



**Figure 10-9: Breakdown of en-route ANS costs at European system level [2009]**

10.4.3 From an economic point of view, CNS costs (i.e. 17%) are likely to have different characteristics and drivers than ATM costs. CNS costs are infrastructure costs and as such are mainly fixed costs in the medium term.

83 Note that in Figure 10-9, Maastricht UAC costs are not included under the EUROCONTROL Agency costs category but reported as ATM/CNS provision costs.

10.4.4 Each of the ANS components are analysed below in order to identify the drivers for the European States performance in terms of cost-effectiveness.

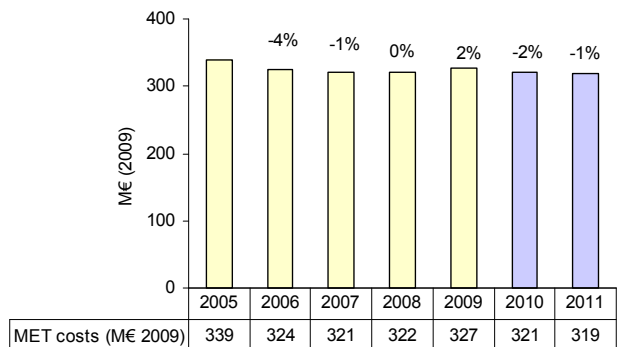
#### ATM/CNS PROVISION COSTS (INCLUDING AIS & MAASTRICHT COSTS)

10.4.5 The bulk of total ANS costs (i.e. some 85%) relate to the provision of ATM/CNS services. These costs are largely under the direct control and responsibility of ANSPs. They are linked to the capacity provided for a safe and efficient management of traffic demand. ATM/CNS service provision costs form the basis of the ANSP cost-effectiveness benchmarking analysis presented in Section 10.6 of this chapter.

#### AERONAUTICAL MET COSTS

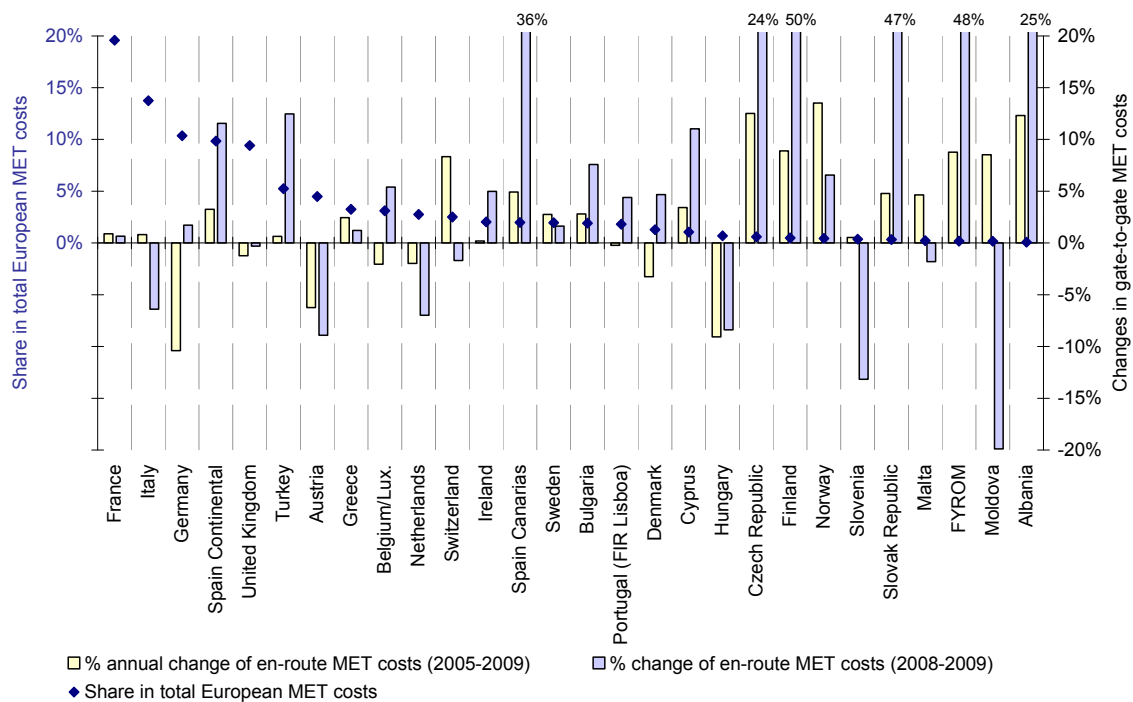
10.4.6 Figure 10-10 shows the trend at European level of MET costs recovered through en-route charges between 2005 and 2011 for a consistent sample of 28 EUROCONTROL Member States for which data for a time-series analysis was available.

10.4.7 At European level, en-route MET costs, i.e. some 5% of en-route ANS costs, amounted to some €327M in 2009 (+1.8% in real terms compared to 2008). In the context of economic downturn with a severe traffic decline, it is expected that all the ANS entities (including MET service providers) contribute towards improving the cost-effectiveness performance at system level.



**Figure 10-10: Changes in en-route MET costs at European level [2005-2011] in €2009**

10.4.8 Figure 10-11 below shows that the -3% decrease in MET costs at European system level between 2005 and 2009 is mainly due to decreases in Germany (-10% per annum), the UK (-1% p.a.) and Austria (-6% p.a.) where MET costs represented 10%, 9% and 4% of the total MET costs at European system level, respectively. The impressive reduction in en-route MET costs for Germany is mainly due to the reassessment of its cost allocation and an effort to rationalise its MET service provision. Furthermore, as of 2007 a part of Germany MET costs has been reallocated from en-route ANS to terminal ANS.



**Figure 10-11: Changes in en-route MET costs at State level [2005-2009] in €2009**

10.4.9 Figure 10-11 also indicates that the increase of system level MET costs (+1.6%) in 2009 is mainly due to increases in Spain Continental (+12%), Spain Canaries (+36%) and Turkey (+12%). These increases should warrant further attention.

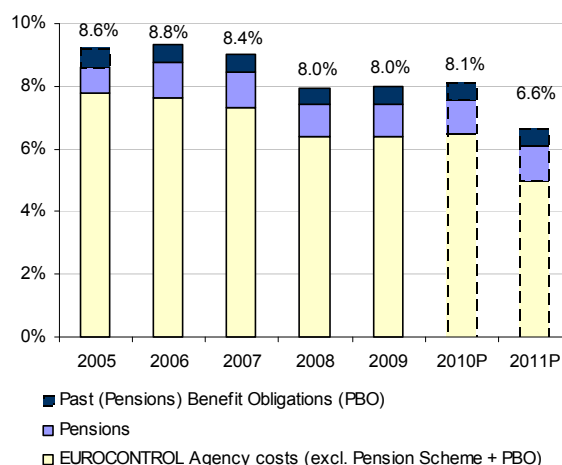
10.4.10 Figure 10-11 shows that the most significant increases in MET costs over the 2005-2009 period took place in States where the MET cost-base was “small” in 2005. This is an indication that these States are currently developing their MET infrastructure. As outlined in the 2004 PRC Report on aeronautical MET costs [Ref. 64], it is important that aviation is not charged for a disproportionately large share of core MET costs (e.g. R&D, computers for long-term forecasts).

10.4.11 The PRC also recommended in its MET Report to “explore the common financing of joint European aeronautical MET services and products”. The PRC considers that in the context of SES II, there is an opportunity to make the most effective use of the existing national and international aeronautical MET infrastructure (e.g., World Area Forecast Centre - WAFC), to avoid duplication without challenging any aspect of civil aviation safety, and to optimise the efficiency of the aeronautical MET system through increased rationalisation and automation.

## EUROCONTROL AGENCY COSTS (EXCLUDING MUAC)

10.4.12 EUROCONTROL Agency costs can be split into two main categories: the EUROCONTROL cost base (Parts I and IX, €537.9M in 2009) and the CRCO costs (Part II, €18.8M in 2009).

10.4.13 In 2009, the EUROCONTROL Agency cost base (Parts I and IX) represents 8.0% of total European en-route ANS costs, which is similar to 2008. This means that in 2009, the EUROCONTROL Agency cost base increase at the same rate as the States national cost bases. As indicated in Figure 10-12 the relative share of EUROCONTROL Agency costs is expected to remain fairly constant in 2010 and then significantly decrease to 6.6% in 2011.



**Figure 10-12: EUROCONTROL Agency costs relative to total European en-route ANS costs**

10.4.14 Figure 10-13 displays the breakdown of EUROCONTROL Agency costs per establishment and expenditure between 2005 and 2009.

Establishment	Yearly costs (M€)						
	2005	2006	2007	2008	2009	% 09/05	% 09/08
CND/ASRO/MIL/HMU	215.3	226.1	220.2	232.4	230.7	7%	-1%
Resources	73.5	71.5	71.1	68.6	70.5	-4%	3%
CFMU / EAD	113.5	111.7	119.9	119.9	122.9	8%	2%
Institutional bodies	6.4	7.0	5.0	5.1	6.1	-4%	21%
Pension in charge of the budget	48.6	65.2	69.2	69.4	71.0	46%	2%
PBO	35.4	35.4	35.8	36.2	36.7	4%	1%
<b>Total Parts I &amp; IX</b>	<b>492.7</b>	<b>516.8</b>	<b>521.2</b>	<b>531.6</b>	<b>537.9</b>	<b>9%</b>	<b>1%</b>
Price Index (Belgium)	1.000	1.023	1.042	1.089	1.089	9%	0%
Real costs (€2009) Total Parts I & IX	536.4	549.8	544.6	531.5	537.9	0%	1%

Type of expenditure	Yearly costs (M€)						
	2005	2006	2007	2008	2009	% 09/05	% 09/08
Staff costs	192.9	209.0	219.6	221.9	233.3	21%	5%
PBO	35.4	35.4	35.8	36.2	36.7	4%	1%
Pensions	48.6	65.2	69.2	69.4	71.0	46%	2%
Operating costs	99.5	141.1	143.8	140.0	142.8	44%	2%
Depreciation costs	107.8	59.4	45.7	56.5	49.8	-54%	-12%
Interest	8.6	6.8	7.2	7.5	4.3	-50%	-43%
<b>Total Parts I &amp; IX</b>	<b>492.7</b>	<b>516.8</b>	<b>521.2</b>	<b>531.6</b>	<b>537.9</b>	<b>9%</b>	<b>1%</b>
Price Index (Belgium)	1.000	1.023	1.042	1.089	1.089	9%	0%
Real costs (€2009) Total Parts I & IX	536.4	549.8	544.6	531.5	537.9	0%	1%

**Figure 10-13: EUROCONTROL Agency costs per establishment & expenditure (Parts I & IX)<sup>84</sup>**

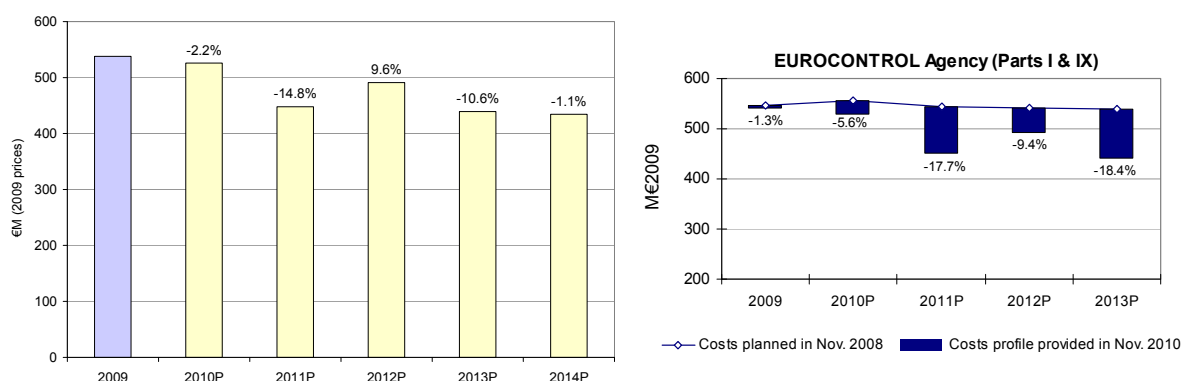
10.4.15 Figure 10-13 shows that EUROCONTROL cost-base remained fairly constant between 2008 and 2009. This is mainly due to a significant decrease in depreciation costs (-12%) and interest (-43%) while staff costs (+5%) increased.

10.4.16 The apparent decrease in depreciation costs in 2009 is mainly due to the fact that in 2008, some equipment assets were written off resulting in exceptional depreciation costs (€5M). The reduction in interest expenses mainly results from the lower amount of debt and very low interest rates in 2009.

10.4.17 The chart provided on the right-hand side of Figure 10-14 shows that 2009 EUROCONTROL costs (i.e. €537.9M) are -1.3% lower than planned in November 2008 (i.e. €545.2M, which included the 98% cap). Figure 10-14 also indicates that from 2010 onwards, the forward-looking profile of EUROCONTROL costs has been significantly revised downwards compared to November 2008 plans.

<sup>84</sup> In Figure 10-12 and Figure 10-13 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.





**Figure 10-14: Planned EUROCONTROL Agency cost-base [Nov. 2008- Nov. 2010]**

10.4.18 In 2010, the EUROCONTROL Agency went through a reorganisation process with the objective to improve its efficiency. The new EUROCONTROL Agency organisation is based on three main pillars: Directorate Single Sky, Directorate Network Management and Directorate SESAR and Research.

10.4.19 The left-hand side of Figure 10-14 shows that the EUROCONTROL cost-base is planned to decrease by -19% (i.e. -4.2% per annum) for the period 2009-2014. It should be noted that the -14.8% cost reduction planned for 2011 is a non recurring event reflecting the decision to align EUROCONTROL accounting rules with IFRS.

10.4.20 Similarly, the -10.6% decrease planned for the year 2013 relates to the implementation of the “User Pays” Principle according to which a part of the EUROCONTROL cost-base will not be financed by user charges. The implementation of the “User Pays” Principle is subject to further approval of the EUROCONTROL Member States.

10.4.21 Furthermore, the EUROCONTROL Agency has recently implemented an early termination scheme according to which some 200 staff will leave in early retirement between 2011 and 2013. Although the implementation of the early termination scheme may lead to higher costs in the short-term, this measure will contribute to significantly reduce the EUROCONTROL Agency workforce and to decrease the corresponding staff costs in the forthcoming years.

10.4.22 The PRC welcomes the EUROCONTROL initiative to improve its efficiency. This will certainly contribute to reduce the total en-route cost-base charged to airspace users.

## 10.5 Terminal ANS cost-effectiveness analysis at EU level

### MONITORING TERMINAL ANS COST-EFFICIENCY PI AND FUTURE KPI

10.5.1 The PRC considers it important to monitor performance in terms of terminal ANS cost-effectiveness to better understand the total performance (from a gate to gate perspective), including any potential reallocation of costs between terminal and en-route. There are already a number of interwoven regulatory requirements relating to terminal ANS cost-efficiency indicators in Regulation (EC) N°1794/2006 (hereinafter the “charging scheme regulation”) and Regulation (EC) N°691/2010 (hereinafter the “performance scheme regulation”):

- With effect from 2010, all States shall establish terminal ANS charges and unit rates in line with the charging scheme regulation;
- During the first reference period of the performance scheme (RP1; 2012-2014), cost-

efficiency performance indicators<sup>85</sup> “Terminal ANS costs” and “unit rates” have to be monitored by States and the European Commission;

- For the second reference period (RP2; 2015-2019) a performance target shall be set for terminal ANS cost-efficiency KPI (the second cost-efficiency KPI), currently defined as the “determined unit rate for terminal air navigation services”.

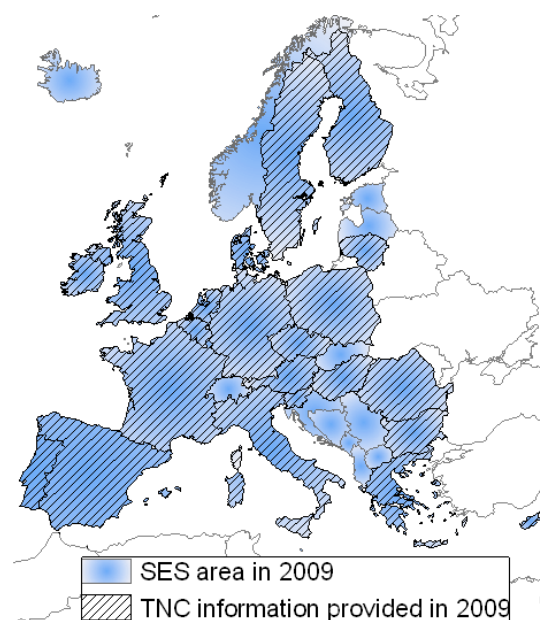
#### APPLICABILITY AREA AND INFORMATION PROVIDED

10.5.2 For the second year in a row, the PRC monitors the Terminal ANS cost information provided by European States (see below figure 10-15 and the related explanations on the States coverage) according to the template requirements of the charging scheme regulation.

10.5.3 The charging scheme regulation entered into force on 1<sup>st</sup> January 2007 and all provisions in respect of route charges were fully applicable from 1<sup>st</sup> January 2008 (Art 18(2)). However Article 9 and Articles 11 to 15 in respect of terminal charges are fully in force since 1<sup>st</sup> January 2010, and therefore all the provisions of the charging scheme regulation should now apply to all 37 States covered by the SES regulations.

10.5.4 Figure 10-15 presents the status of terminal ANS information provision for 2009 data. Information is recorded for 23 EU Member States, all part of the EUROCONTROL membership.

10.5.5 The three EEA-EFTA<sup>86</sup> States (Norway, Iceland, Lichtenstein) and seven States members of the ECAA (Albania, Bosnia and Herzegovina, Croatia, FYROM, Serbia, Montenegro, the United Nations Interim Administration Mission (UNMIC) in Kosovo) as well as Switzerland (EU-Switzerland aviation bilateral agreement), did not provide terminal ANS costs and unit rates information for 2009.



**Figure 10-15: Status of 2009 terminal ANS data provision**

10.5.6 It should be noted that the EU-wide performance targets for RP1 cover 29 States (EU27 plus Norway and Switzerland).

10.5.7 Beyond the State/geographical scope, additional criteria, relating to the number of commercial air transport movements by airports in Art. 1.5 and Art. 1.6 affects the scope of applicability of the charging scheme Regulation. In addition these criteria have been slightly updated by the European Commission in 2010 [Commission Regulation (EU) N°1191/2010 of 16 December 2010 amending Regulation EC N°1794/2006, [Ref. 63] see also in grey box below “Scope of Regulation (EC) N°1794/2006”.

85 EC 691/2010, Art.2(c); ‘Performance Indicators’ means indicators used for the purpose of performance monitoring, benchmarking and reviewing.

86 The European Economic Area (EEA) unites the 27 EU Member States and the 3 European Free Trade Agreement (EFTA) States in an internal market governed by the same basic rules. Switzerland is in EFTA but not in EEA.

10.5.8 According to this Regulation, terminal ANS costs relate to:

- Aerodrome control services, aerodrome FIS including air traffic advisory services and alerting services;
- ATS relating to the approach and departure of aircraft within a certain distance of an airport on the basis of operational requirements; and,
- An appropriate allocation of all other ANS components, reflecting a proportionate attribution between en-route and terminal services.

**Scope of Regulation (EC) 1794/2006**

All airports above 150 000 commercial air transport movements<sup>87</sup> are covered by this Regulation. Airports below 50 000 movements may be exempted at the discretion of States<sup>88</sup>, while airports between 50 000 and 150 000 movements may only be exempted when they fulfil certain criteria related to the economic and regulatory environments in which they operate.

In total, the Regulation covers around 205 airports within the SES area, which represents some 73% of the total European airport movements in 2009.

10.5.9 Four EU States (Estonia, Latvia<sup>89</sup>, Malta and Slovak Republic) did not provide any 2008 and 2009 terminal ANS costs and unit rate information, and indeed they have less than 50000 commercial air transport movements at their airports. EEA-EFTA and ECAA States, also part of the SES regulations applicability area, have not provided terminal ANS costs and unit rates information. However, for the purpose of the “Performance Scheme regulation” a terminal ANS cost-efficiency target will have to be set for the second reference period (RP2: 2015-2019) for all States, irrespective of the number of movements, and as a minimum terminal ANS costs information will be required for the largest airport (in terms of commercial air transport movements) of every State<sup>90</sup>.

10.5.10 Setting meaningful EU-wide performance targets requires some in-depth analysis of historical information and all States covered by the performance scheme are encouraged to start reporting terminal ANS costs and unit rate information in line with the charging scheme requirements, at least for the main airport in their country.

10.5.11 Despite transparency improvements on terminal ANS costs and unit rate information at European level, there is still a great deal of diversity.

10.5.12 Firstly, whereas harmonised processes and mechanisms for reporting ANS en-route charges and setting unit rates are well established, such processes for the determination of terminal ANS charges only started in November 2009 with the setting of the 2010 terminal navigation charges, and became mandatory with effect from 1 January 2010 (Art 18(2) of EC regulation 1794/2006 [Ref. 63]).

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87 Counted as the sum of take-offs and landings.

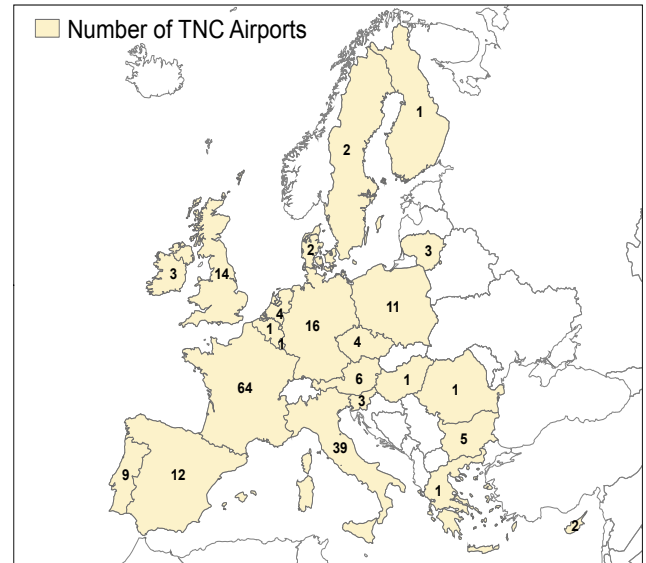
88 Despite having no airport with more than 50 000 airport movements during 2009, Bulgaria and Cyprus have provided terminal ANS cost or unit rate information

89 Latvia provided data from 2011 onwards.

90 Commission Reg. 691/2010 Art.1.3 “(...) Where none of the airports in a Member State reaches the threshold of 50000 commercial air transport movements per year, performance targets shall apply as a minimum to the airport with the highest commercial air transport movements.”

10.5.13 Secondly, as shown in Figure 10-16, a large majority of States have one single terminal charging zone. However the number of aerodromes for which terminal ANS costs are reported vary widely from one State to another ranging from one single aerodrome (e.g., Belgium, Finland, Greece, Hungary, Luxembourg, Romania) up to 64 aerodromes (France).

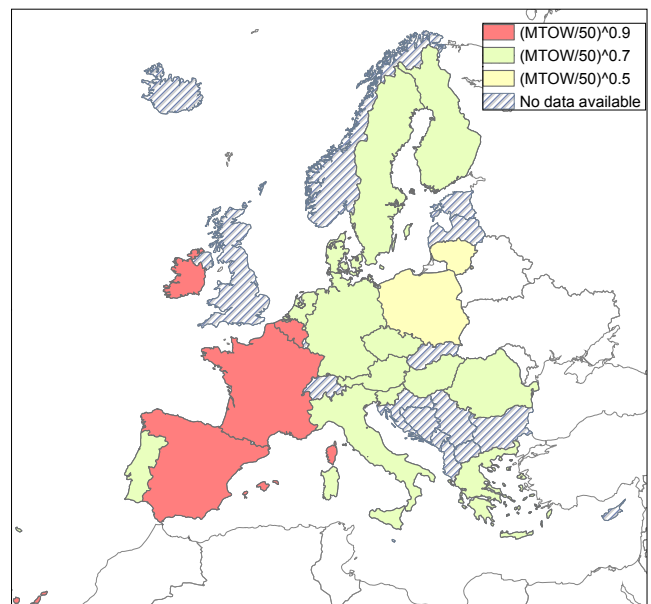
10.5.14 Two countries have more than one charging zone: Sweden (1 for Landvetter and 1 for Arlanda) and the United Kingdom (a charging zone A for a group of 10 airports with between 50 000 and 150 000 movements, and a charging zone B with 4 aerodromes with more than 150 000 movements). See details for each State in Annex VIII of this report.



**Figure 10-16: Distribution of aerodromes in States reporting Terminal ANS cost in 2009**

10.5.15 Only Luxembourg and the UK (for charging zone A) do not report unit rate information as they declare that ANS at these airports fall under the provisions of Art 1.6 of the charging regulation (ANS contestability). However the United Kingdom does not report service units and unit rate information for their second terminal charging zone (Charging Zone B with 4 aerodromes with more than 150 000 movements) and other States did not yet report unit rate information either (Belgium and Ireland).

10.5.16 The Regulation foresees a period of 5 years (2010-2015) to allow for the convergence towards a common terminal service units formula  $[(MTOW/50)^{0,7}]$  for the establishment of terminal navigation charges allowing States to limit redistribution effects between airspace users. Whereas all reporting States are in line with the requirements of the charging scheme regulation (exponent in the terminal service units formula between 0,5 and 0,9), 70% of the States, representing 89 of the 205 airports and close to 50% of the airport movements, are already applying a 0,7 exponent (see Figure 10-17). Terminal service units and unit rates remain not directly comparable across all the States.

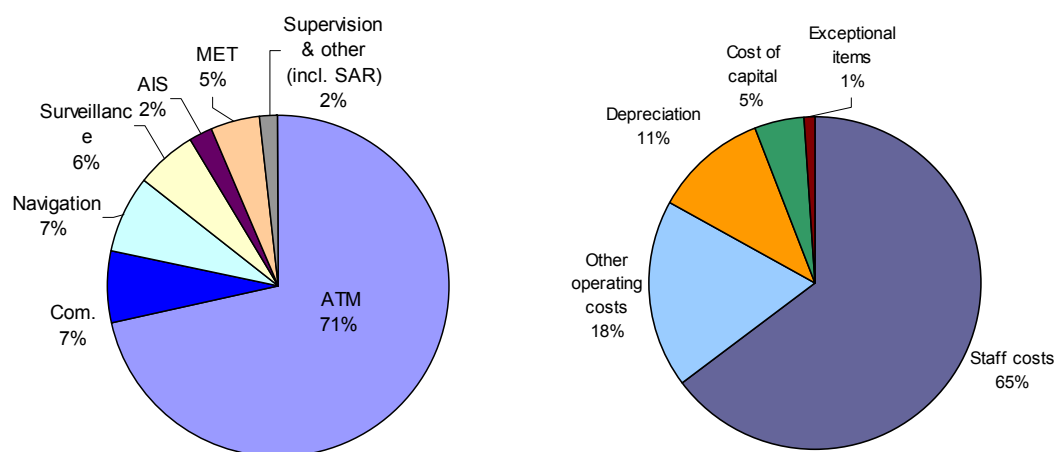


**Figure 10-17: Terminal Service Units formulas in 2009**

10.5.17 The charging scheme regulation explicitly foresees the possibility to recover terminal ANS costs through other sources (e.g. revenues from non ANS activity). For cost-effectiveness and benchmarking analysis purposes this requires having an understanding of, and making a distinction between “the costs to provide terminal ANS” and “the costs charged for terminal ANS”. This information is still not readily available.

## 2009 HIGHLIGHTS

10.5.18 In 2009, the total terminal ANS costs reported by 21 States<sup>91</sup> amounted to around €1 454M, an increase of +1.3% over 2008 in real terms (see also Annex VIII for the list of airports covered). Figure 10-18 below provides the breakdown of terminal ANS costs by services (see left-hand side) and by categories (see right-hand side). By and large the cost breakdown is of the same order of magnitude from year to year and similar to en-route (see Figure 10-9).



data source: 2011 terminal air navigation services costs and charges – Nov2010

**Figure 10-18: Breakdown of Terminal ANS costs at European system level [2009]**

10.5.19 To monitor the terminal ANS cost-effectiveness, the PRC has looked at the evolution of actual and planned cost recorded as well as the unit costs.

10.5.20 In 2009, 21 States within the SES area have reported complete actual and forward looking terminal ANS cost information, representing more than 200 airports<sup>92</sup> and some 73% of the total European airport movements in 2009.

10.5.21 The unit costs for terminal ANS at European system level are obtained by dividing the total terminal ANS costs provided (in real terms) by the number of IFR airport movements. Figure 10-19 summarises the main data used to compute the terminal unit costs per IFR airport movement for 2008 and 2009. According to the available data in Figure 10-19, the unit costs for an IFR movement are €126, an increase of 10.5% over 2008 in real terms (€114) which is the result of an important decrease in traffic (-8.3%) coupled with an increase in costs (+1.3%).

	2 008	2 009	2010F	2011P	2012P	2013P	2014P	09/08	14/09
States (reporting terminal ANS charges)	21	21	21	21	21	21	21		
Nb of airports	204	203							
Total terminal ANS costs (M€2009)	1 436	1 454	1 389	1 397	1 400	1 400	1 409	1.3%	-3.1%
IFR airport movements (M)	12.6	11.5						-8.3%	
Real unit costs (€2009 / IFR airport movement)	114	126						10.5%	

data source : 2011 terminal air navigation services costs and charges, Nov. 2010

**Figure 10-19: Terminal ANS unit costs at European system level [€2009]**

10.5.22 Looking forward, Figure 10-19 indicates that as a whole and for the 21 European States for which information is recorded the current planning is for a decrease of total terminal ANS costs per airport movement by -3.1% in real terms between 2009 and 2014. En-route

91 Only 21 States reported data in 2008, 2009 and up to 2014. Three States did provide some data with a different coverage (Greece did not provide 2008 data, Luxembourg did not provide forward looking information over the whole period, and Latvia provided data from 2011 onwards).

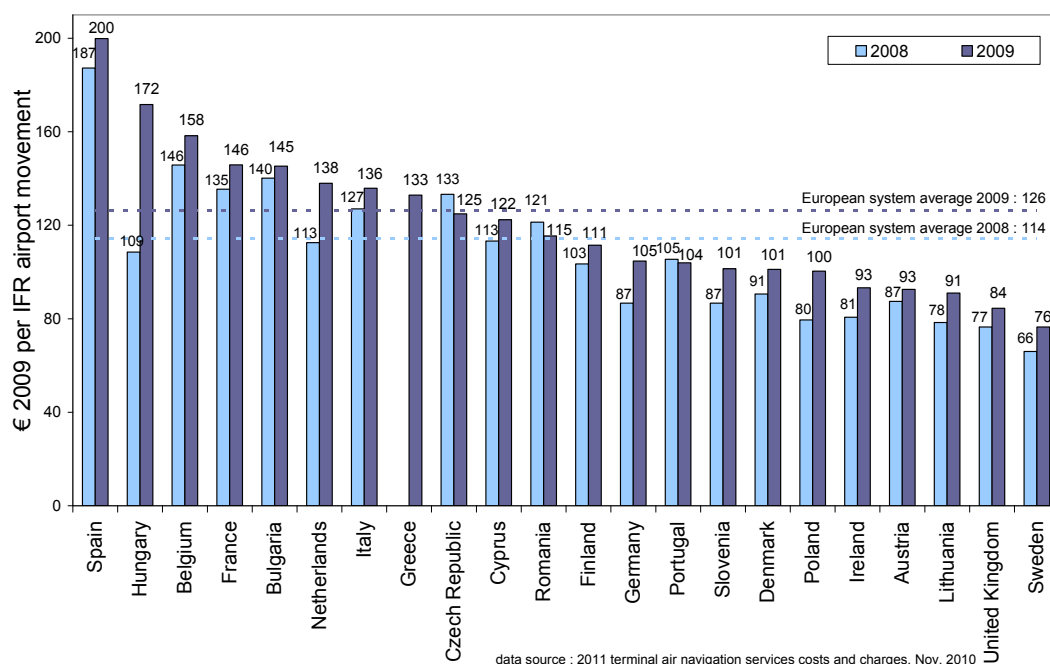
92 Two airports have been excluded from the reporting in 2009: Billund airport (under 50 000 movements in 2009) and Berlin Tempelhof (now closed).



ANS costs per km are planned to increase by 4% over the same period (see Figure 10-1).

#### TERMINAL ANS UNIT COSTS AT STATE LEVEL

10.5.23 Figure 10-20 shows the terminal ANS unit costs per airport movement for each of the 22 States that provided 2008 and 2009 actual data. This reflects latest actual information provided in June 2010. See also Annex VIII which indicates for each State which airports have been considered in this analysis.



**Figure 10-20: Terminal ANS costs per IFR airport movement, 2009 vs. 2008**

10.5.24 Figure 10-20 indicates that there is a wide dispersion in unit costs for terminal ANS which vary from €200 for Spain (an increase of some +7% over 2008) to €76 for Sweden (an increase of around 15% over 2008). Five of the twelve airports for which Spain report individual cost information are located in the Canary or Balearic islands (these represent some 28% of Spain Terminal costs in 2009). The current analysis is not sufficiently detailed to assess the impact of Islands airport operations on terminal ANS costs.

10.5.25 Sweden decided not to apply regulation (EC) N°1794/2006 (updated by EU N°1191/2010) to air navigation services provided at Swedish airports, except for Stockholm-Arlanda and Gothenburg-Landvetter (both recording more than 50 000 commercial air transport movements on average). So for these airports not covered by the regulation EC N°1794/2006, terminal ANS assets (e.g. TWR buildings, ILS, etc.) and capital-related costs are mainly recovered through landing fees or other means rather than terminal ANS charges.

10.5.26 Therefore, the relative low terminal unit costs reported for Sweden is mainly because not all costs are identified and this illustrates some of the difficulties to benchmark terminal ANS costs and unit rates across Europe, in particular where ANS provision is integrated with airport management or/and the charging regulation is not consistently applied.

10.5.27 Consequently, it is sometimes difficult to determine whether the differences shown in Figure 10-20 above are driven by economic and operational factors (for example, size of operations, economies of scale, or traffic complexity), or differences in charging policy.

10.5.28 Furthermore, cost-allocation between en-route and terminal ANS can differ across States and in time. There are known examples of significant reallocation in the past years; e.g.



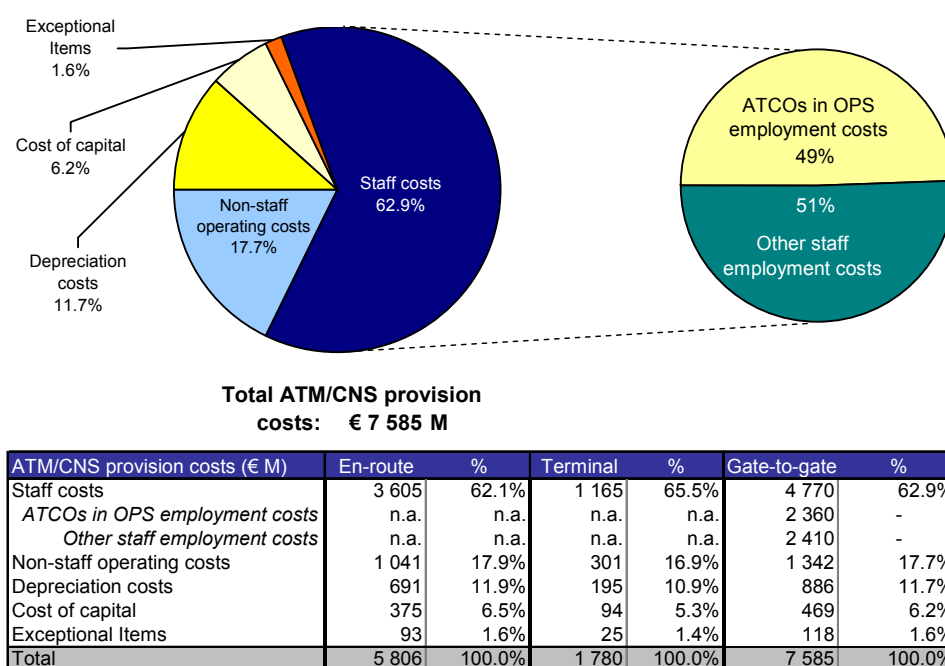
the Netherlands, Norway, Hungary, Slovak Republic and Finland is announcing a major re-allocation of costs from terminal to en-route from 2011 onwards. To limit cost-allocation distortions, for benchmarking purposes the PRC considers that it is preferable to compare gate-to-gate ANSPs cost-effectiveness (i.e. en-route plus terminal ANS costs, see Section 10.6 below).

10.5.29 The PRC considers that it is important to put in place a genuine monitoring of terminal ANS cost-effectiveness performance indicators for all European States. This monitoring will provide the necessary grounds for identifying performance improvement opportunities, as well as for setting meaningful EU-wide performance targets based on solid information.

## 10.6 Gate-to-gate ANSPs' cost-effectiveness performance

10.6.1 The ANSP cost-effectiveness focuses on ATM/CNS provision costs which are under the direct control and responsibility of the ANSP. Detailed benchmarking analysis is available in the ACE 2009 Benchmarking Report [Ref.1].

10.6.2 Figure 10-21 shows a detailed breakdown of gate-to-gate<sup>93</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.



**Figure 10-21: Breakdown of gate-to-gate ATM/CNS provision costs [2009]**

10.6.3 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. A genuine measurement of cost inefficiencies would require full account to be taken of identified and measurable exogenous factors.

93 That is the aggregation of en-route and terminal ANS.

10.6.4 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.

#### **Composite flight-hours<sup>94</sup>**

The “composite gate-to-gate flight-hours” combines the two separate output measures for en-route and terminal ANS. They are determined by weighting the output measures by their respective average cost of the service for the whole European system. This average weighting factor is based on the total monetary value of the outputs over the period 2002-2009 and amounts to 0.26.

The composite flight-hours are therefore defined as:

$$\text{En-route flight-hours} + (0.26 \times \text{airport movements})$$

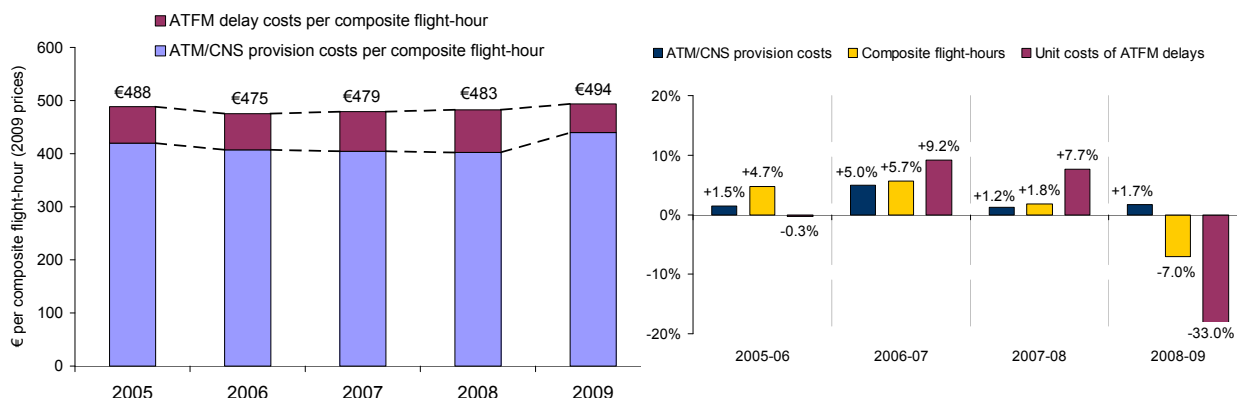
Although the composite gate-to-gate output metric does not fully reflect all aspects of the complexity of the services provided, it is nevertheless the best metric currently available for the analysis of gate-to-gate cost-effectiveness.

### **GATE-TO-GATE COST-EFFECTIVENESS**

#### **2005-2009 TRENDS**

- 10.6.5 Given the substantial impact of the traffic decrease on cost-effectiveness performance in 2009, a special focus is made in this section on the changes in performance between 2008 and 2009 in order to understand how the European ANS system reacted to the significant demand shock.
- 10.6.6 Figure 10-22 displays the trend at European level of the gate-to-gate “economic” unit costs per composite flight-hour between 2005 and 2009 for a consistent sample of 34 ANSPs for which data for a time-series analysis was available. At system level, unit economic costs per composite flight-hour remained fairly constant between 2005 and 2009.
- 10.6.7 Figure 10-22 shows that unit economic costs per composite flight-hour decreased until 2007 and then increased in 2008 and 2009. The drivers for this increase are shown on the left-hand side of Figure 10-22 which indicates that in 2009, traffic volumes significantly fall (-7.0%). In the meantime, gate-to-gate ATM/CNS provision costs slightly increased (+1.7%) in real terms.

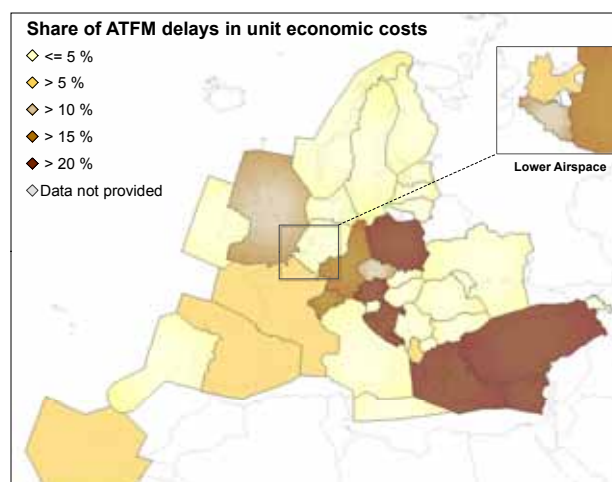
<sup>94</sup> Further information on the computation of the composite flight-hours can be found in the ACE 2009 Benchmarking Report (June 2011).



**Figure 10-22: Changes in economic cost-effectiveness [2005-2009]**

10.6.8 In 2009, following the sharp decrease in traffic, the unit costs of ATFM delays<sup>95</sup> decreased significantly (-33.0%), which is what was expected following the significant traffic decrease in 2009. However, this significant decrease at European system level masks different trends at ANSP level.

10.6.9 Figure 10-23 shows that for six ANSPs (Austro Control, Croatia Control, DCAC Cyprus, DHMI, HCAA and PANSa), ATFM delays contributed more than 20% to their economic cost of ATM/CNS provision in 2009.



**Figure 10-23: Share of ATFM delays in unit economic costs [2009]**

10.6.10 It is important to note that some of these ANSPs experienced a significant decrease in traffic in 2009 (Austro Control (-9%), PANSa (-7%) and to a lower extent DCAC Cyprus (-2%)). This clearly indicates performance issues in terms of quality of service for these ANSPs.

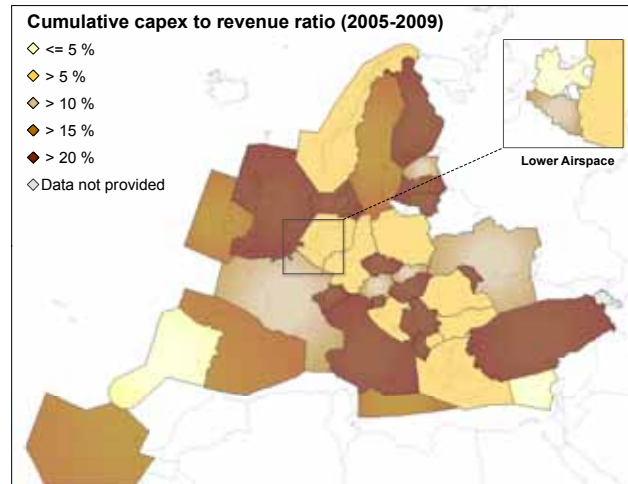
10.6.11 The level of ATFM delays mainly depends on the extent to which the ATC capacity provided by an ANSP is in line with the temporal and spatial traffic demand. In the medium-term, the level of capacity provided can be gradually increased through a variety of measures including (but not limited to) the recruitment of additional ATCOs and capital investment (e.g. ATM systems with higher capabilities, etc.).

<sup>95</sup> The ATFM delays data reported in this section relate to the minutes of ATFM delays greater than 15 minutes. These include en-route ATFM delays but also delays arising from the terminal environment (i.e. from aerodrome capacity and weather issues). A more detailed analysis of ATFM en-route delays is provided in Chapter 7.

10.6.12 During the five-year period 2005-2009, ANSPs invested some €6 Billion with different investment cycles and magnitudes across ANSPs.

10.6.13 Average ANSPs “capex to revenue” ratios – a measure of the magnitude of the investment - for the period 2005-2009 are shown in Figure 10-24.

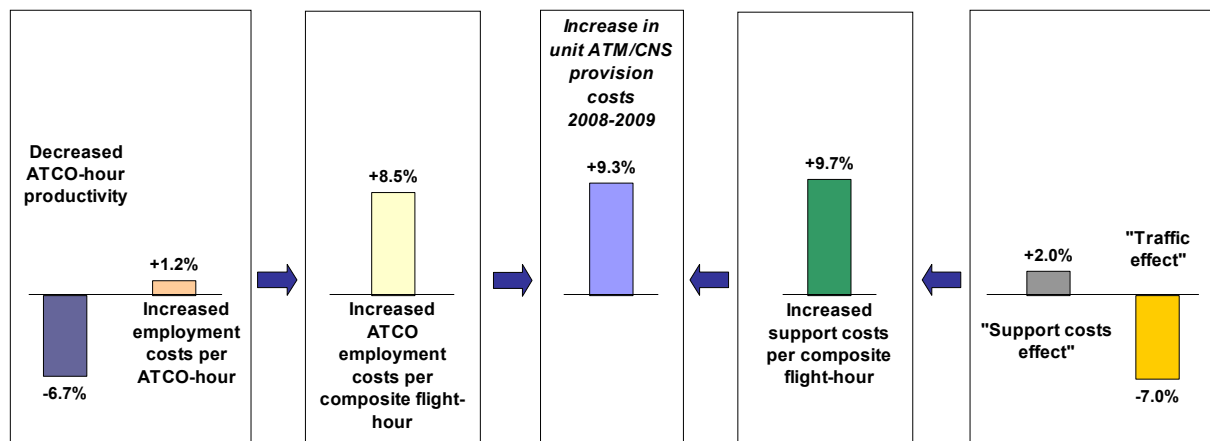
10.6.14 For 18 ANSPs, the “capex to revenue” ratio is higher than 15% indicating substantial investments during the period.



**Figure 10-24: ANSPs cumulative capex [2005-2009]**

10.6.15 Following the traffic downturn in 2009 at European system level (-7.0% in terms of composite flight-hours), the trade-offs between financial cost-effectiveness and quality of service will be less significant than normal in the short term. There should be scope for improving quality of service without incurring significant additional capital expenditure since substantial investments were made during the period 2005-2009. There is therefore an opportunity to better match capacity and demand in the forthcoming years while at the same time improving financial cost-effectiveness. Furthermore, in the context of SES II, the Network Manager should effectively support ANSPs to improve the quality of service provided at system level.

10.6.16 As shown in Figure 10-25, the 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 10-25 indicates that in 2009, a significant lower ATCO-hour productivity (-6.7%) combined with higher ATCO employment costs per ATCO-hour (+1.2%) resulted in unit ATM/CNS provision costs per composite flight-hour which are +9.3% higher than in 2008. This significant increase cancels the improvements in financial cost-effectiveness achieved since 2004.



**Figure 10-25: Breakdown of changes in cost-effectiveness, 2008-2009 (real terms)**

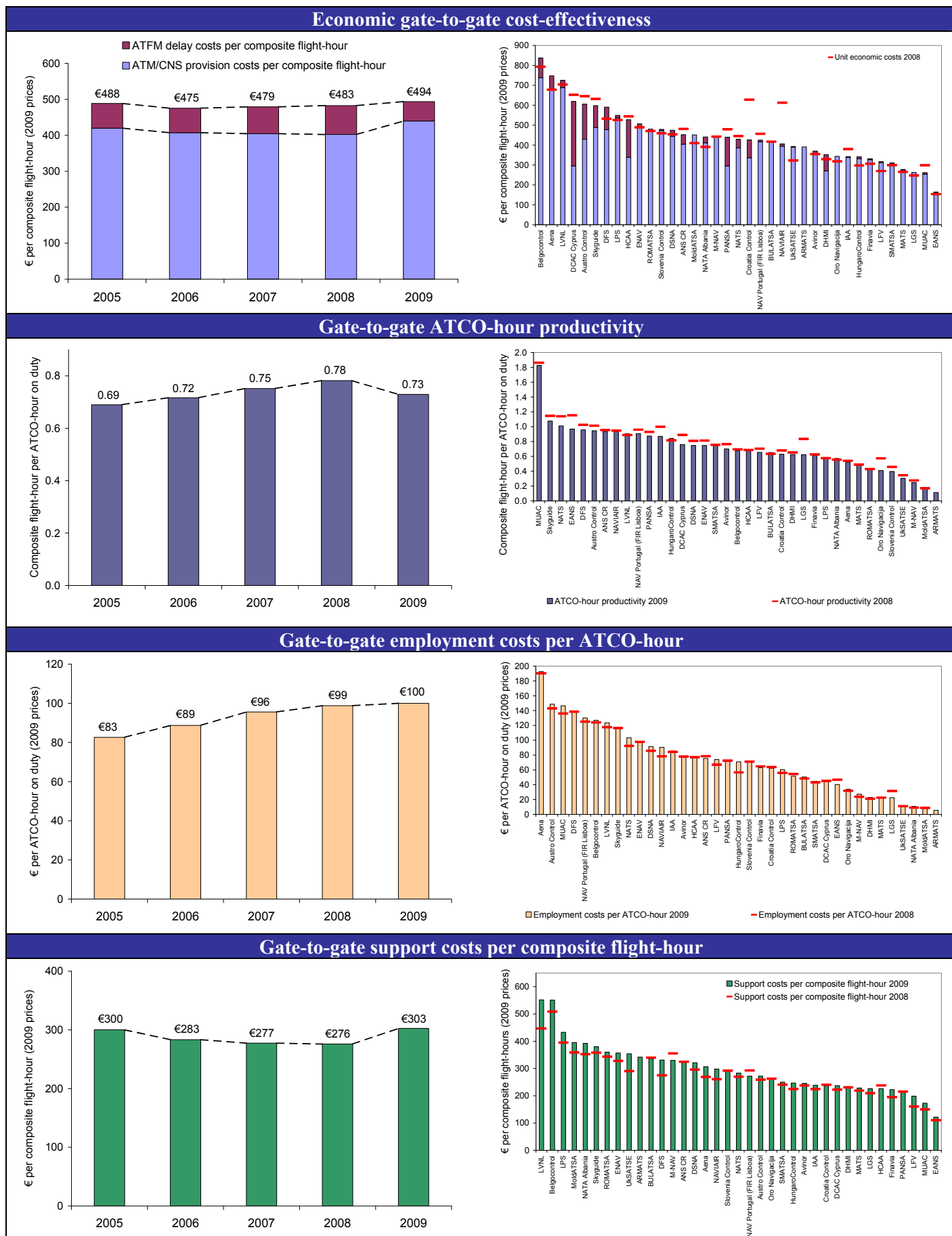


Figure 10-26: ATM/CNS cost-effectiveness comparisons, 2005-2009 (real terms)

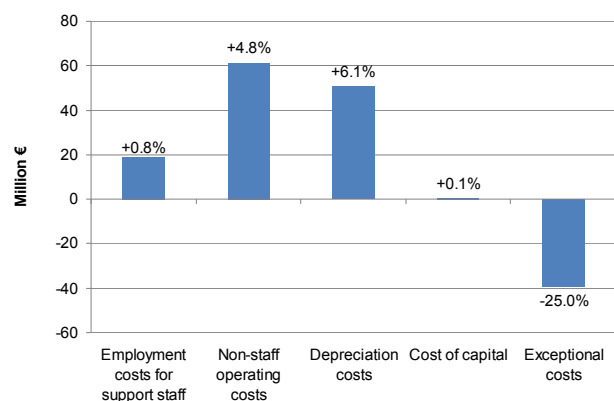
10.6.17 Figure 10-26 shows that after several years of continuous increases, ATCO-hour productivity significantly fell at European system level (-6.7%). However, six ANSPs (LVNL, HungaroControl, LPS, MoldATSA, BULATSA and NATA Albania) achieved an increase in ATCO-hour productivity in 2009. However, it should be noted that for MoldATSA and NATA Albania, this performance improvement was achieved in a context of traffic increase.

10.6.18 Following the sharp traffic decrease in 2009, it is expected that in the short-term productivity improvements result from a better use of existing resources (e.g., adaptation of rosters and shift times by effective management of overtime) and through the adaptation of sector opening times to traffic demand patterns. In other words, in the next years when traffic volumes will bounce back, there should be scope to increase ATCO-hour productivity without significantly affecting the other components of cost-effectiveness.

10.6.19 Similarly, following the significant traffic downturn there is scope to improve ATCO-hour productivity while maintaining adequate levels of quality of service.

10.6.20 Figure 10-26 shows that between 2005 and 2009, ATCO employment costs per ATCO-hour significantly increased (+21.1%) at European system level. This overall change is made of (1) significant employment costs increases over 2005-2007 (+7-8% per annum) and (2) smaller increases in 2008 and 2009 (+1-3% per annum). It is likely that the reduction of the growth rate of ATCO employment costs is linked to a reduction of overtime hours and also reduced bonuses and benefits.

10.6.21 The +2.0% increase in support costs between 2008 and 2009 at system level is mainly due to increases in non-staff operating costs (+4.8%) and depreciation costs (+6.1%) which were not compensated by the decrease in exceptional costs (-25.0%) (see Figure 10-27).



**Figure 10-27: Changes in the components of support costs [2008-2009]**

10.6.22 It is noteworthy that in 2009, the main component of support costs (i.e. employment costs for support staff) remained constant (+0.8%).

10.6.23 In 2009, fourteen ANSPs could reduce their support costs between 2008 and 2009. For most of these ANSPs, the decrease in support costs was not sufficient to compensate for the significant fall in traffic volumes and to avoid an increase of unit support costs. Nevertheless, this indicates a certain degree of reactivity and suggests that cost-containment measures were implemented in 2009 by these ANSPs.

## 10.7 Conclusions

10.7.1 After a constant decrease between 2003 and 2008, en-route unit costs significantly increased in 2009, following an unprecedented traffic downturn (-6.2% in terms of kilometres controlled). They reached €0.80/km (+8.1%), which marks the end of a positive improvement trend.

10.7.2 As a result, the Pan-European target adopted by the PC in Nov. 2007 (-6% reduction of unit costs between 2008 and 2010) is no longer achievable.



- 10.7.3 In April 2009, several European ANSPs stated that they would implement cost-containment measures from 2009 onwards. This was explicitly called for by the European Commission. For a majority of States, 2009 actual en-route costs are lower than the plans made in November 2008. This indicates a certain degree of reactivity to the significant traffic downturn experienced in 2009, and suggests that some cost-containment measures were implemented in 2009. However, it is disappointing that, notwithstanding the efforts made in 2009 to reduce en-route costs compared to the plans (-2.2% which is equivalent to €130M), the total en-route cost base at system level increased by +1.3% in real terms compared to 2008.
- 10.7.4 Given short term rigidities to adjust costs downwards and unavoidable lead times, it is understood that some of the measures that were implemented in 2009 may only have an impact on costs in 2010 and onwards. At system level, en-route costs planned for 2010 were revised downwards by some €320M compared to November 2008 plans. It is important that these planned savings materialise so that, in future years, unit costs can return to the levels achieved before the economic downturn. Following the significant traffic reduction in 2009, and the tools provided by SES II, there is an opportunity to better match capacity and demand in the coming years while at the same time improving cost-effectiveness performance.
- 10.7.5 At system level, en-route unit costs are planned to decrease by -2.8% p.a. between 2009 and 2014, which is well below the performance improvement achieved between 2003 and 2008 (-3.3% p.a.). The planned improvement is rather disappointing given the high expectations that a coordinated implementation of the SES II performance scheme during this period should bring significant performance improvements.
- 10.7.6 The five largest States plan to decrease en-route unit costs between 2009 and 2014. The initiatives taken in France and in Spain to address performance issues show that cost-effectiveness improvements could be achievable when there is a strong political and managerial commitment.
- 10.7.7 Available 2009 data show that average European terminal unit costs per IFR airport movement increased by +10.5% over 2008 in real terms. This results from a significant decrease in traffic (-8.3%) coupled with an increase in costs (+1.3%), a pattern rather similar to en-route.
- 10.7.8 Some States covered by the SES Performance scheme have no airport above the 50,000 IFR airport movements threshold set by the Charging Scheme regulation and therefore do not report Terminal ANS costs and unit rate information. However, all SES States and the PRB will have to monitor Terminal ANS costs and unit rates information during RP1 (2012-2014) to ensure that improvements in en-route ANS cost-efficiency are not achieved at the expense of a deterioration in terminal ANS cost-efficiency performance.
- 10.7.9 Setting meaningful EU-wide performance targets requires historical information and therefore all States covered by the SES legislation are strongly encouraged to start reporting terminal ANS costs and unit rates information at least in relation to the main airport in their country.

# Chapter 11: Economic Assessment of ANS Performance

KEY POINTS	KEY DATA 2010		
1. The total economic en-route unit cost of ANS (charges + delays + flight-inefficiencies) increased significantly in 2010 (+9.1%).	Total ANS en-route related economic costs (€M)	≈ 10 360	+12%
	Projected chargeable Km (M)	≈ 8 532	+2.8%
2. The increase was mainly due to a significant increase in en-route ATFM delay costs (+145%, originating principally from industrial actions and implementation of new ATM systems) and the cost of route extension (mainly caused by increasing jet fuel price and circumnavigation of airspace affected by the ash cloud in April and industrial actions). This was the worst performance since 2004.	Projected chargeable SU (M)	≈ 112.5	+2.9%
	Projected cost of ANS provision en-route (€M)	≈ 6 610	-0.5%
	Estimated cost of en-route ATFM delays (€M)	≈ 1 350	+ 145%
	Cost of horizontal en-route extension (€M)	≈ 2 400	+17.1%
3. The adoption of binding performance targets and corrective mechanisms under the Single European Sky offers the opportunity to make performance improvements more robust.	Jet fuel price/ ton (€ 2009)	604	+35.8%
	Real en-route unit economic costs (€/km)	1.22	+9.1%
	Real en-route unit economic costs (€/service unit)	92.4	+9%

## 11.1 Introduction

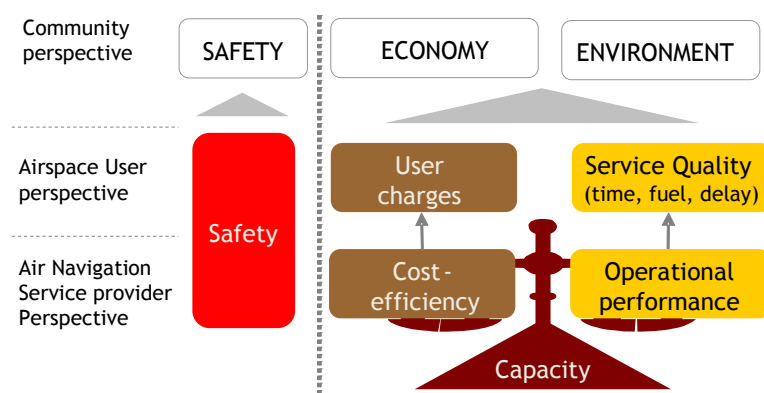
- 11.1.1 The Single European Sky objective adopted in 2009 is to “enhance current air traffic safety standards, to contribute to the sustainable development of the air transport system and to improve the overall performance of ATM and ANS for general air traffic in Europe...” Article 1 of the Framework Regulation 549/2004 [Ref. 24].
- 11.1.2 The strategic economic objective agreed by ECAC Transport Ministers in 2000 [Ref. 26] is more specific, i.e. “*to decrease the direct and indirect ATM-related costs per unit of aircraft operations*”.
- 11.1.3 This chapter aims at providing a high level consolidated assessment of overall economic ANS performance (charges + delays + flight inefficiencies) in order to evaluate whether these policy objectives are being met, and are likely to be met in the coming years, using the concept of total economic cost.
- 11.1.4 The chapter furthermore recalls how the primacy of safety is maintained, and presents the trade-offs between other key performance areas (capacity/delays, environment/flight-efficiency and cost-efficiency).
- 11.1.5 Understanding the interactions between performance areas at system and State levels is becoming increasingly important in view of the target setting process under the SES performance scheme (see also Chapter 2).

## 11.2 Economic assessment of ANS performance

- 11.2.1 Safety is a primary objective of ANS. The primacy of safety will continue to be ensured through safety regulations, oversight/verification by national authorities and EASA that regulations are effectively applied, and monitoring of safety performance by European

and national authorities<sup>96</sup>. More details can be found in Chapter 4.

11.2.2 Figure 11-1 illustrates the interactions and trade-offs between ANS operational performance and cost-efficiency, whilst maintaining a high standard of safety performance.



**Figure 11-1: Consolidated assessment of ANS performance**

11.2.3 There is a trade-off between ANS cost-efficiency and operational performance, critically linked with demand-capacity balancing. Insufficient ATC capacity results in low service quality (high ATFM delays, etc.) with a negative impact on punctuality and on airspace users' costs; while ATC capacity higher than demand contributes towards higher than necessary user charges (underutilisation of resources).

11.2.4 There is also a trade-off between flight-efficiency (economic and environmental impact) and delays (ATC capacity). A more structured route network, e.g. more one-way routes, yields more ATC capacity, and hence less delays, but results in additional flight time, fuel burn and emissions. However, creating ATC capacity through better airspace design and civil-military co-ordination allows more flights to use the shortest available route and therefore improves both areas (see also Section 7.5 in Chapter 7).

#### TOTAL ECONOMIC COST AND ECONOMIC OPTIMUM

11.2.5 In Europe, airspace users bear the total economic costs of ANS services, which consist of direct costs (route and terminal charges paid by airspace users), indirect costs (such as delays and non-optimum flight profiles), and will face further costs from the Emissions Trading Scheme (ETS) from 2012 onwards. The total ANS-related economic costs (en-route) are assessed in Section 11.3 below.

11.2.6 The concept of total economic cost of ANS services presents several advantages:

- It can be used to assess whether the policy objectives mentioned in Section 11.1 above are being met;
- It can be easily understood, has a very concrete meaning for airspace users, and shows that the policy objectives are closely aligned with their interests;
- It aggregates the respective contributions of the different Key Performance Areas (Cost-effectiveness, Capacity, and Environment) in the overall system performance in a single monetary value, and gives indications about trade-offs;
- It forms an objective basis for target setting, based on the minimisation of the total user cost.

<sup>96</sup> The second pillar of the SES II package, incorporating the extension of EASA competence to ANS and airports, aims to ensure that ANS safety remains the first priority.

11.2.7 The concept of total economic cost however has also several drawbacks:

- Its applicability at local level is not obvious, as trade-offs are likely to be very different (different traffic, legal frameworks and working environments);
- It is dependent on external factors, such as fuel prices, as well as estimates and approximations, such as cost of ANS-related delays.
- For these reasons, the PRC has advocated that it is not appropriate to set binding targets on the total economic costs of ANS services [Ref. 15]

### 11.3 Economic assessment of en-route ANS performance

11.3.1 Whilst it is not appropriate to include a value of safety in the assessment of the total economic ANS costs, its primacy is fully recognised.

11.3.2 When analysing ANS performance, and making key operational decisions due account needs to be taken of interactions between the four KPAs (safety, environment, capacity and cost-efficiency) at the system and State/FAB levels. Interactions between KPAs are different at system and local levels which will need to be duly considered by NSAs and States, when setting and implementing national/FAB targets in the context of the EU Performance Scheme (see Chapter 2).

11.3.3 Besides safety, performance in all other KPAs can be expressed in monetary terms to provide a consolidated view of ANS performance and trade-offs (i.e. operational and cost-efficiency performance).

11.3.4 The assessment of total ANS-related economic en-route costs combines the costs for the provision of en-route ANS with the estimated costs incurred by airspace users due to ANS-related inefficiencies<sup>97</sup>, which are measured in terms of:

- ATFM delays (at the gate) due to lack of en-route ATC capacity; and
- extra time and additional fuel burn in the en-route phase.

#### **Measuring total ANS-related economic costs**

Due to the difficulty of measurement, the total economic cost approach inevitably contains a margin of uncertainty. For instance, some of the indicators used for the quantification of ANS operational inefficiencies relate to a theoretical optimum (great circle distance, unimpeded flight time) which is, due to safety and capacity constraints, hardly achievable at system level.

Furthermore, the monetarisation of operational inefficiencies requires a number of assumptions regarding the value of time which can significantly vary across stakeholders and final users.

ANS performance in the en-route environment is well understood, measured and managed as indicated in Chapter 7.

The airport environment is generally more complex, involving more stakeholders and less well defined, although the ATM at Airports Performance (ATMAP) project launched by the PRC in 2008 has made some considerable progress in the quantification of ANS-related service quality at airports (see details Chapter 8). As a result, the related costs at/around airports are not yet available with a sufficient level of precision but work is in progress to provide also an estimate of economic costs of ANS performance at airports in the future.

Furthermore, as outlined in Chapter 10, despite gradual data improvements, there is still heterogeneity of situations resulting in different levels of visibility and transparency on terminal ANS costs at European level. In this chapter no attempt has therefore been made to estimate the economic costs for ANS-related inefficiencies at/around airports.

#### **COSTS OF EN-ROUTE ATFM DELAYS**

11.3.5 Figure 11-2 shows the estimated costs of en-route ATFM delay in Europe between 2004 and 2010.

<sup>97</sup> Note that the costs of cancellations are not considered in the assessment of total economic en-route ANS costs.

Year	Total ATFM delays (min.)	ATFM Delays > 15 minutes			Estimated cost of ATFM delays (€2009 Prices)		
		En-route	Airport	Total	En-route	Airport	Total
2004	14.9 M	5.2 M	6.1 M	11.3 M	€ 450 M	€ 500 M	€ 950 M
2005	17.6 M	6.3 M	7.4 M	13.6 M	€ 500 M	€ 600 M	€ 1 100 M
2006	18.4 M	7.7 M	6.7 M	14.4 M	€ 650 M	€ 550 M	€ 1 200 M
2007	21.5 M	9.2 M	7.7 M	16.9 M	€ 750 M	€ 650 M	€ 1 400 M
2008	23.8 M	11.2 M	7.6 M	18.9 M	€ 950 M	€ 650 M	€ 1 600 M
2009	15.2 M	6.9 M	5.3 M	12.2 M	€ 550 M	€ 450 M	€ 1 000 M
2010	27.7 M	16.4 M	7.2 M	23.5 M	€ 1 350 M	€ 600 M	€ 1 950 M

source: PRC analysis

**Figure 11-2: Estimated costs of ATFM delay [>15 minutes]**

11.3.6 There was a significant increase in ATFM delay in 2010, mainly attributable to en-route causes (from 6.9M minutes in 2009 to 16.4M minutes).

11.3.7 In 2010, the cost of en-route ATFM delays is estimated to be €1 350M and the cost of airport ATFM delays €600M.

11.3.8 The increase in ATFM delay in 2010 is mainly due to ATC industrial action in Spain and France and the impact of a new ATM system implementation in Germany. Some delays, but mainly cancellations, were experienced as a result of the “ash cloud” earlier in April/May 2010.

#### ATFM delay costs

The most comprehensive report on the cost of ATFM delays is the University of Westminster Report [Ref. 65]. An updated version is available on the PRC website ([www.eurocontrol.int/prc](http://www.eurocontrol.int/prc)).

Average costs of “tactical” delay on the ground (engine off) are approximated to be close to zero for the first 15 minutes and €83 per minute, on average, for ATFM delays longer than 15 minutes (€ 2009 prices).

The estimate includes direct costs (crew, passenger compensation, etc.), the network effect (i.e. the costs of reactionary delays that are generated by primary delays) and the estimated costs to an airline to retain passenger loyalty. The cost of time lost by passenger is partly reflected.

It should be noted that there are inevitably margins of uncertainty in the approximation of delay costs. The report is currently being updated and the findings will be reflected in future PRC work.

#### COST OF EN-ROUTE EXTENSION

11.3.9 The costs related to horizontal en-route extension include both the costs of extra fuel burn and additional flight time (see also Chapter 7).

11.3.10 Figure 11-3 shows the estimated cost related to horizontal en-route extension between 2004 and 2010.

#### Cost of strategic time buffers

In the case of en-route extension, as the additional time is predictable in most cases, it is normally reflected in scheduled flight times. This “strategic” time buffer has a cost which is estimated at €43 per minute (€2009 prices) on average for a flight in Europe (i.e. without extra fuel) [Ref. 65].

Year	Total extra distance (M km)	TIME (€ 2009 prices)		FUEL (€ 2009 prices)			Total estimated cost
		Total extra time ('000 hrs.)	Cost of time	Total extra fuel (M t)	Cost per ton	Cost of total extra fuel	
2004	435	555	€ 1 400 M	1.45 Mt	€ 406	€ 600 M	€ 2 000 M
2005	427	544	€ 1 350 M	1.42 Mt	€ 559	€ 800 M	€ 2 150 M
2006	440	560	€ 1 400 M	1.46 Mt	€ 621	€ 900 M	€ 2 300 M
2007	470	599	€ 1 500 M	1.56 Mt	€ 613	€ 950 M	€ 2 450 M
2008	473	603	€ 1 550 M	1.57 Mt	€ 777	€ 1 200 M	€ 2 750 M
2009	429	545	€ 1 400 M	1.47 Mt	€ 454	€ 650 M	€ 2 050 M
2010	450	570	€ 1 450 M	1.57 Mt	€ 604	€ 950 M	€ 2 400 M

source: PRC analysis

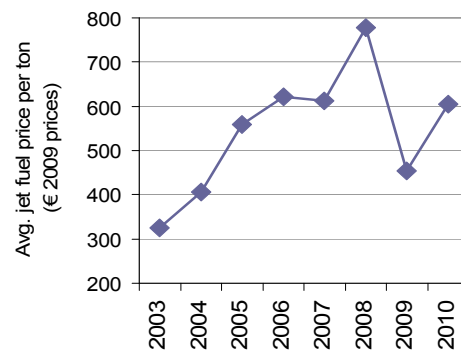
**Figure 11-3: Estimated costs of ANS-related inefficiencies in the horizontal flight profile**

11.3.11 In 2010, the total cost related to en-route extension is estimated to be €2 400M, a significant increase over €2 050M in 2009, of which €300M from higher costs for extra fuel and the remaining €50M from additional cost of time (less efficient routing mainly due to ash cloud and ATC strikes).

11.3.12 Figure 11-4 shows the evolution of the average jet fuel price between 2003 and 2010.

11.3.13 After a continuous increase between 2003 and 2008, the price for jet fuel dropped significantly as a result of the global economic crisis.

11.3.14 In 2010, average jet fuel price increased again by +35.8% vs. 2009 and has reached a level similar to 2006/07.



**Figure 11-4: Average fuel price [€ 2009 prices]**

### TOTAL ECONOMIC COST

11.3.15 The Key Performance Indicator (KPI) for total economic en-route ANS cost is the real unit economic cost, i.e. the deflated total ANS cost per km or per SU<sup>98</sup>. Figure 11-5 shows the calculation of this indicator, and its evolution between 2004 and 2010.

€ 2009 Prices	2004	2005	2006	2007	2008	2009	2010 (P)
Contracting States (CRCO)	30	31	31	31	34	35	35
Cost of en route ANS provision (€M)	5 997	6 092	6 159	6 327	6 556	6 640	6 610
Cost of ATFM en-route delays (€M)	450	500	650	750	950	550	1 350
Cost of route extension (€M)	2 000	2 150	2 300	2 450	2 750	2 050	2 400
Total economic cost (€M)	8 447	8 742	9 109	9 527	10 256	9 240	10 360

Total distance charged (M km)	7 047	7 472	7 823	8 321	8 851	8 302	8 532
En route service units (M SU)	91	97	101	108	115	109	113

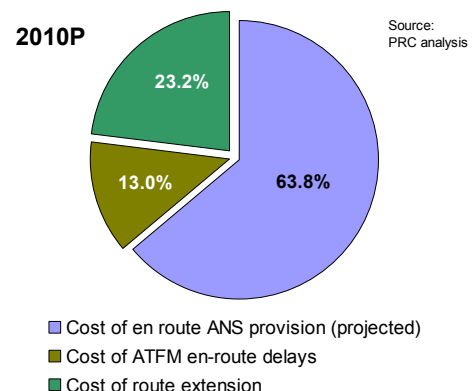
Real unit economic cost	(€2009/km)	1.19	1.18	1.17	1.15	1.16	1.12
	(€2009/SU)	92.1	90.6	90.0	88.7	88.7	92.4

**Figure 11-5: Estimated total economic en-route ANS costs**

11.3.16 Total en-route ANS costs are projected to reach €6 610M in 2010 (-€30M vs. 2009). A more detailed evaluation of ANS provision costs is provided in Chapter 10 of this report.

11.3.17 Figure 11-6 presents a breakdown of estimated total economic costs in 2010. The cost of en-route ANS provision account for the main share (63.8%) followed by costs of en-route extension (23.2%) and ATFM delays (13%).

11.3.18 The evolution of the economic en-route unit costs at European system level in Figure 11-7 illustrates the importance of taking a consolidated view of all KPAs.



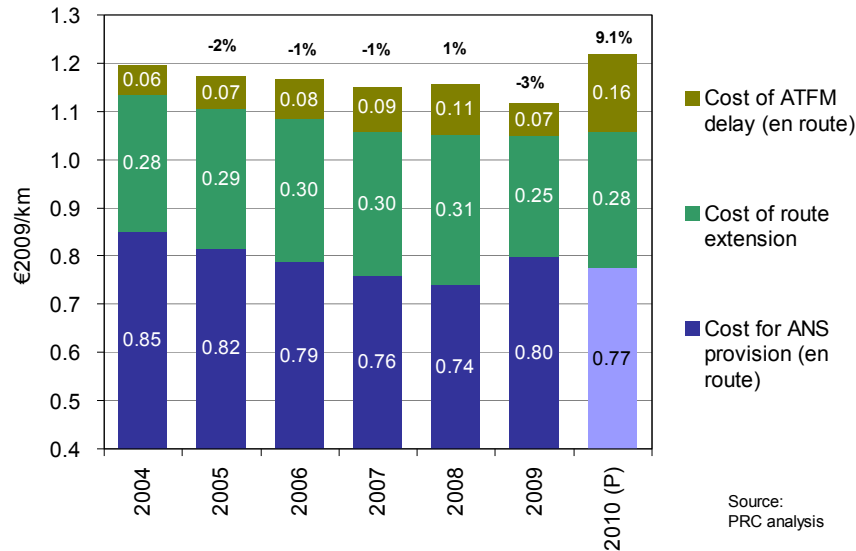
**Figure 11-6: Share of total economic costs [2010P]**

98 As illustrated in Figure 11-5, there is a high correlation (0.954) between the unit costs per kilometre and per service unit.



11.3.19 The notable improvements observed for direct en-route ANS provision costs (dark blue) between 2004 and 2008 were almost neutralised by increases in en-route ATFM delays and en-route extension. This indicates the importance of managing the entire system performance.

11.3.20 The year 2009 was rather exceptional, marked by severely decreasing traffic (-6.6%) and related decreasing ATFM delays (-36%)<sup>99</sup>. The decrease in en-route extension cost mainly originated from lower fuel price, thereby illustrating the dependence of ANS performance on external factors. Both factors taken together more than offset the strong increase in unit costs originating from lower traffic and higher costs.



**Figure 11-7: Real unit economic en-route cost [€2009/km]**

11.3.21 The year 2010 has seen moderate traffic growth as an aftermath of the global economic recession, a major increase in delays resulting mainly from industrial action, higher route extension costs following a 35.8% increase in jet fuel price, and nearly constant unit costs of ANSP provision. Consequently, the unit economic cost (€2009/km) increased by 9.1%, from €1.1/km in 2009 to €1.22/km in 2010. Real unit economic en-route costs in 2010 were above the level in 2004 (€1.19/km).

## 11.4 Opportunities and challenges for the future

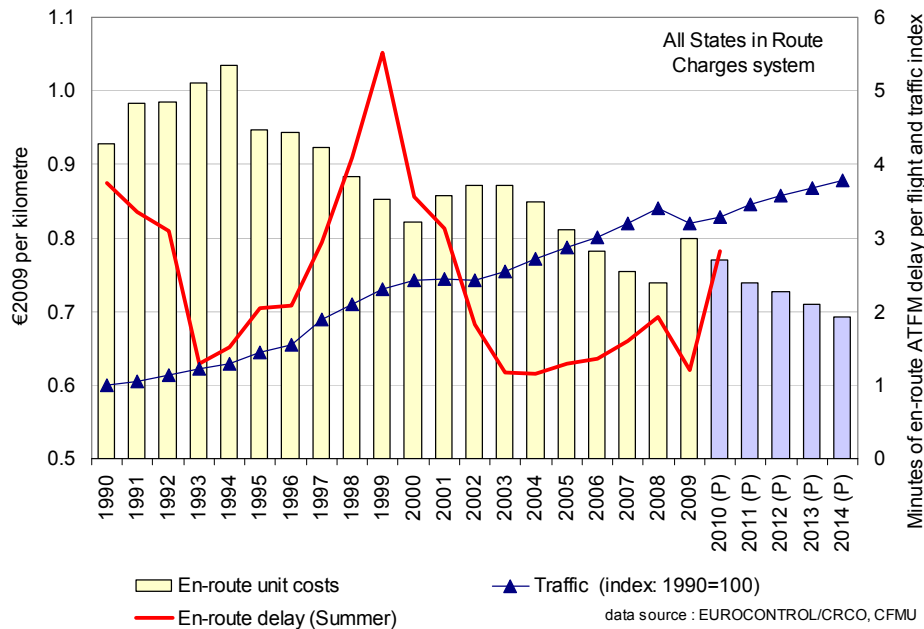
11.4.1 As delays increase very fast when capacity is below demand, planning ahead and managing to meet the capacity plans offers the opportunity to avoid fire-fighting and time lags associated with reactive behaviours.

11.4.2 Periods of high delays and lower unit costs, and vice-versa, can be observed until 2003, as shown in Figure 11-8. The sum of costs for ANS provision and delays remained approximately constant so that there was no improvement in the economic cost borne by airspace users.

11.4.3 This was linked with a reactive management of ATC capacity. Following the delay crises in 1999, capacity was increased with a few years lag, costs increased and delays decreased. Pressure on costs in periods of low delays then led to capacity issues later on. This reactive or opportunistic behaviour led to cyclic patterns in delays and cost-efficiency.

<sup>99</sup> It should be noted that this is in line with an average delay/traffic elasticity of 7 which has been empirically established at system level.

11.4.4 The situation started to improve visibly from 2003 onwards, thanks to a more proactive approach to performance taken two years earlier. The Provisional Council adopted a performance target for delays in 2001<sup>100</sup> and the EUROCONTROL capacity planning process was introduced. This more proactive, yet purely advisory, approach to performance led to delays being contained while unit costs decreased significantly, as shown in Figure 11-8.



**Figure 11-8: Long term trends of traffic, unit costs and en-route ATFM delays**

#### PERFORMANCE TARGETS

11.4.5 The adoption of performance targets for a period of 3-5 years is long enough for performance planning to be effective and short enough for forecasts to be meaningful. Hence, the adoption of EU-wide targets<sup>101</sup> under the SES performance scheme provides an opportunity to raise ANS performance in a more robust manner (see Chapter 2).

#### TRAFFIC UNCERTAINTY

11.4.6 There are significant challenges associated with target setting. One issue is the relative traffic volatility at European level, and even more at local level.

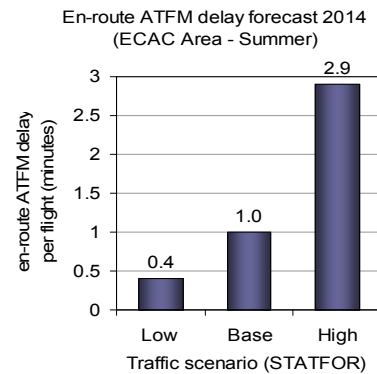
11.4.7 While the baseline traffic scenario for 2014 corresponds to a modest increase of 6% versus 2008 (1% per annum), traffic would increase by 20% from 2009 to 2014 under the high scenario (4% per annum). Additionally, traffic growth is not evenly spread across Europe. Continuously high growth is forecast for Eastern European States while only a small to moderate growth is expected for the more mature markets in Western Europe.

<sup>100</sup> At the time, many people were convinced that the target proposed by the PRC and adopted in 2001 for planning purposes (1 minute per flight for the summer, equivalent to 0.7 min per flight for the whole year, to be reached by 2006) was unrealistic. Experience showed that it was not.

<sup>101</sup> The SES performance scheme targets apply only to EU and associated States (Switzerland, Norway).

11.4.8 The “traffic uncertainty” is critical for en-route unit costs and ATFM delays.

11.4.9 As illustrated in Figure 11-9, due to the non-linear relationship between capacity and delay, an unacceptably high level of en-route ATFM delay (close to 1997 levels) is projected in the “high” traffic scenario, if the current capacity enhancement plans (based on 1 minute delay per flight in Summer) remain unchanged (static delivery).



**Figure 11-9: En-route delay forecast**

11.4.10 The additional cost of these delays would exceed €1 billion which would jeopardise all efforts made to improve cost-efficiency.

11.4.11 If traffic follows the low scenario, delays would be lower, but unit costs would increase if capacity delivery remained static. The “traffic uncertainty” must therefore be minimised and the implementation strategy must be robust to traffic variations.

11.4.12 The EU-wide capacity target is based on a three-pronged approach to “traffic uncertainty” mitigation, building on the features of the SES performance scheme, the charging regime, and the network functions (see Chapter 2):

- 1) Planning for an en-route ATFM delay target that is closer to the economic optimum<sup>102</sup>, while achievable. The adopted EU-wide capacity target corresponds to advancing the current capacity planning by 1-2 years (i.e. delivering the capacity level foreseen for 2015/16 already in 2014. The additional capacity required corresponds roughly to the difference between the baseline and the high traffic forecast scenario.
- 2) More flexible delivery of capacity, responsiveness of ANSPs in adapting en-route capacity to changes in demand. Some flexibility in delivering capacity to match unexpected changes in traffic is an essential factor to improve ANS performance. This can be achieved through, inter alia:
  - network management (e.g. pre-tactical ATFCM); and
  - more flexible working conditions (e.g. individual rostering, overtime).

It should be emphasized that the SES charging regime provides ANSPs with additional revenue if traffic is higher than planned.

- 3) Mitigation of congestion by the network manager (e.g. re-routing, at the expense of flight-efficiency)

11.4.13 However, the upward trends in the costs of delay and route extension in 2010, as illustrated in Figure 11-7, show that great efforts will be needed if the industry is to achieve the targets under the SES performance scheme. New tools provided through FABs, the new technology emerging from the SESAR programme, the SES performance scheme and its associated incentives, and the Network functions should enable a better understanding of trade-offs and a push towards overall improvement in performance across all areas, including improved safety, increased ATCO productivity, and greater predictability of operational performance (see also Chapter 2).

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<sup>102</sup> It is important to note that while the system wide optimum delay level does not change significantly in the different traffic scenarios, the effort to provide the required en-route capacity to meet the traffic demand varies considerably.

## 11.5 Conclusions

- 11.5.1 Besides safety, which is ensured mainly through a prescriptive approach, ANS performance can be translated in economic terms. In Europe, airspace users bear the cost of capacity (charges), of delays associated with insufficient capacity, and of flight inefficiencies (additional fuel burn, flight time). Better understanding the trade-offs between quality of service and cost-effectiveness at both system and State level will become increasingly important in view of target setting and performance management under the SES Performance Scheme.
- 11.5.2 The total economic en-route unit cost of ANS (charges + delays + flight-inefficiencies) increased significantly in 2010 (+9.1%).
- 11.5.3 The increase was mainly due to a significant increase in en-route ATFM delay costs (+145%), originating principally from industrial actions and implementation of new ATM systems) and the cost of route extension (mainly caused by increasing jet fuel price, circumnavigation of airspace affected by the ash cloud in April and industrial actions). This was the worst performance since 2004.
- 11.5.4 A reactive approach to ANS performance, awaiting crises to take action, proved to be inefficient. The cooperative proactive approach in en-route capacity planning led by EUROCONTROL did deliver significant improvements from 2003 to 2008, but is vulnerable to external factors such as industrial actions.
- 11.5.5 The adoption of binding performance targets and corrective mechanisms under the Single European Sky offers the opportunity to make performance improvements more robust.
- 11.5.6 There is an opportunity to extend the benefits to the entire EUROCONTROL area through adoption of Pan-European performance targets, and facilitation of performance management by the Network functions.
- 11.5.7 The PRC acknowledges that the efforts required by the ANS industry to contain costs while ensuring the provision of sufficient capacity to meet present and future performance objectives require a number of genuine changes which can be of different nature (e.g. institutional, organisational, managerial, financial, operational and technical). Among the key success factors for meeting the future challenges, the following deserve special focus:
- Drive sustainable long term change (i.e. short term cost-effectiveness improvements should not jeopardise the provision of future capacity);
  - Maximise the use of existing human and capital resources;
  - Engage in genuine changes with the different partners:
    - effective social dialogue to drive sustainable changes
    - explore different degrees of cooperative business opportunities among ANSPs (e.g. FABs)
    - drive cost-effective technological changes from SESAR; and,
    - make the most effective use of the Network functions;
  - Strengthen the medium term planning process while developing the need for business flexibility; and,
  - Incentivise the timely delivery of ATC capacity.

# ANNEX I - ACC TRAFFIC AND DELAY DATA (2008-2010)

3Y-AAGR = Annual average growth rate			Traffic evolution				Total ATFM			En-route ATFM			Causes of en-route				
PRU_ACC	State	ACC	Avg. daily traffic		2010/ 09 growth (%)	3Y- AAGR	delay per flight			delay per flight			Capacity/ Staffing	ATFM delay in 2010			
			2008	2009			2010	2008	2009	2010	ATC Other	Weather		Other reasons			
LAAAACC	Albania	Tirana	405	442	497	12.4%	8.6%	0.1	0.1	0.1	0.1	0.1	0.1	29.1%	70.9%		
UDDDACC	Armenia	Yerevan		119	132	11.4%											
LOVVACC	Austria	Wien	2 108	1 976	1 968	-0.4%	-1.7%	2.1	1.6	2.0	1.4	1.2	1.5	82.8%	0.9%	16.1%	0.2%
EBBUACC	Belgium	Brussels	1 606	1 470	1 471	0.1%	-3.4%	0.6	0.6	0.6	0.2	0.2	0.2	68.5%	1.2%	3.6%	26.7%
LQSBACC	Bosnia and Herzegovina	Sarajevo	2	1	4												
LBSRACC	Bulgaria	Sofia	1 187	1 230	1 322	7.5%	23.3%	0.0			0.0						
LBWRACC		Varna	42														
LDZOACC	Croatia	Zagreb	1 039	1 063	1 177	10.7%	6.5%	2.1	0.7	1.1	2.1	0.7	1.1	69.7%		29.9%	0.5%
LCCCACC	Cyprus	Nicosia	739	729	776	6.5%	5.6%	2.7	2.4	3.6	2.7	2.3	3.6	100.0%	0.0%		0.0%
LKAAACC	Czech Republic	Praha	1 782	1 707	1 771	3.7%	1.6%	0.5	0.3	0.2	0.4	0.3	0.1	80.6%		18.4%	0.9%
EKDKACC	Denmark	Kobenhavn	1 456	1 354	1 403	3.6%	-2.1%	2.6	0.1	0.1	2.3	0.0	0.0	15.8%	68.6%	7.2%	8.3%
EETTACC	Estonia	Tallinn	433	401	410	2.2%	2.1%	0.0	0.0	0.0	0.0	0.0	0.0	49.8%	17.2%		33.0%
EFESACC	Finland	Tampere	474	444	459	3.4%	-0.1%	0.1	0.1	0.2	0.0	0.0	0.0	66.0%	27.5%		6.6%
EFPSACC		Rovaniemi	92	92	81	-11.3%	-3.9%										
LFBBALL	France	Bordeaux	2 324	2 121	2 114	-0.4%	-3.0%	0.1	0.0	1.1	0.0	0.0	1.1	21.8%	58.9%	10.5%	8.8%
LFRRACC		Brest	2 460	2 248	2 228	-0.9%	-3.6%	0.1	0.1	2.3	0.1	0.1	2.3	52.4%	41.5%	2.0%	4.1%
LFMMACC		Marseille	2 867	2 692	2 731	1.4%	-1.6%	0.1	0.1	3.0	0.1	0.1	3.0	43.8%	43.1%	10.9%	2.2%
LFFFALL		Paris	3 449	3 265	3 122	-4.4%	-3.5%	1.0	0.7	1.4	0.5	0.2	0.8	30.4%	59.0%	8.1%	2.5%
LFEEACC		Reims	2 457	2 174	2 141	-1.5%	-4.4%	0.5	0.1	0.3	0.5	0.1	0.3	49.5%	45.2%	4.6%	0.7%
LWSSACC	FYROM	Skopje	336	337	340	0.8%	1.0%										
EDWWACC	Germany	Bremen	1 762	1 623	1 661	2.4%	-1.6%	0.3	0.4	0.6	0.2	0.3	0.3	63.0%	22.1%	6.1%	8.8%
EDFFALL		Langen	3 577	3 363	3 381	0.5%	-2.0%	1.2	1.3	2.3	0.3	0.6	1.1	77.2%	12.0%	6.1%	4.6%
EDMMACC		Munchen	4 021	3 780	3 977	5.2%	0.5%	0.4	0.4	0.4	0.2	0.2	0.2	55.1%	0.9%	37.8%	6.2%
EDUUUAC		Rhein	4 012	3 744	3 739	-0.1%	-1.6%	0.9	0.6	1.4	0.9	0.6	1.4	10.7%	1.0%	5.1%	83.2%
LGACC	Greece	Athinai+Macedonia	1 699	1 693	1 742	2.9%	2.0%	2.2	2.2	1.6	1.5	1.2	1.0	89.3%	7.2%		3.5%
LHCCACC	Hungary	Budapest	1 602	1 572	1 612	2.6%	0.5%	0.0	0.1	0.0		0.0	0.0				100.0%
EIDWACC	Ireland	Dublin	620	520	480	-7.7%	-8.3%	1.5	0.1	0.2	0.3	0.0	0.0		64.5%		35.5%
EISNACC		Shannon	1 204	1 086	1 072	-1.3%	-3.8%	0.1		0.0	0.1		0.0		11.8%		88.3%
LIBBACC	Italy	Brindisi	865	817	863	5.6%	1.0%	0.0	0.0	0.0	0.0	0.0	0.0		100.0%		
LIMMACC		Milano	1 783	1 664	1 700	2.1%	-3.5%	0.2	0.1	0.1	0.0	0.0	0.0		82.9%	1.7%	15.4%
LIPPACC		Padova	1 799	1 673	1 792	7.1%	-1.6%	0.4	0.2	0.1	0.1	0.0	0.0	79.6%	0.7%	17.0%	2.7%
LIRRACC		Roma	2 699	2 585	2 680	3.7%	-0.3%	0.5	0.1	0.1	0.0	0.0	0.0		100.0%		
EVRRACC	Latvia	Riga	515	460	477	3.8%	0.1%										
EYVACC	Lithuania	Vilnius	583	515	512	-0.6%	2.4%										
EDYYUAC		Maastricht	4 395	4 068	4 171	2.5%	-1.8%	0.5	0.0	0.0	0.5	0.0	0.0	34.3%	21.1%	29.8%	14.8%
LMMMACC	Malta	Malta	231	233	260	11.5%	5.2%	0.0	0.0	0.0	0.0	0.0	0.0				
LUUUUAC	Moldova	Chisinau	110	119	147	23.6%	16.0%										
EHAAACC	The Netherlands	Amsterdam	1 439	1 331	1 330	-0.1%	-3.7%	1.1	0.3	0.9	0.0	0.0	0.2	58.5%		11.4%	30.2%
ENBDACC	Norway	Bodo	530	522	534	2.3%	0.4%	0.1	0.0	0.0	0.0	0.0	0.0	80.7%			19.3%
ENOSACC		Oslo	929	866	891	2.9%	0.2%	0.2	0.1	0.1	0.0	0.0	0.0	40.3%			59.7%
ENSVACC		Stavanger	558	540	541	0.2%	-0.9%	0.1	0.4	0.1	0.1	0.3	0.1	91.8%	2.8%		5.4%
EPWWACC	Poland *	Warszawa	1 558	1 438	1 524	6.0%	2.6%	2.2	1.8	1.2	2.1	1.7	1.2	94.1%	2.5%	2.0%	1.4%
LPPCACC	Portugal	Lisboa	1 121	1 036	1 097	5.9%	0.0%	0.4	0.1	0.1	0.2	0.0	0.0	96.0%	4.0%		
LPPOOAC		Santa Maria	283	274	290	5.8%	3.1%										
LRBBACC	Romania	Bucuresti	1 212	1 186	1 284	8.2%	2.8%	0.0		0.0			0.0				100.0%
LYBAACC	Serbia	Beograd	1 314	1 373	1 459	6.2%	6.2%	0.0	0.0	0.0	0.0	0.0	0.0	4.7%			95.3%
LTBBACC	Slovakia	Bratislava	1 567	1 653	1 840	11.3%	7.8%	0.9	1.6	1.3		0.0	0.0	85.3%		14.7%	
LJLAACC	Slovenia	Ljubjana	671	632	673	6.5%	2.6%	0.0	0.0	0.0	0.0	0.0	0.0	48.1%	3.6%	36.8%	11.5%
LECBACC	Spain	Barcelona	2 250	2 033	2 054	1.0%	-4.0%	0.4	0.2	1.9	0.2	0.1	1.8	94.7%	0.6%	4.4%	0.4%
LECMALL		Madrid	2 860	2 609	2 649	1.5%	-3.0%	1.1	1.2	2.5	0.7	0.7	1.4	92.4%	3.8%	1.2%	2.6%
LECPACC		Palma	733	678	685	0.9%	-3.0%	0.9	0.6	0.6	0.0	0.1	0.1	84.6%		1.7%	13.6%
LECSACC		Sevilla	1 067	956	978	2.2%	-3.9%	0.1	0.2	0.5	0.1	0.2	0.5	88.7%	2.7%	3.4%	5.2%
GCCCACC		Canarias	840	730	753	3.1%	-3.7%	0.5	1.7	1.4	0.3	1.6	1.2	55.5%	11.5%	31.0%	2.0%
ESMMACC	Sweden	Malmo	1 448	1 271	1 295	1.9%	-1.8%	0.1	0.0	0.1	0.1	0.0	0.1	73.8%	12.7%	8.6%	4.9%
ESOSACC		Stockholm	1 128	1 028	1 021	-0.6%	-2.9%	0.1	0.1	0.3	0.0	0.0	0.2	88.5%	7.9%	0.2%	3.4%
LSAGACC	Switzerland	Geneva	1 813	1 645	1 648	0.2%	-3.5%	0.8	0.4	0.6	0.5	0.2	0.3	80.5%	0.3%	18.4%	0.8%
LSAZACC		Zurich	2 156	2 014	2 031	0.9%	-1.5%	1.1	0.8	0.7	0.8	0.6	0.5	75.0%	2.0%	4.7%	18.3%
LTAAACC	Turkey	Ankara	1 544	1 600	1 760	10.0%	7.2%	0.5	0.2	0.2	0.2	0.1	0.1	99.2%	0.1%		0.7%
LTBBACC		Istanbul	1 567	1 653	1 840	11.3%	7.8%	0.9	1.6	1.3		0.0	0.0	85.3%		14.7%	
UKBVACC	Ukraine	Kyiv	547	488	536	9.8%	4.0%		0.1	0.1		0.0	0.1	81.0%	2.8%		16.2%
UKCCACC		Donets'k	4	37	6	-83.3%											
UKDDACC		Dnipropetrovsk	60	45	7	-84.0%	-50.9%										
UKDVACC		Dnipropetrovsk ALL**			314						0.0		0.0				100.0%
UKFVACC		Simferopol	481	463	559	20.6%	6.7%				0.0		0.0				100.0%
UKHVACC		Kharkiv	324	308	50	-83.6%	-43.2%										
UKLVACC		L'viv	428	416	448	7.6%	6.5%				0.0		0.0				100.0%
UKOVACC		Odesa	208	202	244	20.9%	10.1%				0.0		0.0				100.0%
EGTTACC	United Kingdom	London AC	5 427	4 980	4 798	-3.7%	-4.5%	0.6	0.2	0.1	0.6	0.2	0.1	72.9%	2.7%	16.4%	8.0%
EGTTTC		London TC	3 780	3 480	3 318	-4.7%	-4.9%	1.1	0.6	0.6	0.1	0.0	0.0	38.0%	5.7%	25.8%	30.5%
EGPXALL		Prestwick			2 402					0.2			0.1	40.1%	4.6%	9.1%	46.2%
EGCCACC		Manchester	1 569	1 352				0.2	0.1		0.1	0.0					
EGPXACC		Scottish	1 800	1 582				0.2	0.0		0.2	0.0					

ACCs geographical areas might change over time, preventing year on year comparison (e.g. Prestwick, Dnipropetrovsk ALL)

\* does not include EPWWICTA and EPKKTMA

\*\* Dnipropetrovsk ALL was created in March 2010 replacing Kharkiv, Dnipropetrovsk and Donetsk' ACCs

## ANNEX II - 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).

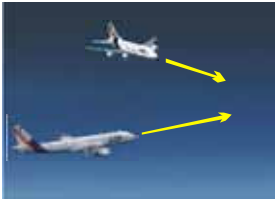


The complexity indicators are based on the concept of “interactions”. Interactions arise when there are two aircraft in the same “place” at the same time. For the purpose of this study, an interaction is defined as the simultaneous presence of two aircraft in a cell of 20x20 nautical miles and 3,000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

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

$$\text{Complexity score} = \text{Traffic density} \times \text{Structural index}$$

**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

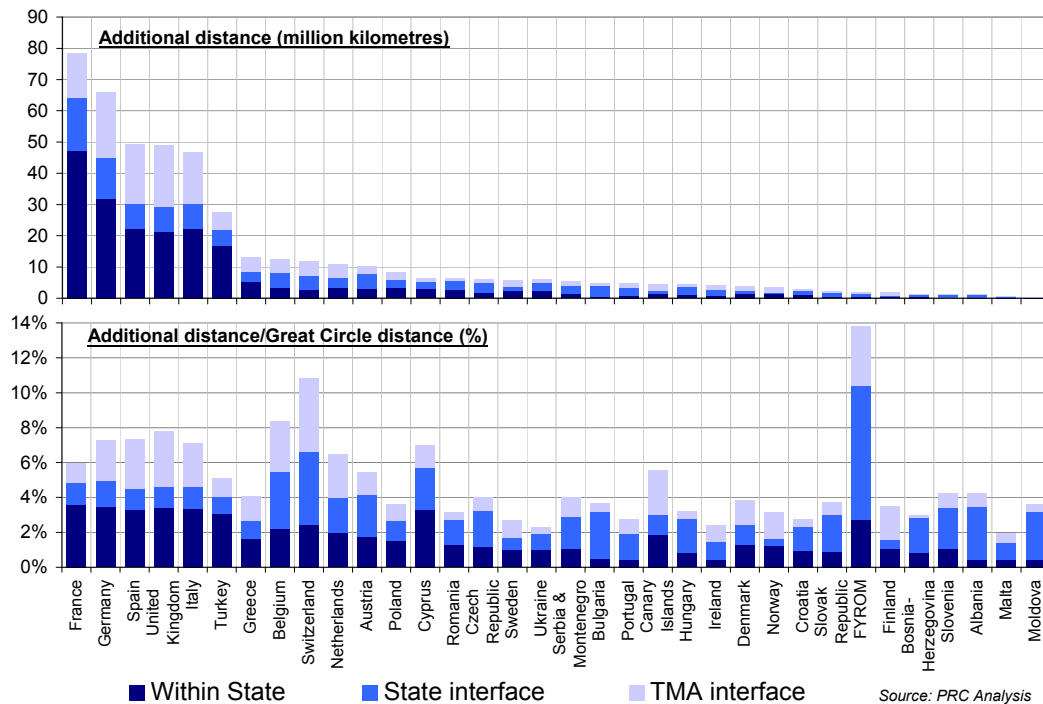
	<p><b>Horizontal interactions indicator:</b> A measure of the complexity of the flow structure based on the potential interactions between aircraft on different headings. The indicator is defined as the ratio of the duration of horizontal interactions to the total duration of all interactions.</p>
	<p><b>Vertical interactions indicator:</b> 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</p>
	<p><b>Speed interactions indicator:</b> 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</p>



### ANSP Complexity score (2010)

State	ANSP	Complexity score	Adjusted Density	Structural index			
		a *e	a	Vertical	Horizontal	Speed	Total
				b	c	d	e=b+c+d
CH	Skyguide	12.0	11.5	0.28	0.55	0.21	1.04
BE	Belgocontrol	11.9	8.8	0.42	0.53	0.42	1.36
DE	DFS	11.3	10.4	0.29	0.53	0.26	1.08
UK	NATS	10.9	10.0	0.37	0.41	0.31	1.09
MUAC	MUAC	9.7	10.5	0.25	0.51	0.16	0.92
NL	LVNL	9.3	9.9	0.21	0.36	0.36	0.94
AT	Austro Control	7.6	8.3	0.21	0.49	0.22	0.92
CZ	ANS CR	7.1	8.2	0.17	0.50	0.20	0.87
FR	DSNA	6.4	9.3	0.15	0.39	0.14	0.69
SI	Slovenia Control	5.7	7.5	0.15	0.49	0.12	0.76
IT	ENAV	5.7	5.6	0.27	0.55	0.19	1.01
LY	SMATSA	5.2	9.0	0.05	0.47	0.06	0.58
HU	HungaroControl	4.9	7.5	0.07	0.44	0.14	0.66
SK	LPS	4.9	6.2	0.14	0.48	0.17	0.78
ES	Aena	4.6	6.6	0.17	0.39	0.13	0.69
HR	Croatia Control	4.0	6.5	0.06	0.47	0.08	0.61
PL	PANSA	3.9	4.3	0.14	0.52	0.25	0.92
DK	NAVIAIR	3.8	4.0	0.18	0.55	0.21	0.93
TR	DHMI	3.5	5.6	0.14	0.38	0.11	0.63
RO	ROMATSA	3.3	5.3	0.07	0.39	0.15	0.61
CY	DCAC Cyprus	2.8	4.4	0.14	0.39	0.11	0.63
SE	LFV	2.8	3.1	0.22	0.46	0.23	0.91
MK	M-NAV	2.7	4.6	0.11	0.42	0.06	0.59
GR	HCAA	2.5	4.3	0.11	0.39	0.09	0.59
BU	BULATSA	2.4	6.8	0.05	0.25	0.06	0.36
AL	NATA Albania	2.4	5.5	0.06	0.33	0.05	0.43
PT	NAV Portugal (FIR Lisboa)	2.2	3.4	0.17	0.39	0.08	0.65
NO	Avinor	2.1	2.0	0.33	0.47	0.25	1.04
EE	EANS	2.1	3.3	0.15	0.29	0.19	0.62
LV	LGS	2.0	3.0	0.10	0.43	0.14	0.68
FI	Finavia	1.9	2.0	0.27	0.34	0.36	0.98
UA	UkSATSE	1.9	3.0	0.05	0.39	0.18	0.62
LT	Oro Navigacija	1.8	2.9	0.07	0.37	0.17	0.62
IE	IAA	1.6	4.1	0.07	0.22	0.10	0.40
MD	MoldATSA	1.1	1.7	0.05	0.39	0.19	0.63
AM	ARMATS	0.7	1.2	0.09	0.37	0.17	0.62
MT	MATS	0.7	1.2	0.11	0.36	0.12	0.59
	Average	6.1	7.2	0.21	0.44	0.19	0.84

### ANNEX III - ADDITIONAL EN-ROUTE DISTANCE PER STATE



#### Additional en-route distance per State

### ANNEX IV - TOP 50 MOST-CONSTRAINING POINTS

Waypoint	State	On border	Constrained flights	Extra miles (NM)	
				Total 000's	Per flight
RIDSU	Germany	No	33 956	1 539	45
RESMI	France	No	47 414	1 229	26
MOU	France	No	50 412	1 114	22
BAG	Turkey	No	43 124	711	16
TRA	Switzerland	No	34 900	700	20
BOMBI	Germany	No	57 029	699	12
KUDES	Switzerland	No	32 023	689	22
MUT	Turkey	No	20 859	685	33
KFK	Turkey	No	62 734	658	10
ARTAX	France	No	45 653	643	14
ALSUS	Cyprus	No	19 874	639	32
LOHRE	Germany	No	29 133	591	20
TINTO	Italy	No	12 833	583	45
VADOM	France	No	13 763	569	41
MJV	Spain	No	23 906	551	23
SPY	Netherlands	No	31 070	533	17
STG	Spain	No	26 448	500	19
MAKOL	Bulgaria/	Yes	22 271	493	22
GEN	Italy	No	28 494	488	17
BUK	Turkey	No	26 782	471	18
PAM	Netherlands	No	25 304	468	18
ZMR	Spain	No	39 312	462	12
VLC	Spain	No	36 312	460	13
BCN	Spain	No	24 556	450	18
DJL	France	No	30 467	432	14

Waypoint	State	On border	Constrained flights	Extra miles (NM)	
				Total 000's	Per flight
LAM	UK	No	22 827	421	18
ELB	Italy	No	47 322	419	9
MILPA	France	No	24 645	402	16
DERAK	France	No	19 682	401	20
OLBEN	Switzerland	No	19 160	399	21
KEPER	France	No	16 778	398	24
BOL	Italy	No	38 520	398	10
TERPO	France	No	17 568	390	22
MAXIR	France	No	13 800	379	27
PIXIS	France	No	21 706	375	17
ROMIR	Switzerland	No	12 299	372	30
IST	Turkey	No	15 024	369	25
SUMIR	Italy	No	13 087	367	28
MOLUS	Switzerland	No	16 078	367	23
GAPLI	Ireland/UK	Yes	12 306	364	30
MHN	Spain	No	14 412	351	24
CPT	UK	No	28 253	351	12
BAKUL	France	No	16 478	348	21
OBLAD	France	No	10 201	345	34
RDS	Greece	No	20 449	345	17
WAL	UK	No	41 606	345	8
RLP	France	No	23 851	342	14
VIBAS	Spain	No	28 717	334	12
MAVAR	Albania/FYROM	Yes	14 292	334	23
BIG	Turkey	No	27 861	329	12

#### Most constraining points

## ANNEX V - INDICATORS - ANS PERFORMANCE AT AIRPORTS

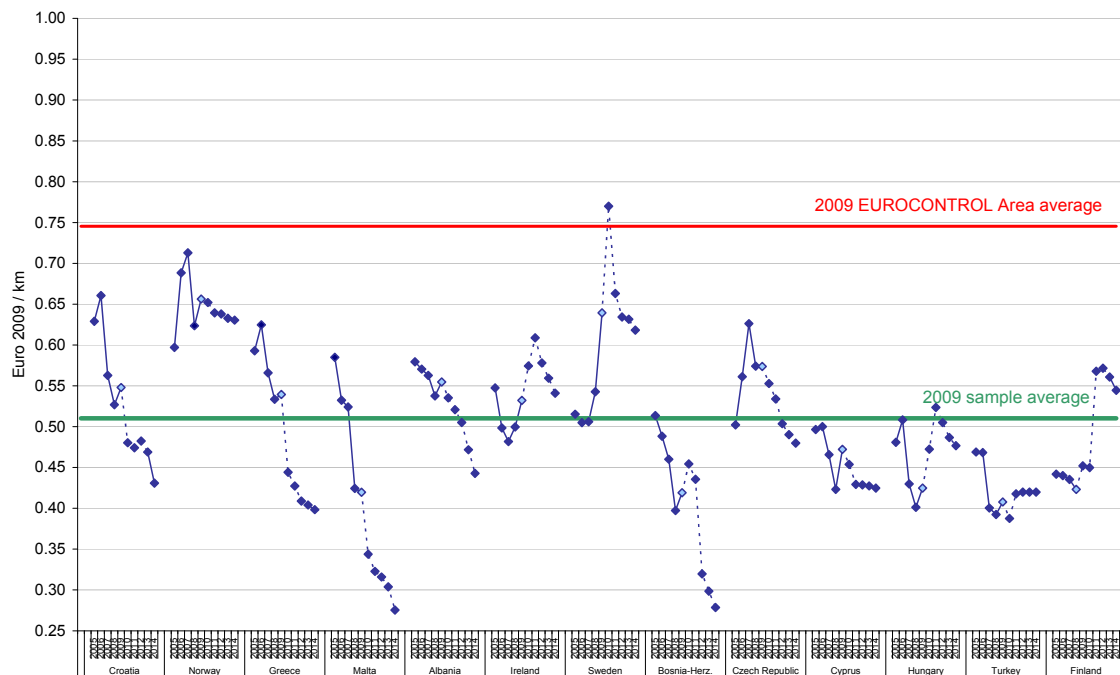
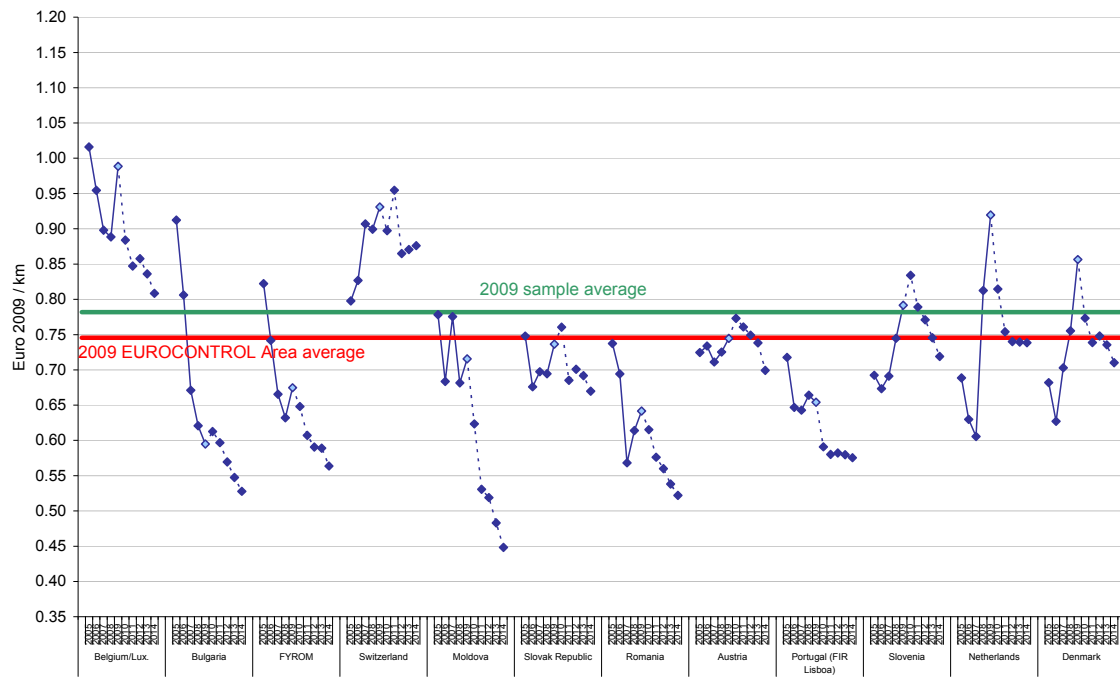
	Indicator	What should be measured?	Description
Capacity	Airport Declared capacity	Coordination parameters to be used for the airport slot allocation process.	Number of aircraft movements per unit of time (usually one hour) that an airport could accept. The airport declared capacity is the output of the capacity declaration process.
	Peak service rate	Approximation of the operational capacity of the airport by using the maximum hourly throughput in ideal conditions as a proxy	The peak service rate is the first percentile of the number of aircraft movements in “static” hours sorted from the busiest to the least busy hour in the peak month.
ANS efficiency	Airport arrival ATFM delays	Delays experienced at the origin airport due to constraints at the destination airport	Difference between the CTOT (Calculated Take-Off Time) and the ETOT (Estimated Take-Off Time).
	Arrival sequencing and metering (ASMA) additional time	ANS-related inefficiencies between 40nm and landing.	Difference between a statistical reference ASMA (40 nm to landing- based on an unconstrained set of flights) and the actual ASMA time. The methodology is explained in the ATM airport (ATMAP) Framework [Ref. 42].
	Local ATC departure delays	Departure delays experienced at the gate due to local ATC constraints	The delay reported to CODA as IATA code 89, which contains ATC delays.
	Taxi-out additional times	ANS-related inefficiencies in the taxi-out phase.	Difference between a statistical reference taxi-out time (off-block to take-off -based on an unconstrained set of flights) and the actual taxi-out time. The methodology is explained in the ATM airport (ATMAP) Framework [Ref. 42].
	ATFM slot adherence	Level of adherence to ATFM slots allocated by the CFMU.	Share of flights with an actual take off time outside the allocated ATFM slot tolerance window [-5 and +10 minutes].
	Operational cancellations due to ANS	Number of cancelled flights in a period of time.	Operational cancellations due to ANS deficiencies.

## ANNEX VI - INDICATORS - ANS COST-EFFECTIVENESS

	Indicator	How is it measured?	Comments
En-route cost-efficiency	En-route unit costs per km	$\frac{(\text{En-route ANS costs (ANSP, MET, NSA/CAA)} + \text{EUROCONTROL costs})}{\text{total km in the charging zone}}$	In the context of the SES II performance scheme, the en-route cost-efficiency KPI is defined as the en-route determined unit rate. The en-route determined costs correspond to the sum of en-route national costs including ANSP, MET and CAA/NSA costs with EUROCONTROL costs.  Note that the determined unit rate is different from the unit rate that will ultimately be charged to airspace users (which includes several adjustments such as the over/under recoveries arising from the traffic risk sharing mechanism).
	En-route determined unit rate	$\frac{\text{En-route determined costs}}{\text{total en-route service units}}$	
Terminal cost-efficiency	Terminal unit costs per IFR airport movement	$\frac{\text{Terminal ANS costs}}{\text{IFR airport movements}}$	In the context of the SES II performance scheme, the terminal determined costs correspond to the sum of terminal ANSP, MET and CAA/NSA costs.
	Terminal determined unit rate	$\frac{\text{Terminal determined costs}}{\text{total terminal service units}}$	
Gate-to-gate ANSP cost-effectiveness benchmarking	Gate-to-gate unit ATM/CNS provision costs	$\frac{\text{En-route + terminal ATM/CNS provision costs}}{\text{composite flight-hours}}$	Composite flight-hours combine the two separate output measures for en-route (flight-hours) and terminal (IFR airport movements) into a unique indicator. More information on the computation of composite flight-hours is available in Annex 2 of the ACE 2009 Benchmarking Report.

## ANNEX VII - CHANGE IN REAL EN-ROUTE UNIT COSTS

The tables below show the change in real en-route unit costs for States, excluding the five largest States, between 2005 and 2014.



States	Charging Zone	2009	2008		2009		States	Charging Zone	2009	2008		2009			
	Aerodromes	Movements	(in EUR 2009)		(in EUR 2009)			Aerodromes	Movements	(in EUR 2009)		(in EUR 2009)			
			TNC formula	Unit Rate	ANS Terminal costs (€'000)	Unit Rate	ANS Terminal costs (€'000)			TNC formula	Unit Rate	ANS Terminal costs (€'000)	Unit Rate	ANS Terminal costs (€'000)	
AUSTRIA	1 zone - 6 aerodromes	369 872	(MTOW/50)*0.7	193.49	35 728	202.17	34 240	ITALY	1 zone (39 aerodromes) ***	1 326 205	(MTOW/50)*0.7	2.22	179 162	2.34	180 118
	Wien	260 665							Fumicino	324 316					
	Salzburg	30 358							Milano Malpensa	187 624					
	Linz	21 286							Milano Linate	120 412					
	Klagenfurt	12 164							Venezia Tessera	75 464					
	Innsbruck	21 483							Orio al Serio	64 987					
	Graz	23 914							Bologna	64 623					
BELGIUM	1 zone - 1 aerodrome	224 609	(MTOW/50)*0.9	N/A	36 697	N/A	35 552		Napoli	64 134					
	Brussels	224 609							Catania	56 706					
BULGARIA*	1 zone - 5 aerodromes	74 465	N/A	N/A	11 665	N/A	10 819		Palermo	51 068					
	Sofia	45 450							Torino Caselle	50 235					
	Burgas	14 926							Cagliari	38 094					
	Varna	12 804							Bari	30 538					
	Plovdiv	963							Firenze	29 516					
	Garna Oryahovitsa	323							Olbia	26 962					
CYPRUS*	1 zone - 2 aerodromes	62 146	N/A	N/A	7 283	N/A	7 605		Genova	21 267					
	Larnaca	48 390							Alghero	15 635					
	Paphos	13 755							Lamezia	15 142					
CZECH REP.	1 zone - 4 aerodromes	180 152	(MTOW/50)*0.7	259.07	25 932	257.53	22 496		Ronchi dei Legionari	13 068					
	Praha-Ruzyně	159 653							Ancona Falconara	11 120					
	Brno-Tuřany	9 410							Forlì	9 492					
	Ostrava-Mošnov	9 365							Brescia Montichiari	9 073					
	Kaňov Vary	1 724							Pescara	8 073					
DENMARK	1 zone - 2 aerodromes	235 949	(MTOW/50)*0.7	189.47	24 790	193.93	24 863		Parma	6 126					
	København	236 147							Reggio Calabria	5 790					
	Roskilde	9 802							Bolzano	4 506					
ESTONIA **									Perugia	4 333					
	Tallinn/Ulemiste	29 378							Lampedusa	3 654					
FINLAND	1 zone - 1 aerodrome	172 460	(MTOW/50)*0.7	142.29	19 165	127.00	19 219		Pantelleria	3 547					
	Helsinki-Vantaa	172 460							Foggia	2 823					
FRANCE	1 zone - 64 aerodromes	1 820 437	(MTOW/50)*0.9	4.55	262 615	4.68	265 468		Cuneo	2 345					
	Charles de Gaulle	525 270							Crotone	1 178					
	Orly	224 106							Albenga	1 041					
	Nice	130 615							Salerno	842					
	Lyon	123 188							Roma Urbe	789					
	Marseille	102 544							Grottaglie	773					
	Toulouse	87 415							Padova	488					
	Bordeaux	61 019							Venezia Lido	156					
	Le Bourget	54 740							Torino Aerialia	144					
	Nantes	51 996							Rieti	2					

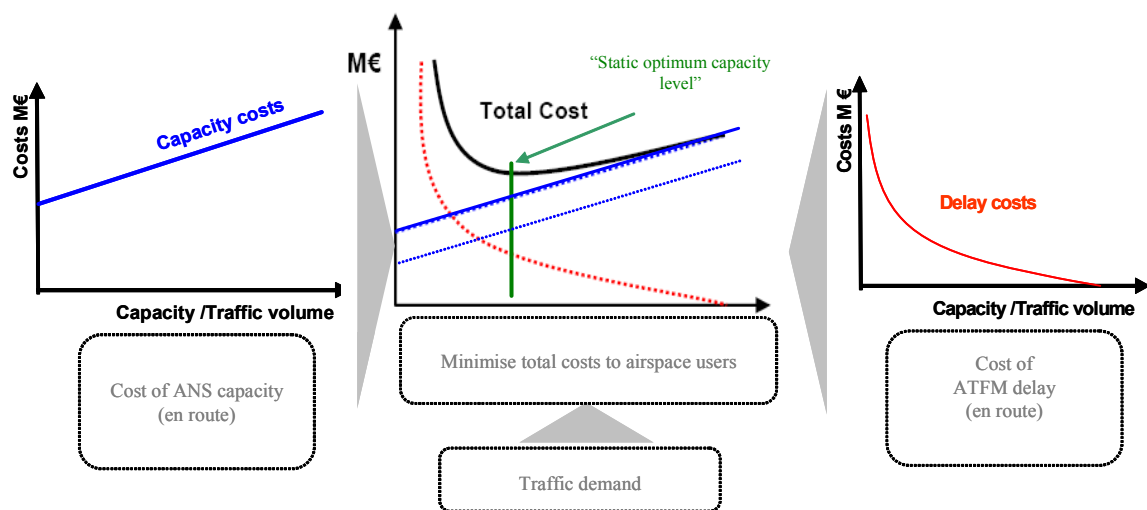
## ANNEX IX -TOTAL ECONOMIC COST AND ECONOMIC OPTIMUM

The minimisation of costs to airspace users is presently applied to the cost-efficiency/delay trade-off. The EUROCONTROL Agency has developed a methodology agreed with ANSPs to compute the optimum capacity/delay and allocation of capacity requirements among ACCs to reach a given delay target [Ref. 66].

The cost of ANS capacity provision tends to be a step function at local level due the “lumpy nature” of investments required to increase capacity beyond a certain point, and nearly constant costs before that point. However, at aggregated system level, the cost of capacity tends to grow continuously with capacity (left side of the figure).

The cost of delay has an exponential behaviour and increases very fast if capacity drops below demand. It decreases slowly if capacity is above demand (right side of the figure).

The total cost has a U-shape and a minimum where capacity equals demand (centre of the figure).



In a first approximation, the cost of ANS capacity provision is considered to be dependent on capacity and to remain static in time. This leads to the notion of “static economic optimum”, where the cumulated cost of capacity and delays is minimal, as shown in the middle of the Figure above.

Over time, the cost of a given level of capacity can be improved (dotted blue line in the centre of the figure) while maintaining safety, which leads to the concept of “dynamic optimum”.

Static and dynamic optimisation can be combined in the medium term. Hence, over a time period of 3-5 years which corresponds to the duration of a reference period in the SES II performance scheme (see Chapter 2), it is generally possible to improve both capacity and cost-efficiency simultaneously.



## ANNEX X - 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 25 May 2011.

<b>TRAFFIC</b>		
IFR Flight	CFMU	IFR flights controlled by the ANSP. For EANS, LGS, Oro Navigacija : source is ACE: D10 – Total IFR flights controlled by the ANSP. F4 – IFR flights controlled by the ANSP (Forecast).
Seasonal Variation	CFMU	
Complexity	Report	Complexity metrics for ANSP Benchmarking analysis (report by the ACE Working group on Complexity)
<b>KEY DATA</b>		
Total IFR flights controlled ('000)	CFMU	IFR flights controlled by the ANSP. For EANS, LGS, Oro Navigacija : source is ACE. D10 – Total IFR flights controlled by the ANSP. F4 – IFR flights controlled by the ANSP (Forecast).
IFR flight-hours controlled ('000)	CFMU	IFR flights 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 (Forecast).
IFR airport movements controlled ('000)	CFMU	IFR airport movements at airports controlled by the ANSP 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)	CFMU	ATFM delays due to a regulation applied on a sector or an en-route point. ATFM delays: see Glossary.
Airport ATFM Delays ('000 minutes)	CFMU	ATFM delays due to a regulation applied on an airport or a group of airports
Total Staff	ACE <sup>103</sup>	C14 -TOTAL STAFF [En-route + Terminal] (FTE = full time equivalent).
ATCOs in OPS	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)	ACE	A12 – TOTAL “Controllable ANSP costs” [En-route + Terminal] in real term. F14 - TOTAL “Controllable ANSP costs” [En-route + Terminal] in real term.
Capital Investment (M €)	ACE	F34 : TOTAL En-route + Terminal CAPEX (see Glossary).
<b>SAFETY</b>		
	ANSP	Annual Report published by the ANSP + other reports.
<b>COST-EFFECTIVENESS</b>		
ATM/CNS provision Cost Per composite Flight hour	ACE	ATM/CNS provision costs in real term / Composite Flight hours. Composite Flight Hours: see Glossary.
Employment Cost Per ATCO hour	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	ACE	Support Cost in real term: [ATM/CNS provision costs - Employment Cost]. Composite flight hour: see Glossary.
Composite flight hours per ATCO hours	ACE	Composite flight hours: see Glossary. ATCO hours: D20: Sum of “ATCO in OPS” hours on duty [ACC+APP+TWR].
<b>EN-ROUTE ATFM DELAY</b> <sup>104</sup>		
Days with En-route delay per flight > 1 minute	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	CFMU	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	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.
<b>AIRPORT ATFM DELAY</b>		
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) <sup>105</sup> .
ATFM Delay per Arrival flight (Weather – Other)	CFMU	Same as above but with the split between delay due to weather or other delays.
Airports with ATFM delays	CFMU	List of Top 10 Airports with the highest Airport ATFM delay per arrival flight.

<sup>103</sup> See “Specification for Information Disclosure, V. 2.6” (Dec 2008) document for description of code (e.g. D10).

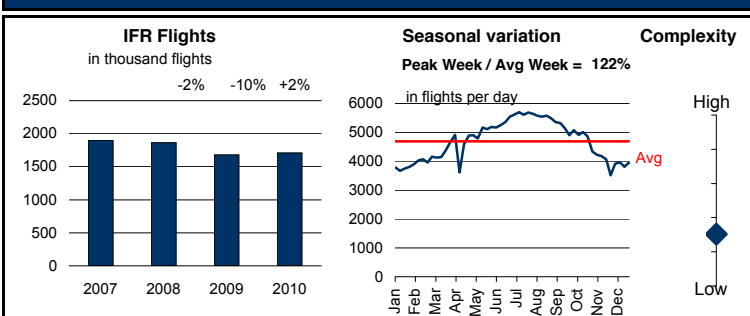
<sup>104</sup> Regulations on traffic volumes EGLL60, EGLL60WX, EGLLTCWX, EHFIRAM, LEBLFIN, LECMARR1 have been reclassified as airport regulations.

<sup>105</sup> Delays due to groups of airports are allocated proportionally to the traffic at these airports.

ANSP name	Country	Page
Aena	Spain	A-1
ANS CR	Czech Republic	A-2
ARMATS	Armenia	A-3
Austro Control	Austria	A-4
Avinor	Norway	A-5
Belgocontrol	Belgium	A-6
BULATSA	Bulgaria	A-7
Croatia Control	Croatia	A-8
DCAC Cyprus	Cyprus	A-9
DFS	Germany	A-10
DHMI	Turkey	A-11
DSNA	France	A-12
EANS	Estonia	A-13
ENAV	Italy	A-14
Finavia	Finland	A-15
HCAA	Greece	A-16
HungaroControl	Hungary	A-17
IAA	Ireland	A-18
LFV	Sweden	A-19
LGS	Latvia	A-20
LPS	Slovak Republic	A-21
LVNL	Netherlands	A-22
MATS	Malta	A-23
M-NAV	FYROM	A-24
MoldATSA	Moldova	A-25
MUAC		A-26
NATA Albania	Albania	A-27
NATS	United Kingdom	A-28
NAV Portugal (FIR Lisboa)	Portugal	A-29
NAVIAIR	Denmark	A-30
Oro Navigacija	Lithuania	A-31
PANSA	Poland	A-32
ROMATSA	Romania	A-33
Skyguide	Switzerland	A-34
Slovenia Control	Slovenia	A-35
SMATSA	Serbia and Montenegro	A-36
UkSATSE	Ukraine	A-37

## Aena, Spain

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	1864	1683	1711
IFR flight-hours controlled ('000)	1410	1270	1324
IFR airport movements controlled ('000)	2048	1830	1827
En Route ATFM delays ('000 minutes)	1063	1309	3301
Airport ATFM delays ('000 minutes)	809	600	1275
Total Staff	3973	4121	
ATCOs in OPS	2005	2004	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	1211	1188	948*
Capital Investment (million € <sub>2009</sub> )	158	161	142*

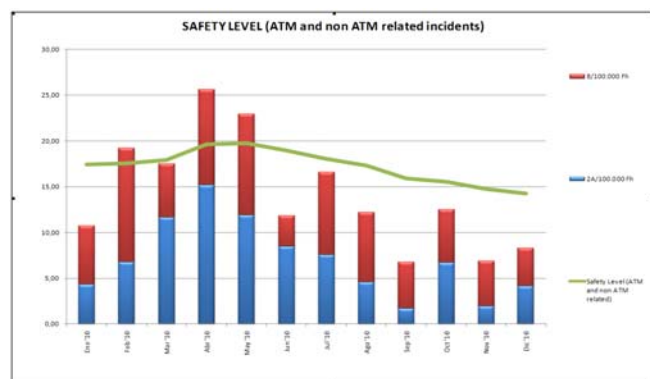
\* Forecast

### Safety

AENA is committed to maintain the highest levels of safety in the Spanish Airspace, minimizing the impact of ATM in the global safety level. In line with this principle, AENA has defined two safety indicators. One, using all incidents (Weighted Safety Indicator) and the other using only the ATM related incidents (ATM Weighted Safety Indicator).

In 2010, the total number of incidents was 1085, with 47 severity A incidents and 95 severity B. With these figures, the 2010 WSI value is 14,27 and the ATM WSI value is 13,23. It is remarked that in 2010 no accidents with ATM contribution happened in Spain.

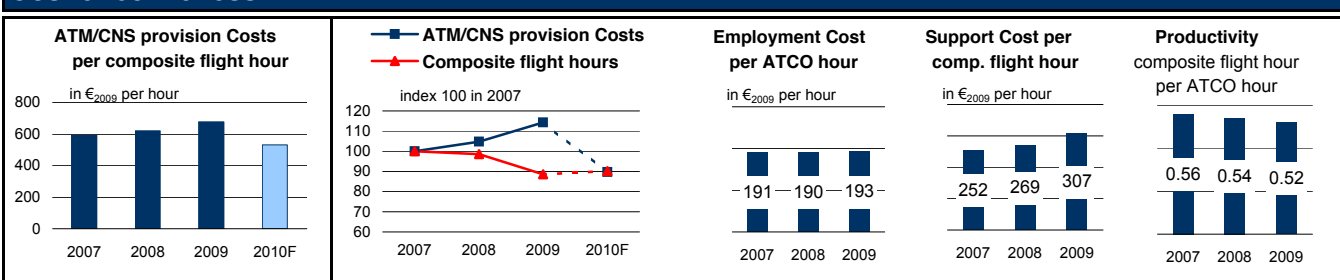
(Source: AENA communication)



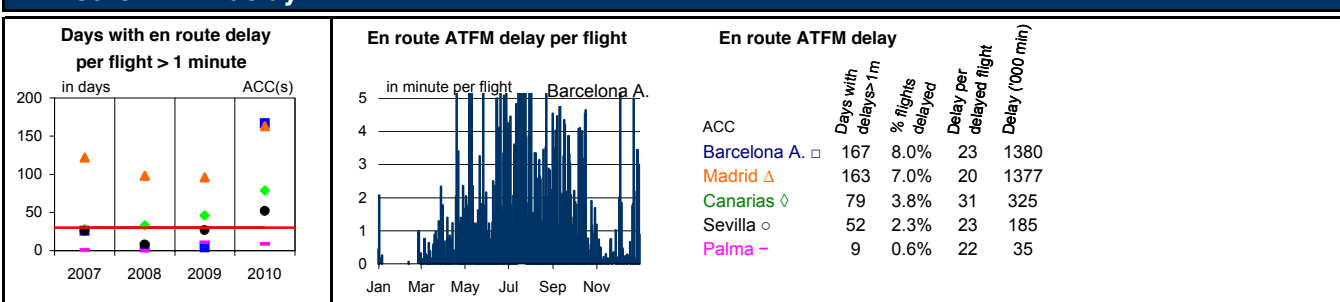
(Source: AENA communication)

ESARR 2 severity classification.

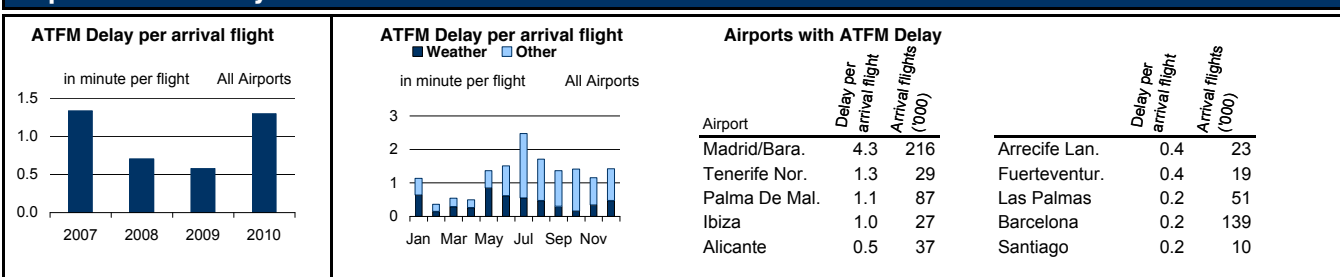
### Cost effectiveness



### En Route ATFM delay

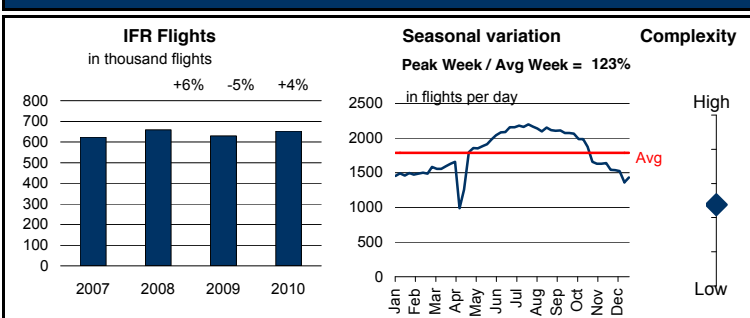


### Airport ATFM delay



# ANS CR, Czech Republic

## Traffic



## Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	659	629	652
IFR flight-hours controlled ('000)	224	219	228
IFR airport movements controlled ('000)	195	180	170
En Route ATFM delays ('000 minutes)	291	182	95
Airport ATFM delays ('000 minutes)	38	25	42
Total Staff	894	880	
ATCOs in OPS	183	187	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	112	108	110*
Capital Investment (million € <sub>2009</sub> )	17	19	21*

\* Forecast

## Safety

As in previous year, no case was recorded in 2010 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 have remained stable regarding both the number of incidents and the seriousness of their impact on the safety of air transport. Only 4 incidents occurred in 2010 of which, in accordance with EUROCONTROL classification, 1 was assessed as "Major Incident" (third degree on five-point scale of seriousness) and three as a "Significant Incident" (second lowest degree).

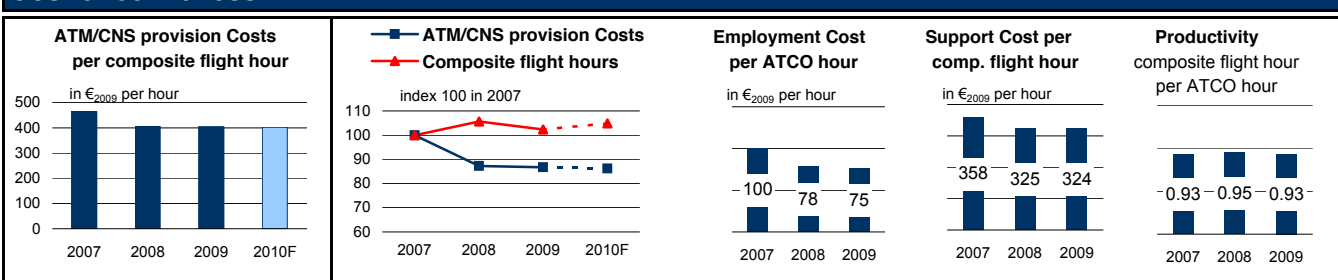
(Source: ANS CR communication)

ESARR 2 severity classification.

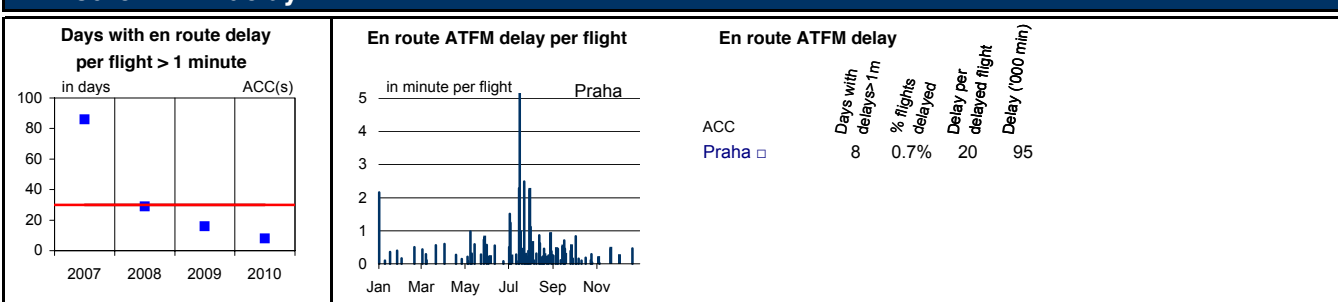
	SIGNIFICANCY	2006	2007	2008	2009	2010
ATS	Accident					
	Serious incident					
	Major incident		4	1	2	1
	Significant incident	6	2	1	1	3
	No safety effect	1	1	3	2	
SYSTEMS	Serious inability to provide ATM services					
	Serious inability to provide ATM services					
	Partial Inability to provide safe ATM service	1		1		
	Ability to provide safe but degraded ATM service	17	14	17	3	17
	No effect on ATM service	35	48	45	49	58
	Not determined					2

(Source: ANS CR communication)

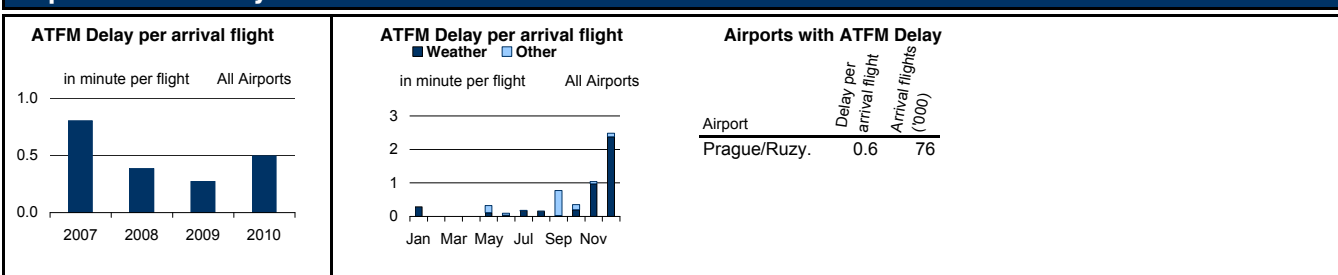
## Cost effectiveness



## En Route ATFM delay

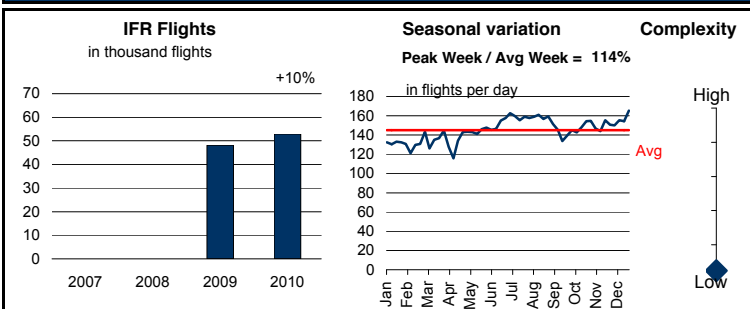


## Airport ATFM delay



## ARMATS, Armenia

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	n/a	48	53
IFR flight-hours controlled ('000)	n/a	11	13
IFR airport movements controlled ('000)		19	21
En Route ATFM delays ('000 minutes)	0	0	0
Airport ATFM delays ('000 minutes)	0	0	0
Total Staff	n/a	499	
ATCOs in OPS	n/a	95	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	n/a	6	7*
Capital Investment (million € <sub>2009</sub> )	n/a	1	1*

\* Forecast

### Safety

There were no accidents or serious incidents caused by ARMATS in 2010. The level of reporting was significantly improved due to taken administrative and awareness campaign. The main numbers of incidents happened in the approach phase of operations. No ATS-related Runway incursions took place caused by ARMATS. There were no RVSM deviation reports.

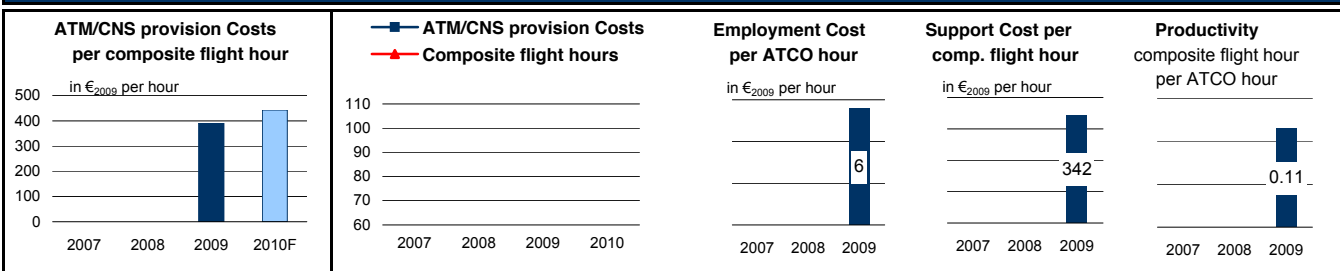
(Source: ARMATS communication)

Incidents	Severity	2009	2010
	A	0	0
	B	0	2
	C	2	6
	D	7	19
	E	8	90

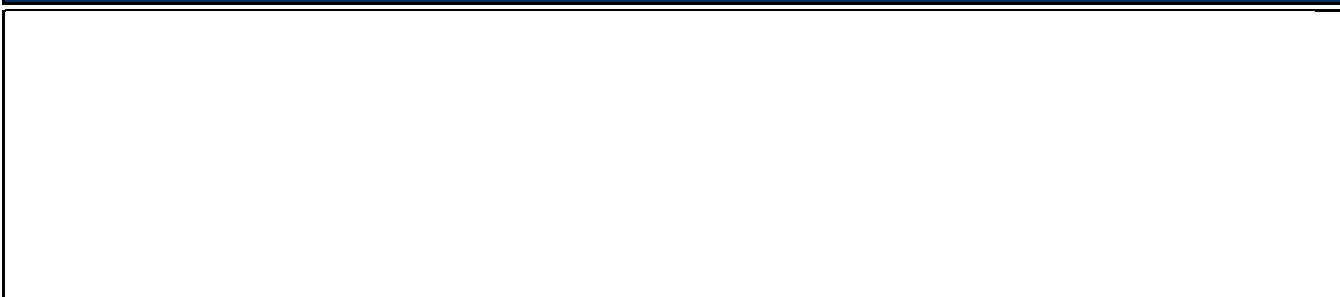
ESARR 2 severity classification.

(Source: ARMATS communication)

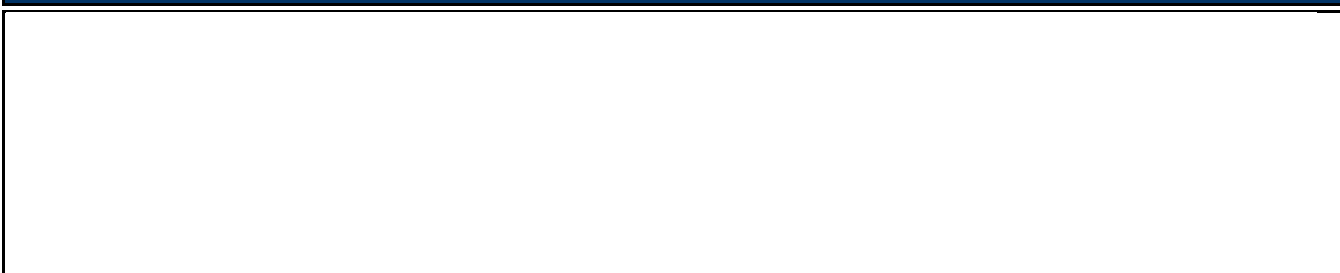
### Cost effectiveness



### En Route ATFM delay

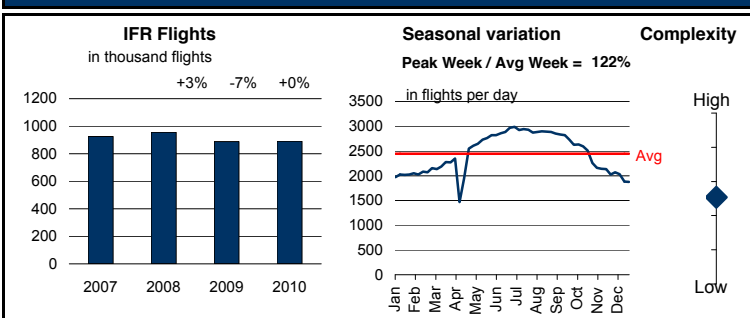


### Airport ATFM delay



# Austro Control, Austria

## Traffic



## Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	955	889	892
IFR flight-hours controlled ('000)	316	289	286
IFR airport movements controlled ('000)	409	370	374
En Route ATFM delays ('000 minutes)	1047	858	1101
Airport ATFM delays ('000 minutes)	564	281	342
Total Staff	863	876	
ATCOs in OPS	259	266	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	170	166	170*
Capital Investment (million € <sub>2009</sub> )	17	19	42*

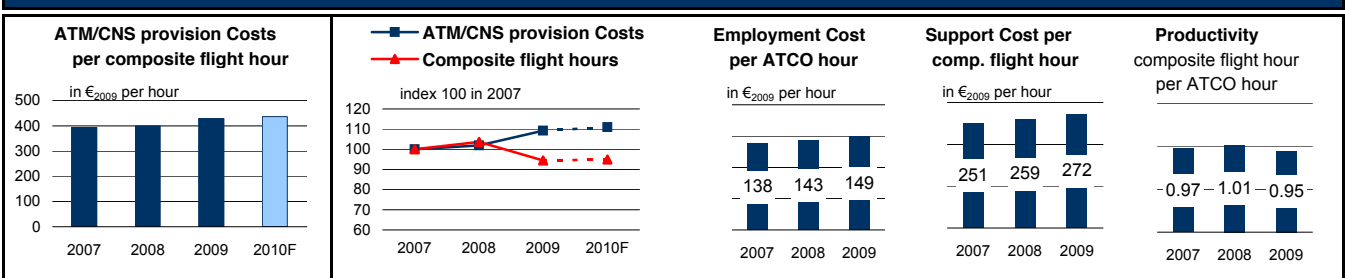
\* Forecast

## Safety

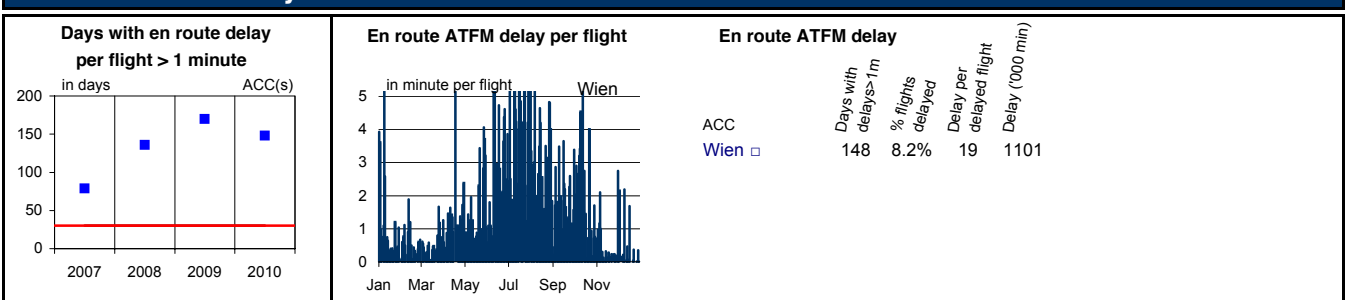
No information found in Annual Report

National severity classification.

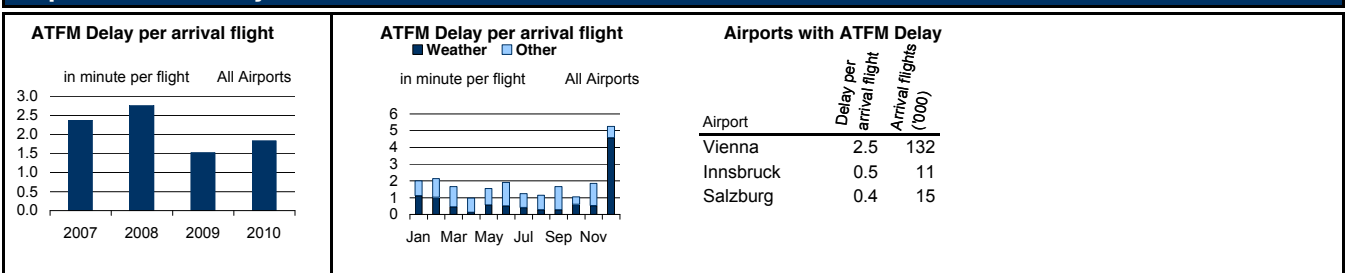
## Cost effectiveness



## En Route ATFM delay



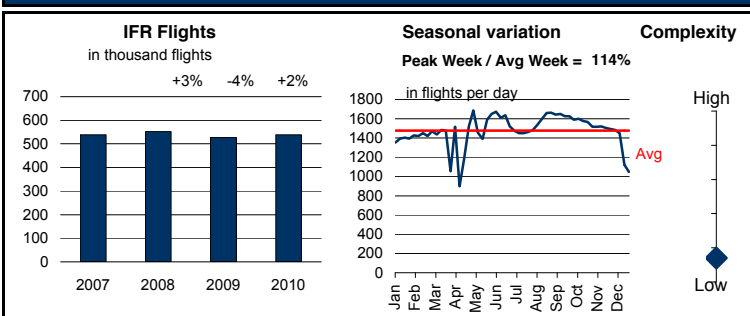
## Airport ATFM delay





## Avinor, Norway

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	552	528	539
IFR flight-hours controlled ('000)	315	303	310
IFR airport movements controlled ('000)	761	718	721
En Route ATFM delays ('000 minutes)	29	71	29
Airport ATFM delays ('000 minutes)	78	38	43
Total Staff	981	1001	
ATCOs in OPS	349	356	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	164	164	171*
Capital Investment (million € <sub>2009</sub> )	7	n/a	10*

\* Forecast

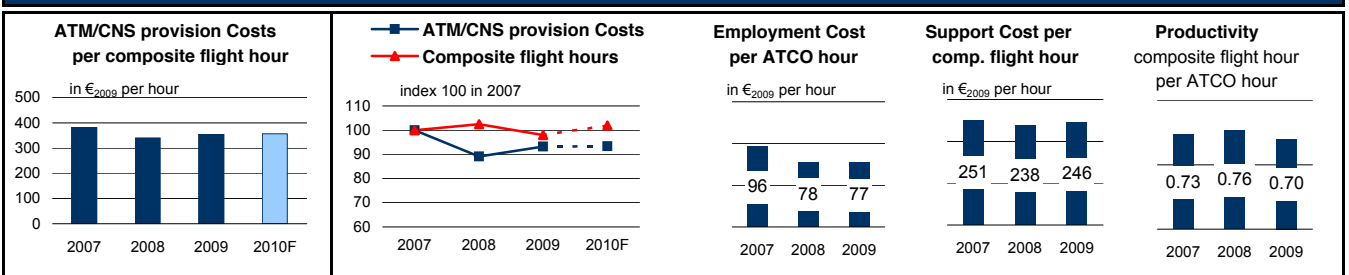
### Safety

The Avinor group consist of Airport divisions as well as the ANS division. The statistics for the whole Avinor group is including 2 accidents (without any personnel damages).  
"There were 0 accidents and 3 serious incidents where Avinor ANS were a contributory party"

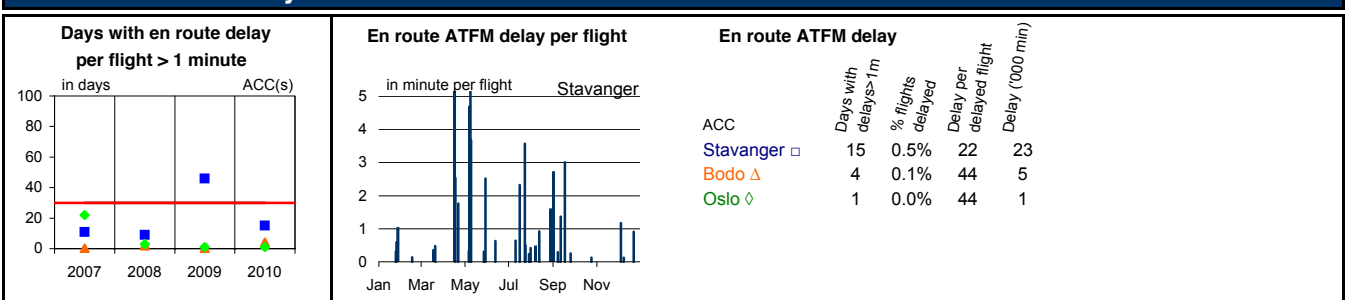
(Source: Avinor communication)

ESARR 2 severity classification.

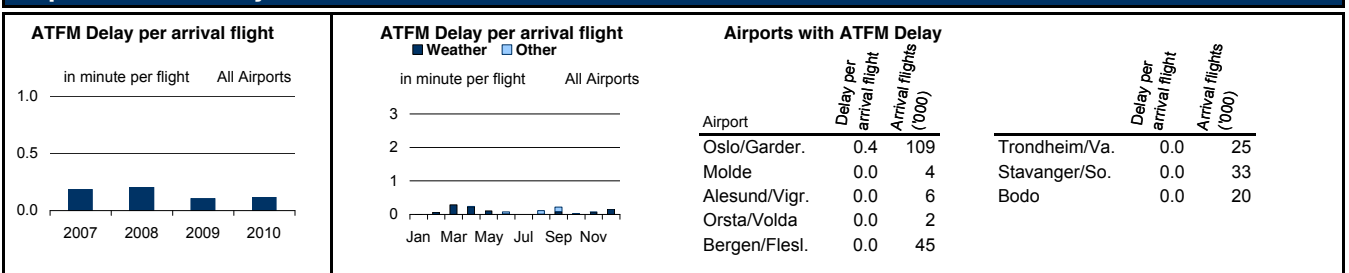
### Cost effectiveness



### En Route ATFM delay

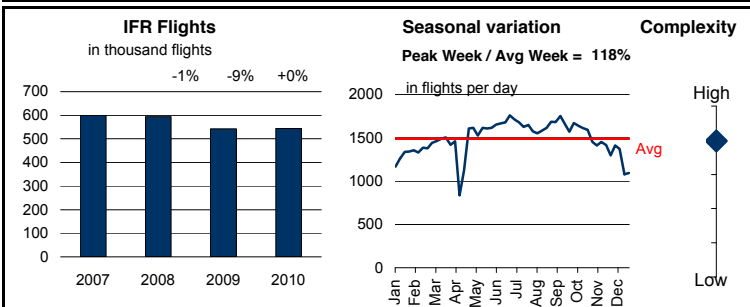


### Airport ATFM delay



## Belgocontrol, Belgium

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	594	542	543
IFR flight-hours controlled ('000)	120	111	110
IFR airport movements controlled ('000)	332	310	317
En Route ATFM delays ('000 minutes)	101	129	110
Airport ATFM delays ('000 minutes)	227	175	202
Total Staff	965	937	
ATCOs in OPS	219	216	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	149	150	146*
Capital Investment (million € <sub>2009</sub> )	27	16	19*

\* Forecast

### Safety

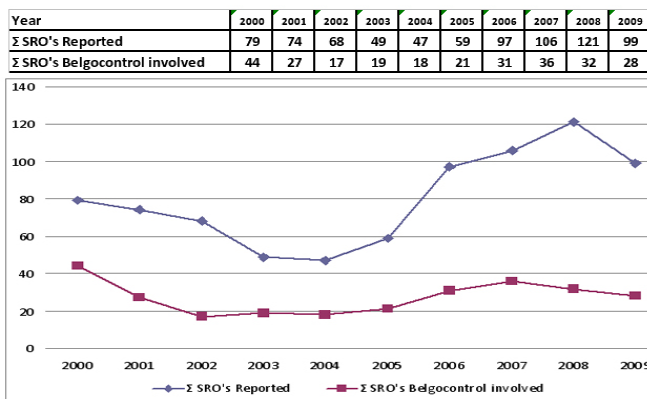
The number of occurrences for which Belgocontrol bears responsibility decreased in comparison to 2008 (28 compared to 32).

There was a slight increase in type A & B incidents compared to 2008 (5 A & 11 B in 2009 compared to 6 A & 9 B in 2008).

Belgocontrol is still fulfilling the safety requirement under its management contract in 2009 by remaining below (0.001482%) the threshold of 0.0015% of occurrences in relation to the number of movements controlled.

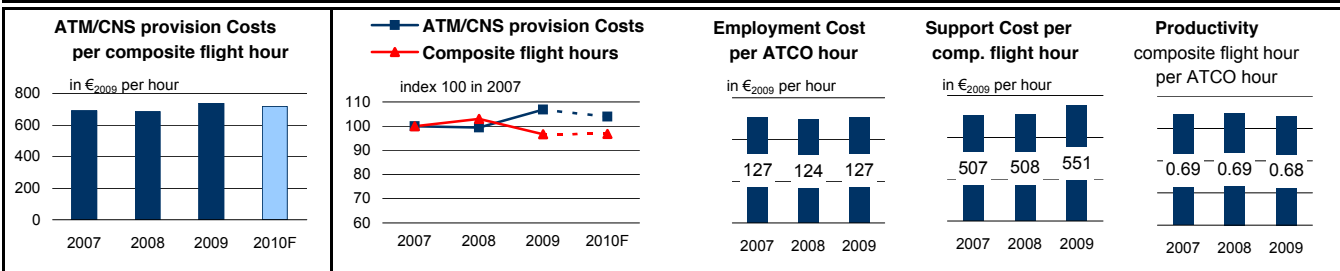
(Source: Belgocontrol communication)

ESARR 2 severity classification.



(Source: Belgocontrol communication)

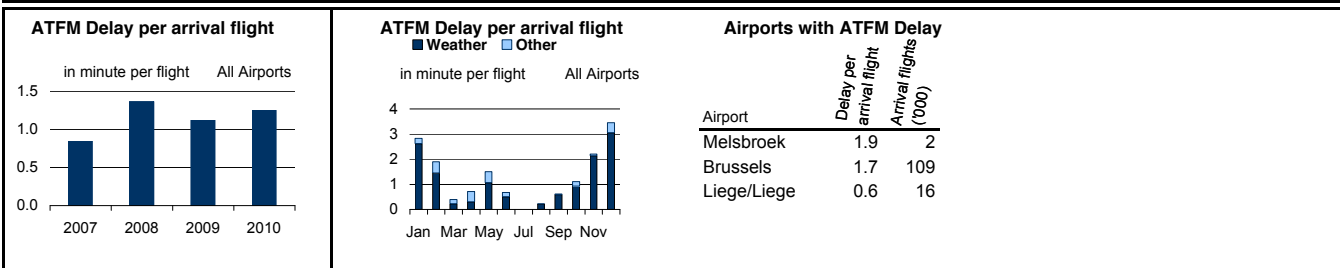
### Cost effectiveness



### En Route ATFM delay

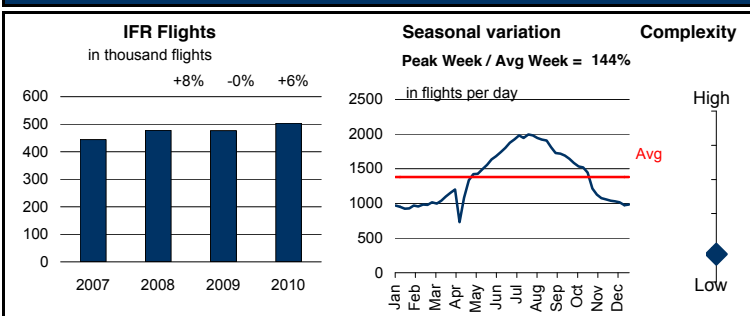


### Airport ATFM delay



## BULATSA, Bulgaria

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	478	477	504
IFR flight-hours controlled ('000)	161	161	169
IFR airport movements controlled ('000)	83	74	76
En Route ATFM delays ('000 minutes)	1	0	0
Airport ATFM delays ('000 minutes)	1	0	0
Total Staff	1243	1209	
ATCOs in OPS	223	216	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	78	77	78*
Capital Investment (million € <sub>2009</sub> )	14	3	2*

\* Forecast

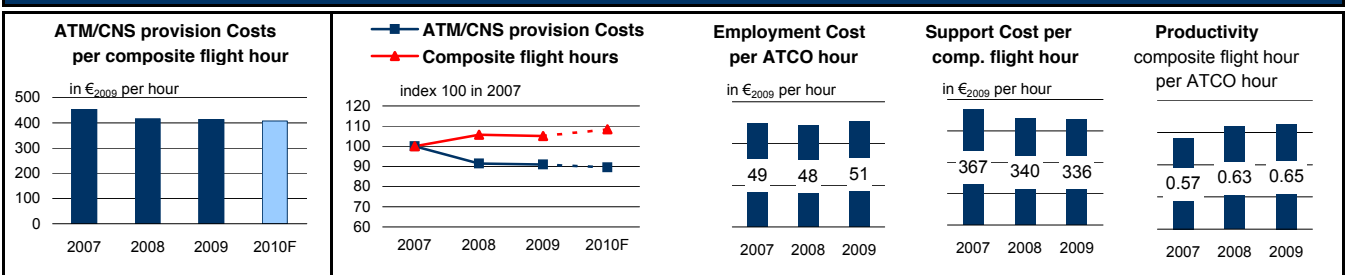
### Safety

Two hundred and fifty one (251) ATM-related occurrences were reported in 2009. When assessing safety levels only occurrences with BULATSA direct contribution are taken into account. On the basis of the investigation carried out, one of the occurrences was classified as a serious incident with severity class (A), one was classified as a major incident with severity class (B), and eleven were classified as incidents with severity class (C) - significant incident or 13 total. In comparison, 252 incidents were reported in 2008, from which 15 were with BULATSA direct contribution: two with severity class (A) - serious incidents, three with severity class (B) major incidents, and ten with severity class (C) - significant incidents.

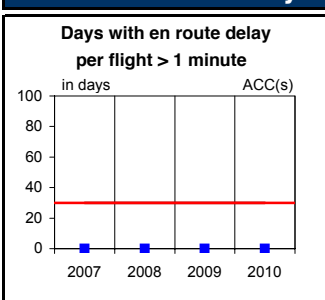
(Source: BULATSA 2009 Annual report)

National severity classification.

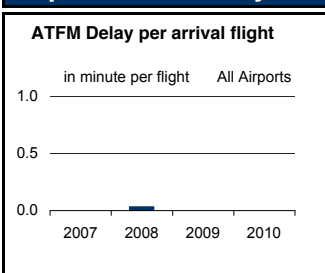
### Cost effectiveness



### En Route ATFM delay

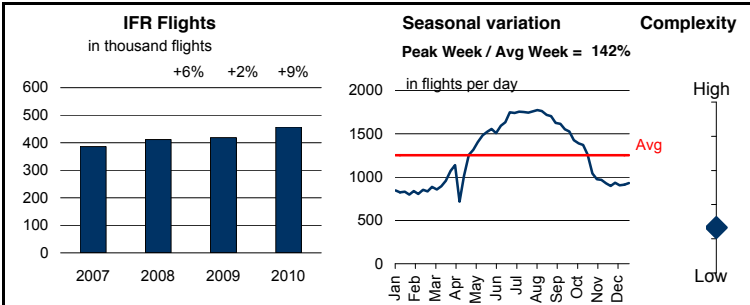


### Airport ATFM delay



## Croatia Control, Croatia

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	411	419	457
IFR flight-hours controlled ('000)	162	169	181
IFR airport movements controlled ('000)	86	86	84
En Route ATFM delays ('000 minutes)	808	280	471
Airport ATFM delays ('000 minutes)	1	0	0
Total Staff	758	740	
ATCOs in OPS	207	220	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	62	64	66*
Capital Investment (million € <sub>2009</sub> )	4	2	3*

\* Forecast

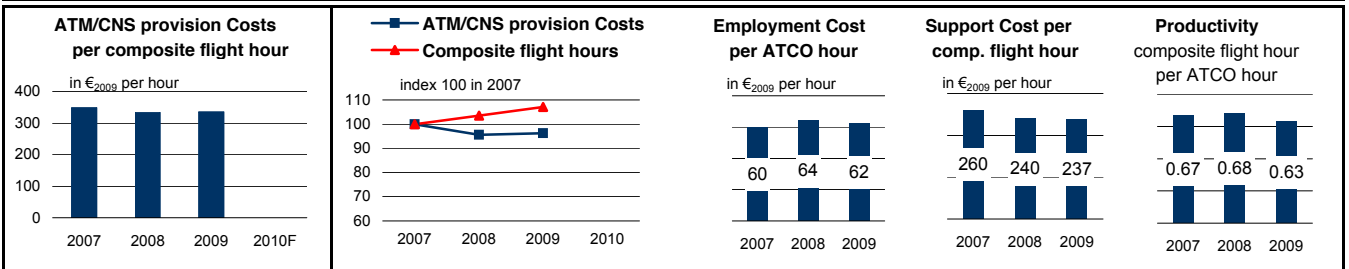
### Safety

In investigating the occurrences, Croatia Control used the ESARR 2 classification for years because it is part of national regulation (recommended matrix from EAM2GUI1), which means 2 types of occurrences are dealt with (relating safe a/c operations, relating the ability to provide safety ATM services).

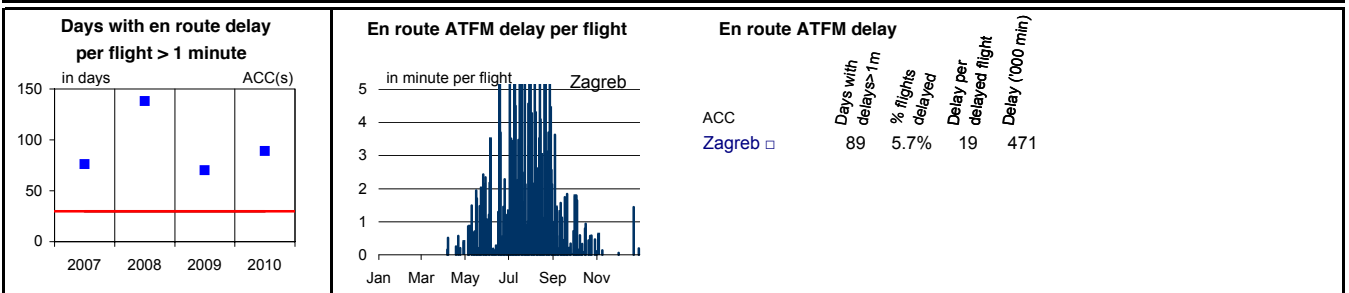
(Source: Croatia Control communication)

ESARR 2 severity classification.

### Cost effectiveness



### En Route ATFM delay

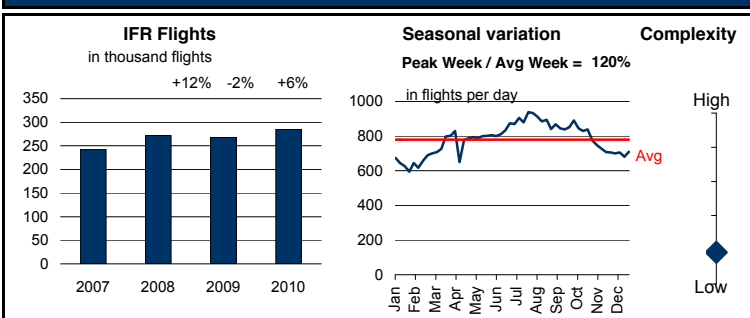


### Airport ATFM delay



## DCAC Cyprus, Cyprus

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	272	268	285
IFR flight-hours controlled ('000)	124	122	131
IFR airport movements controlled ('000)	64	62	64
En Route ATFM delays ('000 minutes)	720	621	1008
Airport ATFM delays ('000 minutes)	19	10	0
Total Staff	203	192	
ATCOs in OPS	68	68	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	39	41	43*
Capital Investment (million € <sub>2009</sub> )	5	3	3*

\* Forecast

### Safety

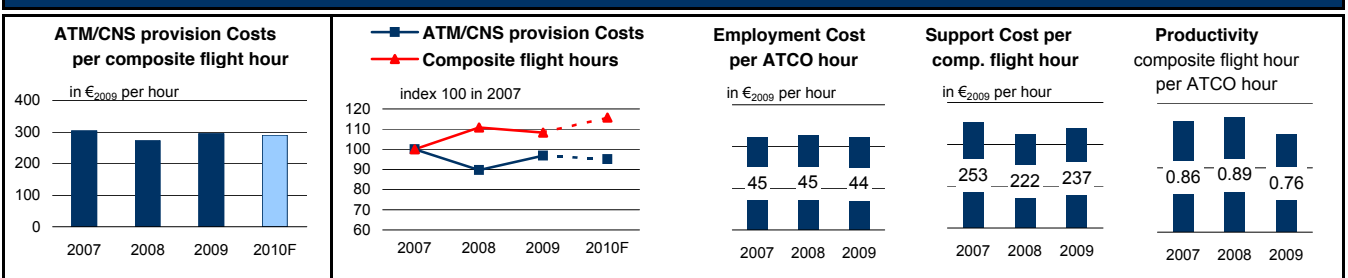
The Cyprus Air Traffic Services operate a primary mandatory occurrence reporting scheme compliant to the SES requirements.  
(Source:DCAC Communication)

OCCURRENCE CLASSIFICATION FOR THE MANDATORY REPORTING SCHEME	2010
<b>Safety Occurrences in ATS</b>	
Accidents	0
Serious Incident (A)	0
Major Incident (B)	7
Significant Incident (C)	86
No safety effect (E)	9
<b>ATM Specific Occurrences</b>	
Total inability to provide safe ATM service (AA)	0
Serious inability to provide safe ATM service (A)	1
Partial inability to provide safe ATM service (B)	1
Ability to provide safe but degraded ATM service (C)	60
No effect on ATM service (E)	3

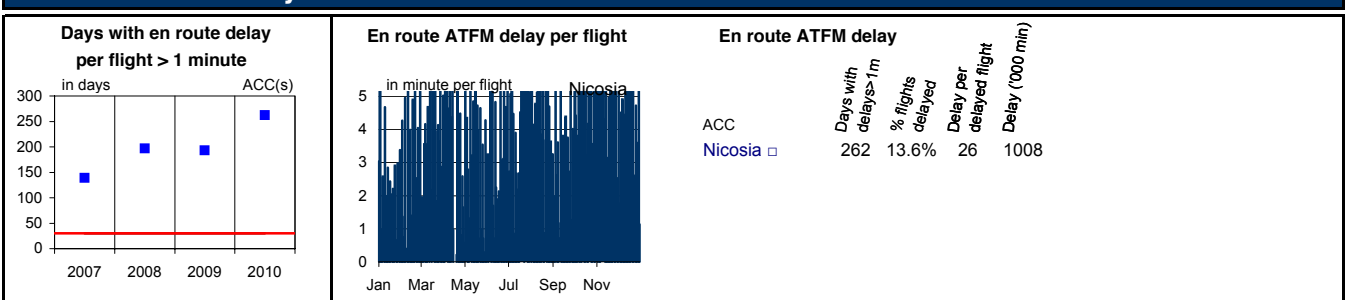
ESARR 2 severity classification.

(Source:DCAC Communication)

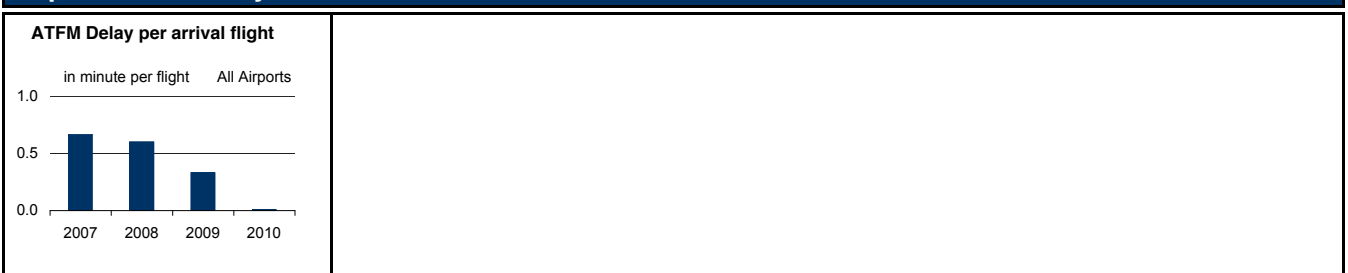
### Cost effectiveness



### En Route ATFM delay

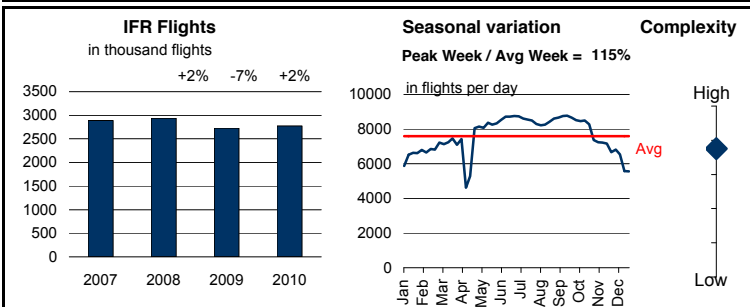


### Airport ATFM delay



## DFS, Germany

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	2935	2728	2773
IFR flight-hours controlled ('000)	1443	1333	1363
IFR airport movements controlled ('000)	2155	1996	1999
En Route ATFM delays ('000 minutes)	2132	1973	3713
Airport ATFM delays ('000 minutes)	1605	1246	1985
Total Staff	4789	5047	
ATCOs in OPS	1716	1714	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	825	888	905*
Capital Investment (million € <sub>2009</sub> )	65	115	97*

\* Forecast

### Safety

"There is still a high safety level in German airspace. Even though the number of aircraft movements has significantly increased over the past few decades, the number of aircraft proximities since 2003 has remained at a single-digit level. DFS maintained this high level of safety in 2009. The independent committee of experts known as APEG classified four aircraft proximities as category A (risk of collision) and three as category B (safety not assured). DFS was not responsible for any of these cases.

It is worth remembering that the traffic level today is four times as high as that of the mid-1970s. In 1975, for example, the German air navigation services controlled 744,000 flights. In the same year, there were 210 aircraft proximities.

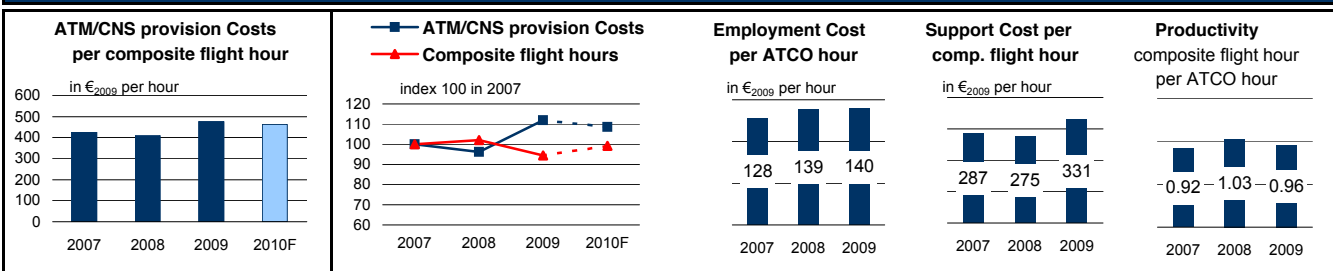
(DFS Website - 09/11/2010)

ESARR 2 severity classification.

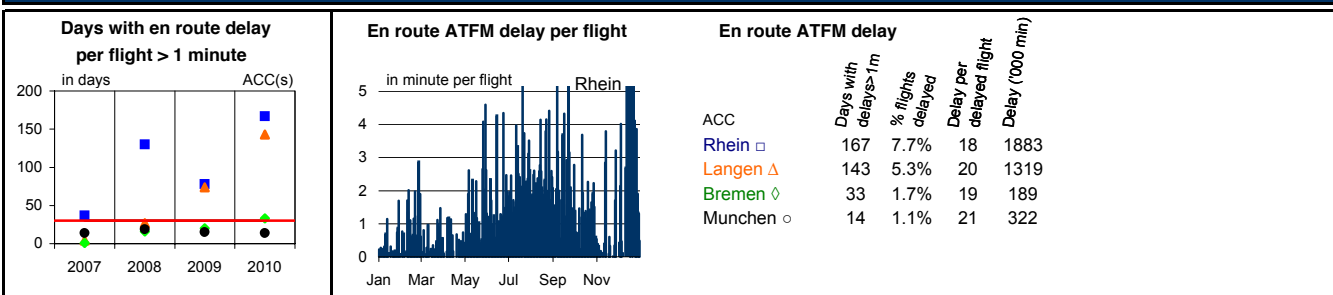
Year	Total number of controlled flights	AIRPROX category A	AIRPROX category B	AIRPROX category A+B
2009	2,927,000	4	3	7
2008	3,150,000	1	3	4
2007	3,115,000	3	3	6
2006	2,983,000	0	2	2
2005	2,866,000	2	1	3
2004	2,719,000	3	3	6
2003	2,548,000	4	4	8
2002	2,488,000	5	8	13
2001	2,561,000	10	5	15
2000	2,584,000	7	5	12
1995	2,034,000	13	10	23
1990	1,553,000	12	28	40
1985	1,012,000	17	31	48
1980	940,000	23	27	50
1975	744,000	104	106	210

source : DFS website 24/02/2010

### Cost effectiveness



### En Route ATFM delay



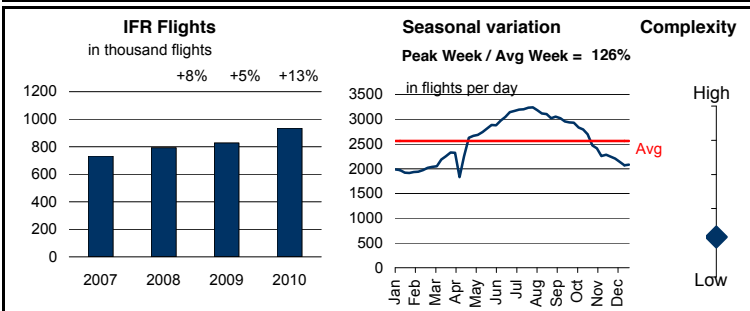
### Airport ATFM delay





## DHMI, Turkey

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	792	828	935
IFR flight-hours controlled ('000)	674	717	811
IFR airport movements controlled ('000)	649	684	806
En Route ATFM delays ('000 minutes)	135	49	74
Airport ATFM delays ('000 minutes)	674	986	891
Total Staff	4876	4997	
ATCOs in OPS	701	771	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	222	243	271*
Capital Investment (million € <sub>2009</sub> )	76	141	59*

\* Forecast

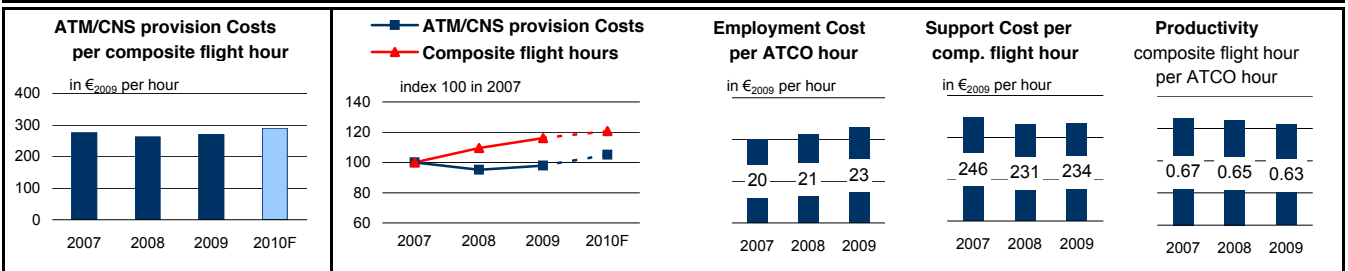
### Safety

" While 113 occurrences reports have been investigated and 44 of which were classified as ATM related in 2008, 130 incident reports have been investigated and 33 of which were classified as ATM related in 2009 with the increase of traffic volume by 5,4 % over the previous year. When compared to the previous year no air accident with a direct or indirect ATM system contribution and 0,28 serious incidents per 100.000 movements have been recorded in 2009 almost same in 2008 (0,3).".

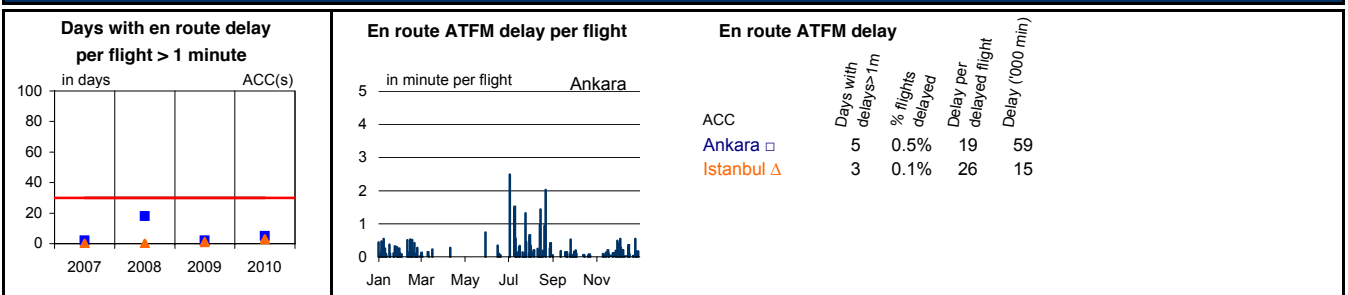
(ANSP's 2009 annual report).

ESARR 2 severity classification.

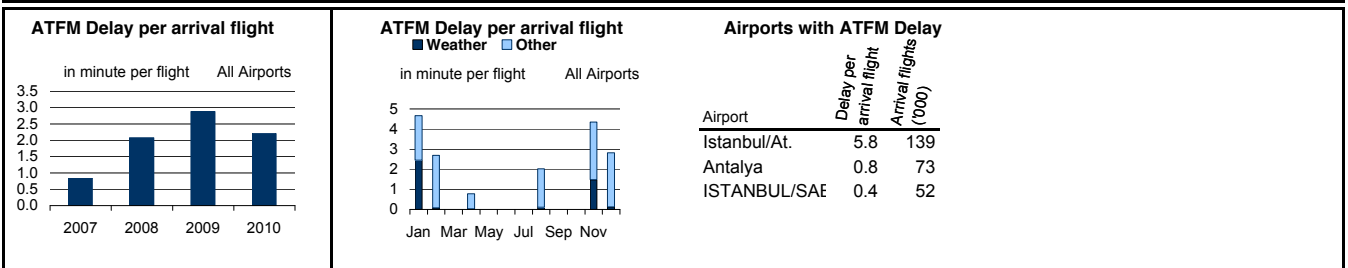
### Cost effectiveness



### En Route ATFM delay

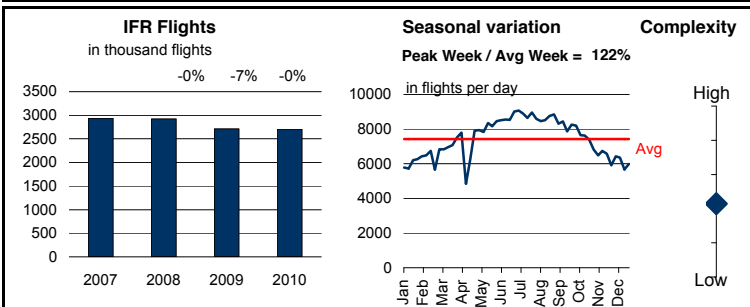


### Airport ATFM delay



## DSNA, France

### Traffic



### Key data

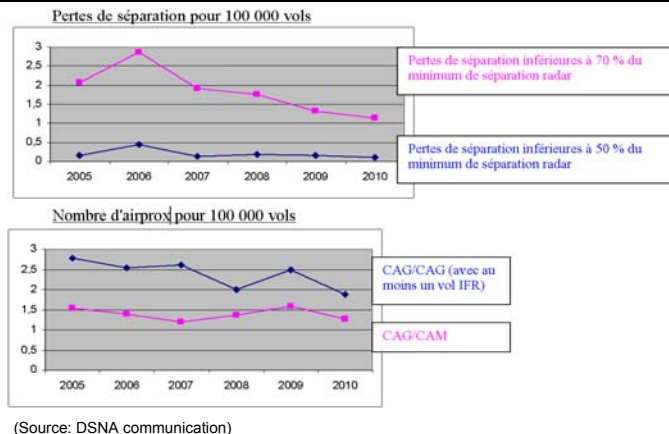
	2008	2009	2010(F)
Total IFR flights controlled ('000)	2925	2715	2710
IFR flight-hours controlled ('000)	2178	2031	2024
IFR airport movements controlled ('000)	1933	1821	1790
En Route ATFM delays ('000 minutes)	1377	496	6843
Airport ATFM delays ('000 minutes)	842	730	1063
Total Staff	8734	8034	
ATCOs in OPS	2662	2677	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	1127	1158	1165*
Capital Investment (million € <sub>2009</sub> )	145	145	159*

### Safety

En 2010, l'instance de traitement des événements sécurité (ITES) a analysé 38 événements pour 2,7 millions de vols contrôlés (comme en 2009) : 17 ont été classés « très important » et 21 « importants » répartis avec les critères de gravité suivants : 14 incidents graves (A), 18 incidents majeurs (B) et 5 incidents significatifs.

Les types d'événements examinés ont concerné essentiellement les rapprochements anormaux (13 pertes de séparation IFR/IFR en-route ou en approche : 6 « HN50 » et 7 « HN70 », 4 événements IFR/IFR en circulation d'aérodrome, 8 événements IFR/VFR et aucun événement VFR/VFR) et les incursions de piste.

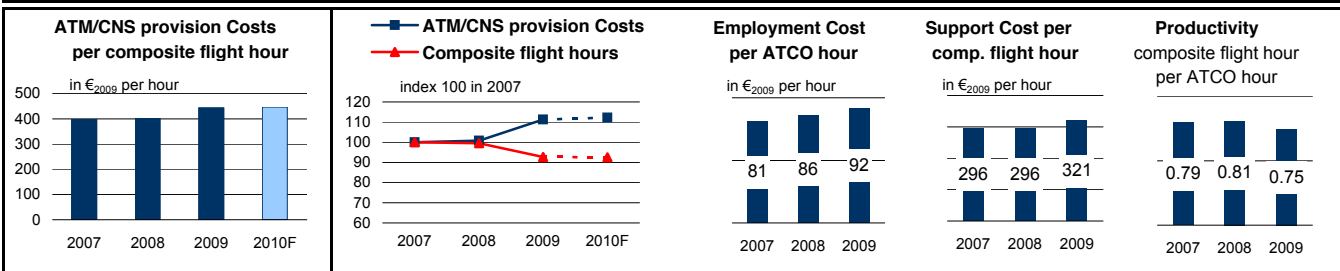
(Source: DSNA communication)



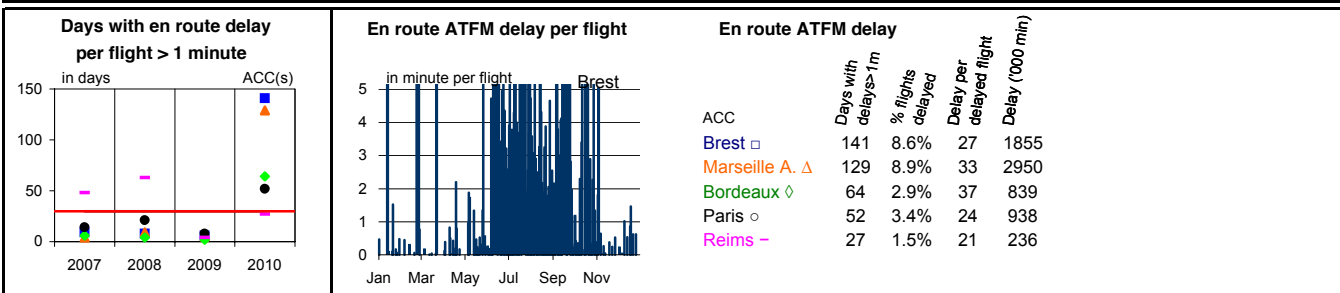
National severity classification.

(Source: DSNA communication)

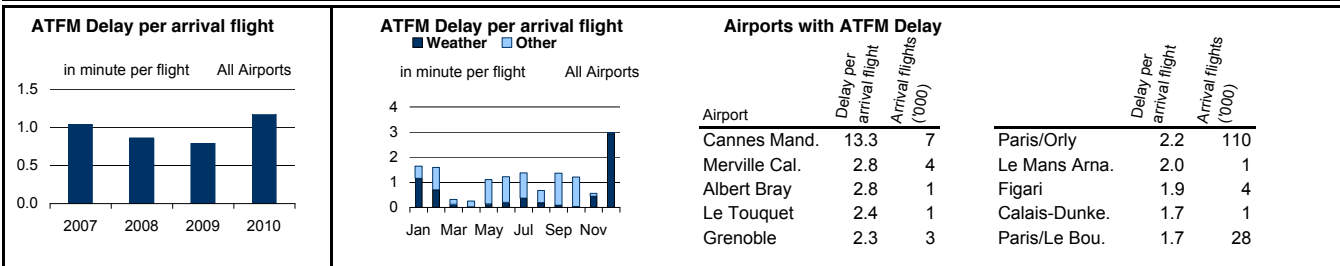
### Cost effectiveness



### En Route ATFM delay

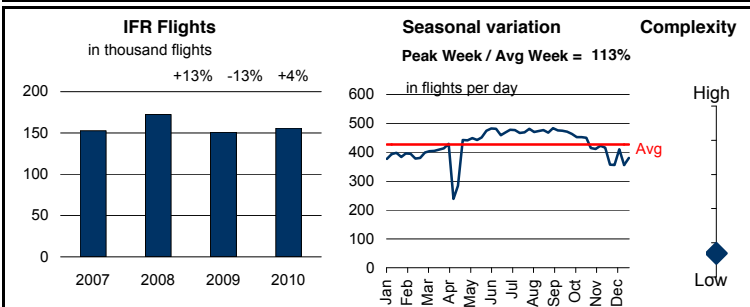


### Airport ATFM delay



## EANS, Estonia

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	173	151	156*
IFR flight-hours controlled ('000)	60	53	54*
IFR airport movements controlled ('000)	42	29	30*
En Route ATFM delays ('000 minutes)	3	0	5
Airport ATFM delays ('000 minutes)	0	0	0
Total Staff	122	128	
ATCOs in OPS	37	37	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	11	10	11*
Capital Investment (million € <sub>2009</sub> )	3	2	n/a

\* Forecast

### Safety

The structure of EANS-induced safety occurrences has changed – the safety performance indicators have improved during the year 2010; The number of recorded specific occurrences demonstrates that the acuity of the problem has drifted towards the quality of services. The absence of separation minimum infringement and decreased inadequate separation occurrences are notable achievements.  
(Source: EANS communication)

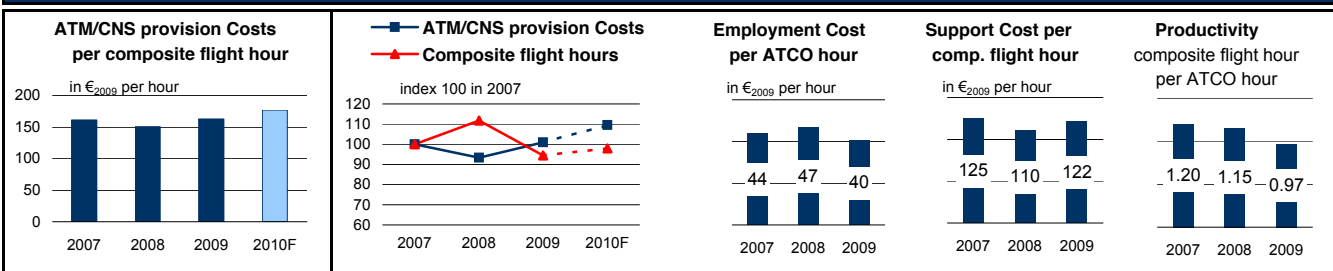
EANS -induced safety occurrences 2010

Type of occurrence	Goal for 2010	Achievement 2010
Accident (In particular the following types of accidents, of specific interest to the ATM-community)	Total	0
Near collision		
Separation minima infringement	Occurrences per 100000 operations	≤1
Inadequate separation	Occurrences per 100000 operations	≤4
Near Controlled Flight Into Terrain (Near CFIT)	Occurrences per 100000 operations	0
Runway incursion where avoiding action was necessary	Occurrences per 30000 operations	≤2
Potential for collision or near collision	Occurrences per 100000 operations	≤4
ATM-specific occurrences	Occurrences per 100000 operations	≤10

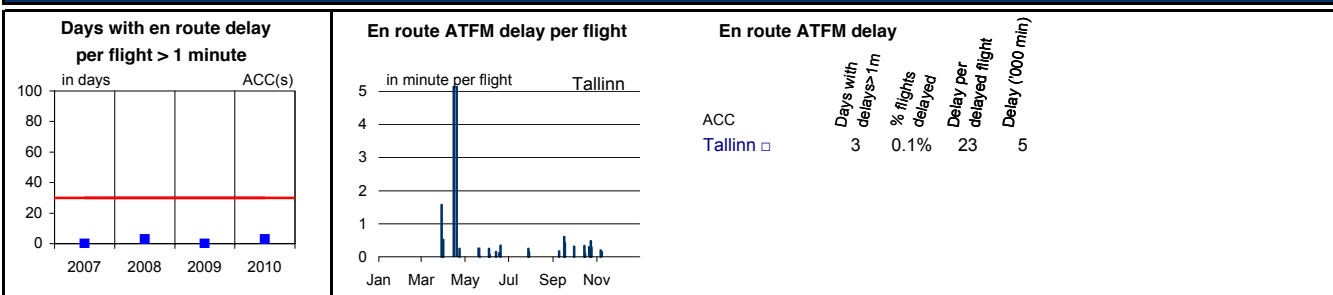
ESARR 2 severity classification.

(Source: EANS communication)

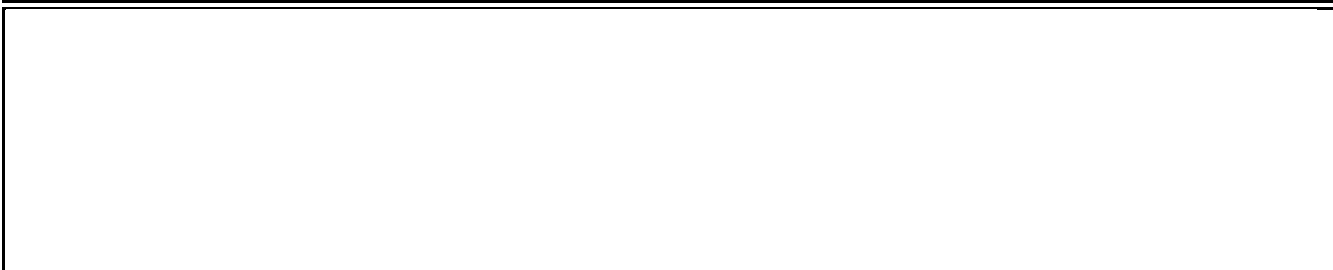
### Cost effectiveness



### En Route ATFM delay

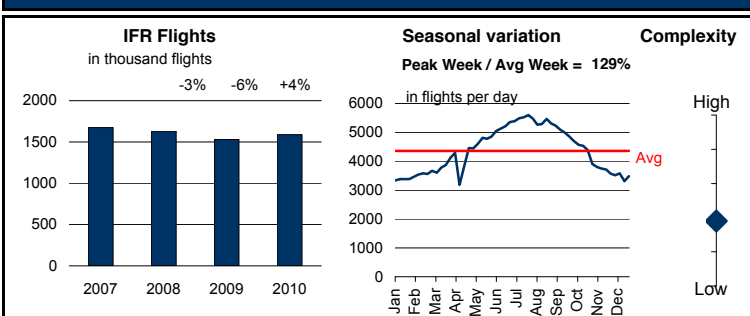


### Airport ATFM delay



# ENAV, Italy

## Traffic



## Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	1631	1533	1588
IFR flight-hours controlled ('000)	1111	1036	1085
IFR airport movements controlled ('000)	1410	1325	1341
En Route ATFM delays ('000 minutes)	75	17	10
Airport ATFM delays ('000 minutes)	818	333	212
Total Staff	2764	2795	
ATCOs in OPS	1206	1233	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	643	649	647*
Capital Investment (million € <sub>2009</sub> )	175	225	170*

\* Forecast

## Safety

In 2010 ENAV implemented revisions to its SMS Manual and Procedures, including those related to reporting and occurrence analysis. A safety audit campaign (in accordance with SES requirements) and a general safety culture survey, supported by Eurocontrol, have also been conducted.  
(Source: ENAV communication)

2009 ANS Safety Perfo Highlights	
Total flights	1,787,350
Total safety reports received:	2,731
with ATM contribution	121
a) SMI A / B / FN 50*	19
b) Roy Incursion A / B	1

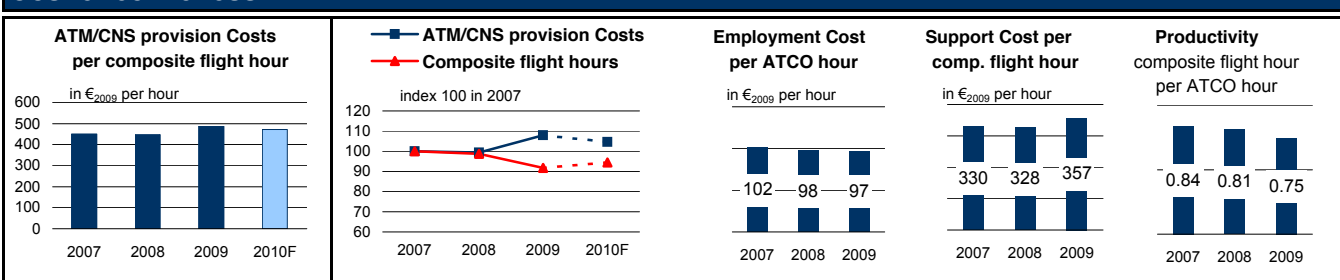
2010 ANS Safety Perfo Highlights - provisional	
Total flights	1,813,524
Total safety reports received:	3,427
with ATM contribution	113
a) SMI A / B / FN 50*	3*
b) Roy Incursion A / B	1

\* FN (Fori) Norma - deviation from the rule; separation actually occurred and expressed as a percentage of that applicable, in a combination of the applicable separation and the rate of closure. FN50= less than 50%.

ESARR 2 severity classification.

(Source: ENAV communication)

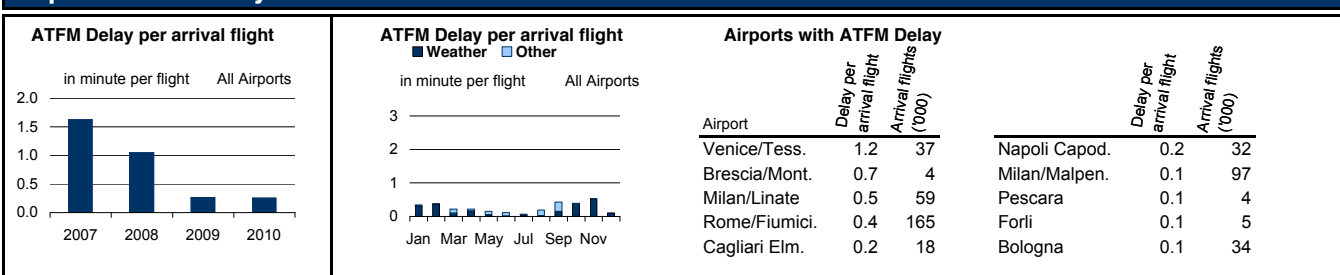
## Cost effectiveness



## En Route ATFM delay

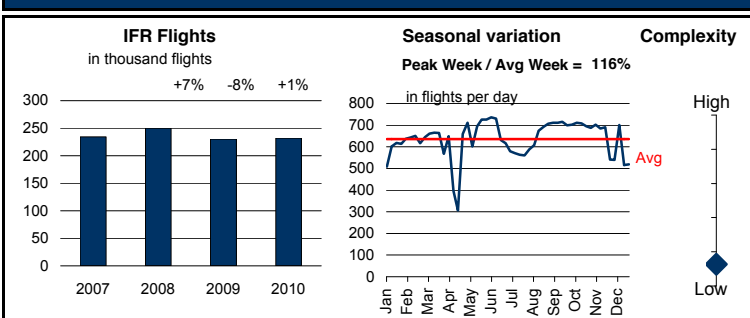


## Airport ATFM delay



## Finavia, Finland

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	250	230	232
IFR flight-hours controlled ('000)	116	108	110
IFR airport movements controlled ('000)	279	262	259
En Route ATFM delays ('000 minutes)	1	6	4
Airport ATFM delays ('000 minutes)	22	8	21
Total Staff	507	481	
ATCOs in OPS	204	194	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	56	57	51*
Capital Investment (million € <sub>2009</sub> )	5	20	1*

\* Forecast

### Safety

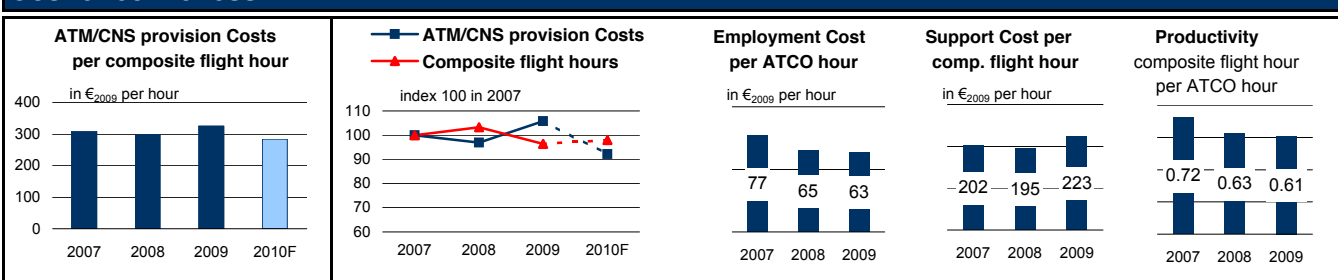
The main safety objective, set by the board for Finavia, is zero accidents or zero serious incidents caused by Finavia.

In 2010 there were no accidents resulting from Finavia's operations. However, there were eleven incidents that resulted to the loss of control of the situation (by Finavia's system or staff) and which were considered resulting of our operations. The actual severity of these incidents will be classified by the NSA.

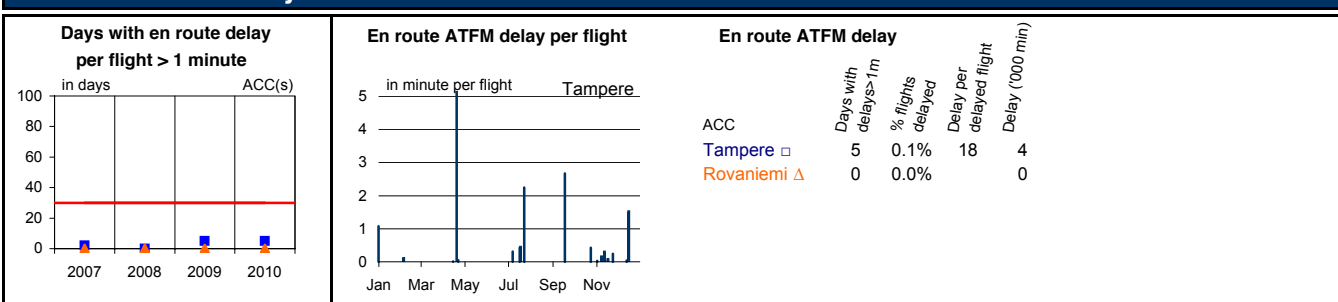
(Source: Finavia communication)

Unknown severity classification.

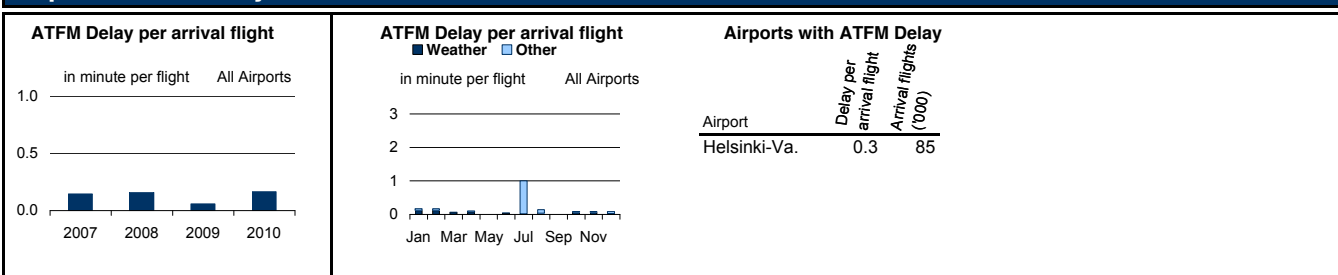
### Cost effectiveness



### En Route ATFM delay

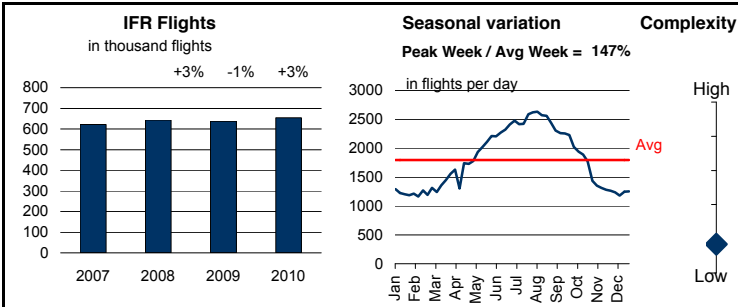


### Airport ATFM delay



## HCAA, Greece

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	643	638	655
IFR flight-hours controlled ('000)	484	472	488
IFR airport movements controlled ('000)	443	460	428
En Route ATFM delays ('000 minutes)	945	714	652
Airport ATFM delays ('000 minutes)	446	643	337
Total Staff	1870	1870	
ATCOs in OPS	530	530	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	187	178	160*
Capital Investment (million € <sub>2009</sub> )	15	15	n/a

\* Forecast

### Safety

The Hellenic ATS Division within Hellenic CAA uses ESARR-2 guidelines for ATM incidents taxonomy and their severity classification.

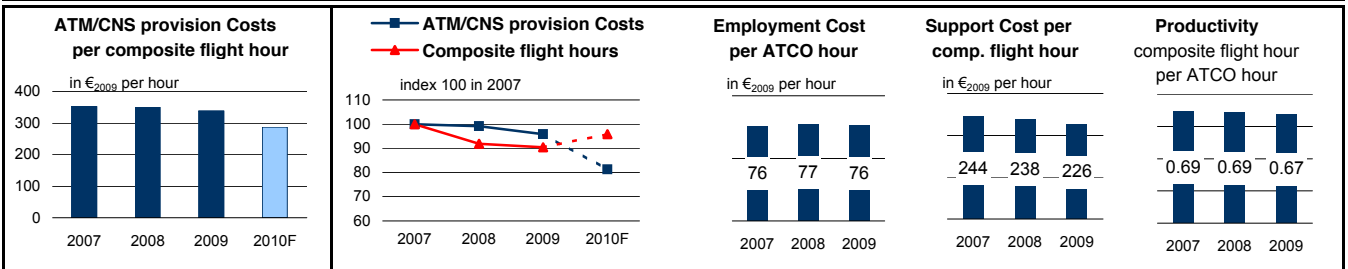
Safety ATM incidents in 2009:

Separation Minima Infringements	11
Runway Incursions	0

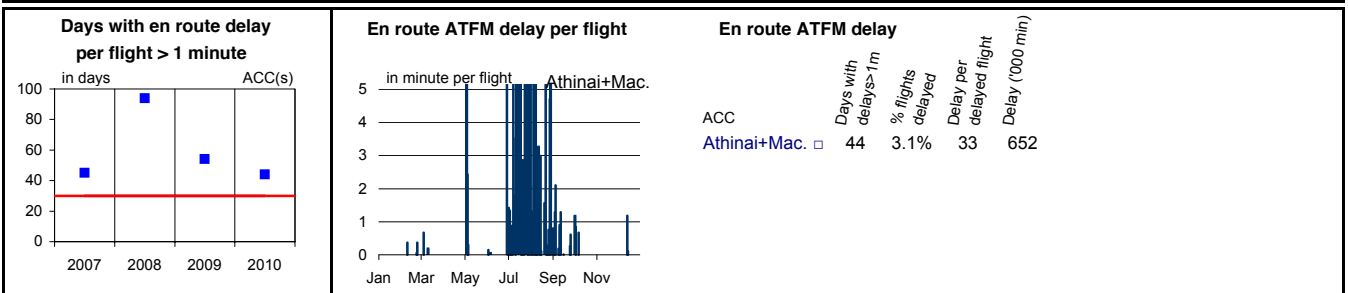
(Source: HCAA communication)

ESARR 2 severity classification.

### Cost effectiveness



### En Route ATFM delay



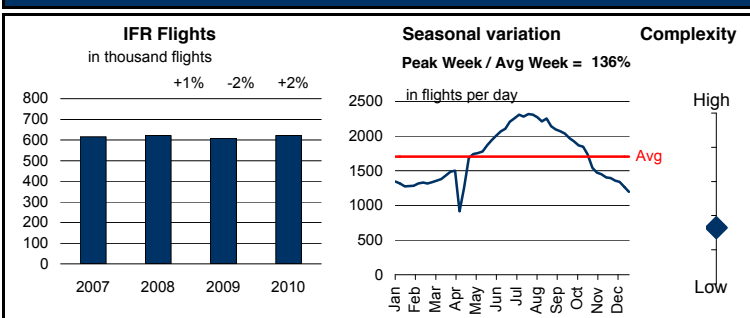
### Airport ATFM delay





## HungaroControl, Hungary

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	622	607	622
IFR flight-hours controlled ('000)	202	195	196
IFR airport movements controlled ('000)	119	110	107
En Route ATFM delays ('000 minutes)	0	15	0
Airport ATFM delays ('000 minutes)	10	24	2
Total Staff	691	701	
ATCOs in OPS	185	172	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	69	74	84*
Capital Investment (million € <sub>2009</sub> )	13	6	19*

\* Forecast

### Safety

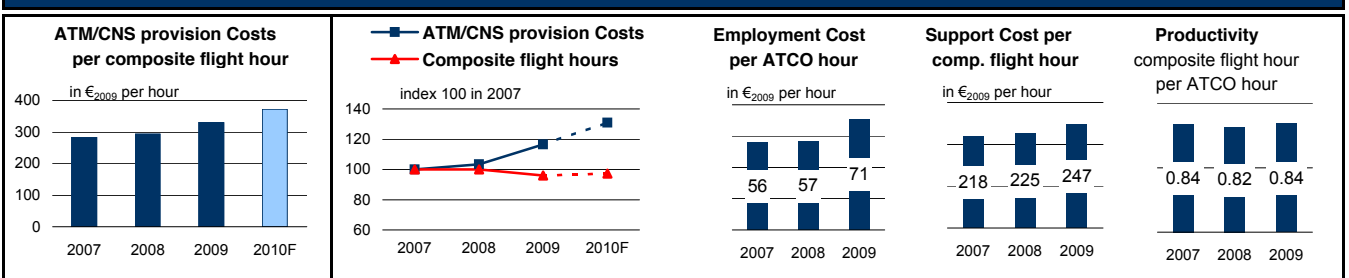
The accomplishments of safety management system in 2009 show the following numbers:

- In 2009 flights provided by air traffic services including flight information services amounted to 646 069, those provided only by air traffic control was 604 008;
- significant incidents relating to the activity of HungaroControl Pte. Ltd. Co. in terms of safety amounted to 26;
- the operation or failure of technical devices caused no problems in the safe execution of services;

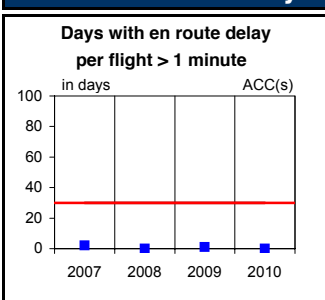
(Source: HungaroControl communication)

ESARR 2 severity classification.

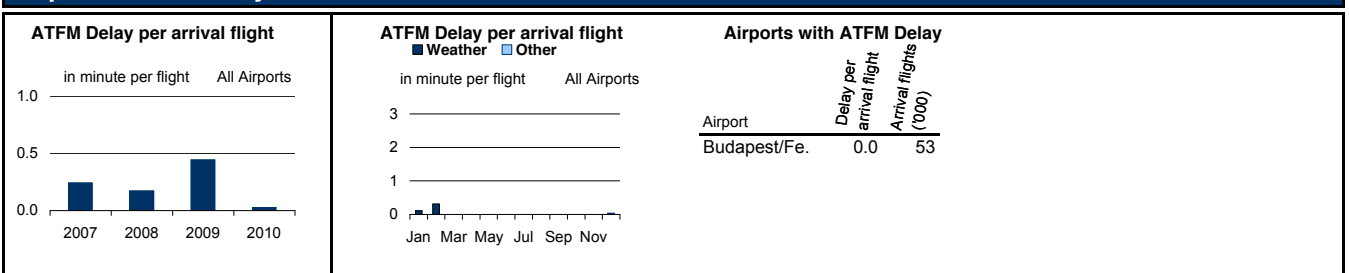
### Cost effectiveness



### En Route ATFM delay

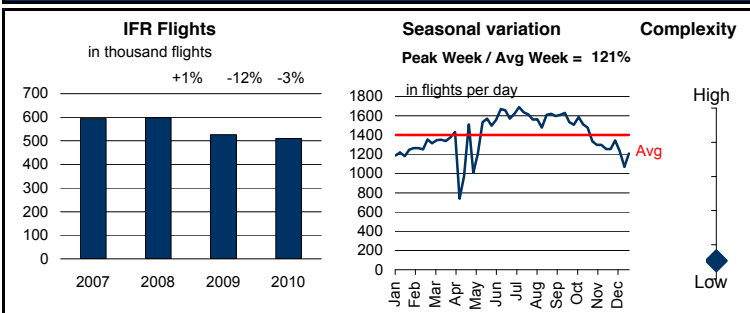


### Airport ATFM delay



## IAA, Ireland

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	598	526	510
IFR flight-hours controlled ('000)	285	256	253
IFR airport movements controlled ('000)	279	234	208
En Route ATFM delays ('000 minutes)	100	0	2
Airport ATFM delays ('000 minutes)	254	22	32
Total Staff	483	488	
ATCOs in OPS	228	231	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	111	107	116*
Capital Investment (million € <sub>2009</sub> )	20	27	23*

\* Forecast

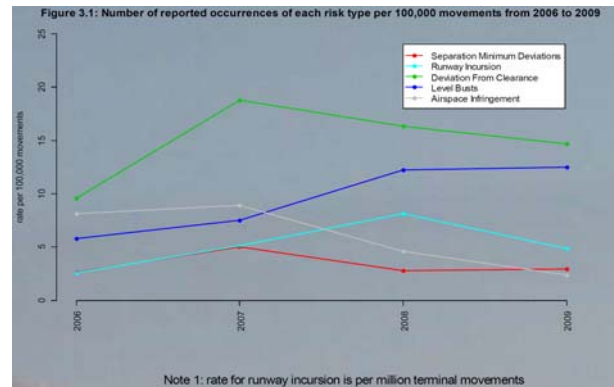
### Safety

Ireland's safety performance in the area of Aerodromes and air traffic management faces the same challenges as all aerodromes and airspace worldwide. There were a small number of runway incursions and excursions reported and this remains a priority challenge for all aerodromes worldwide.

The five key safety risks in European airspace and at aerodromes are separation minimum deviations, runway incursions, deviation from ATC clearance, level busts and airspace infringement. Progress in these key risk areas continues, with a large amount of research and development at a pan-European level.

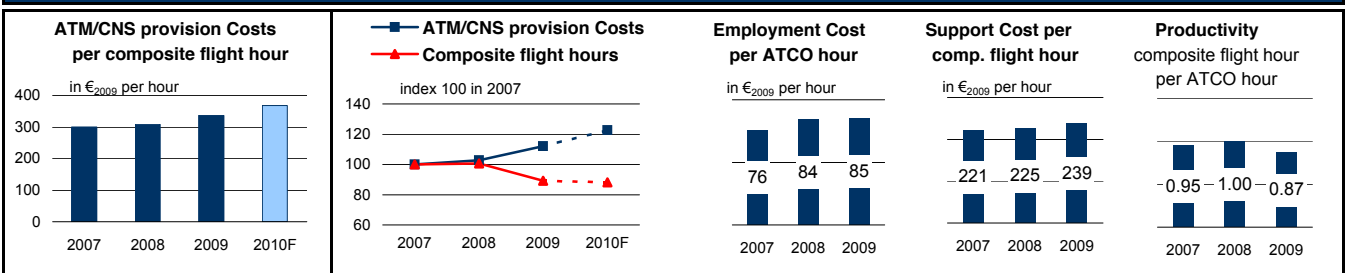
(Source: Annual Aviation Safety Performance Review 2009)

ESARR 2 severity classification.

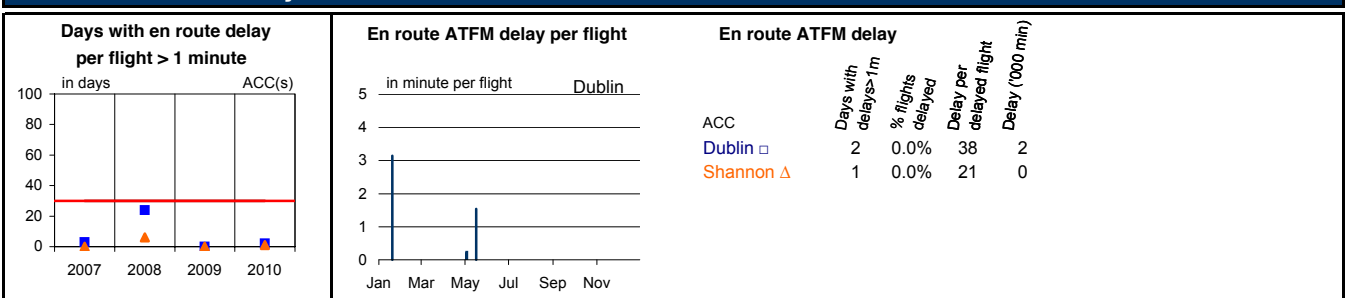


source: Annual Aviation Safety Performance Review 2009, IAA

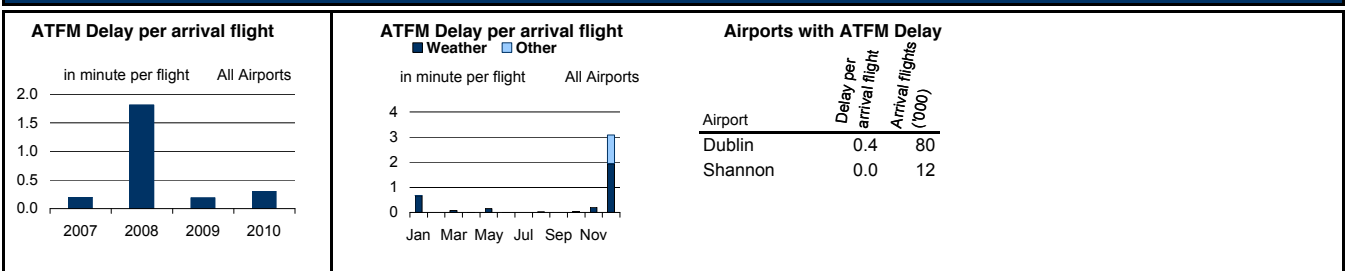
### Cost effectiveness



### En Route ATFM delay

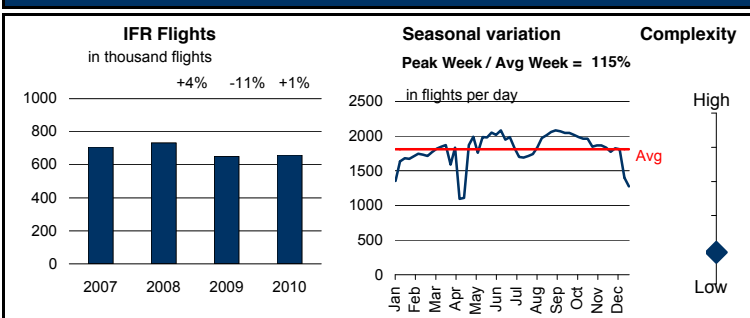


### Airport ATFM delay



## LFV, Sweden

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	732	651	660
IFR flight-hours controlled ('000)	444	400	402
IFR airport movements controlled ('000)	538	483	488
En Route ATFM delays ('000 minutes)	78	20	103
Airport ATFM delays ('000 minutes)	48	19	28
Total Staff	1021	1046	
ATCOs in OPS	514	500	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	151	166	206*
Capital Investment (million € <sub>2009</sub> )	19	33	19*

\* Forecast

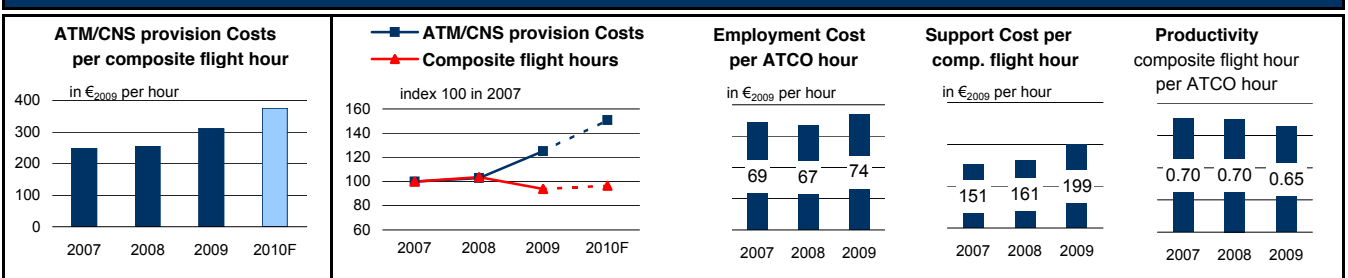
### Safety

During 2010 LFV may be considered as involved in one accident where a GA aircraft crashed after takeoff in adverse weather. The accident is however still subject to investigation by the Swedish AIB. LFV was also part of one serious incident involving traffic participating in an air show over parts of Stockholm.

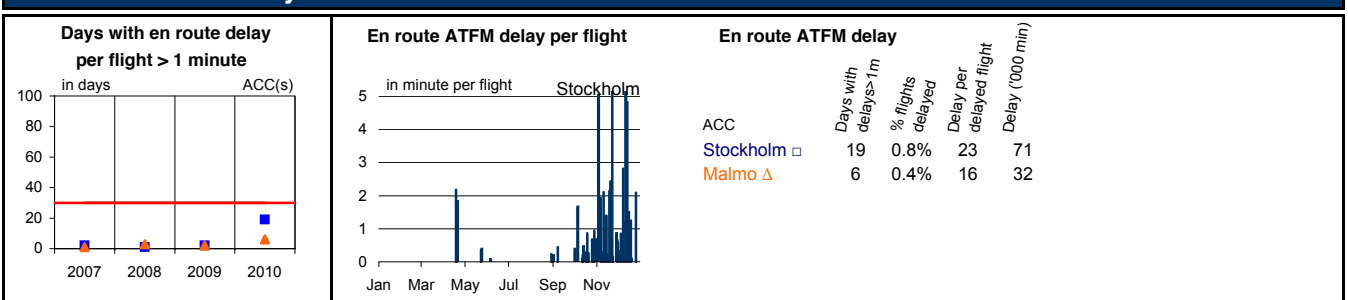
(Source: LFV communication)

ESARR 2 severity classification.

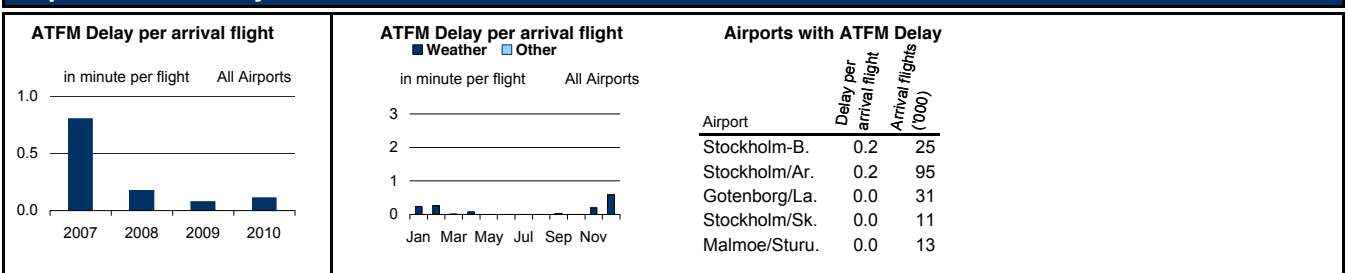
### Cost effectiveness



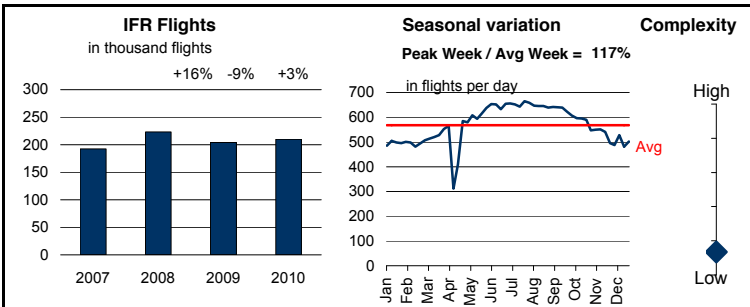
### En Route ATFM delay



### Airport ATFM delay



## Traffic



## Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	223	204	210*
IFR flight-hours controlled ('000)	69	61	61.5*
IFR airport movements controlled ('000)	58	60	63*
En Route ATFM delays ('000 minutes)	0	0	0
Airport ATFM delays ('000 minutes)	0	0	0
Total Staff	309	334	
ATCOs in OPS	64	73	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	21	20	22*
Capital Investment (million € <sub>2009</sub> )	13	2	4*

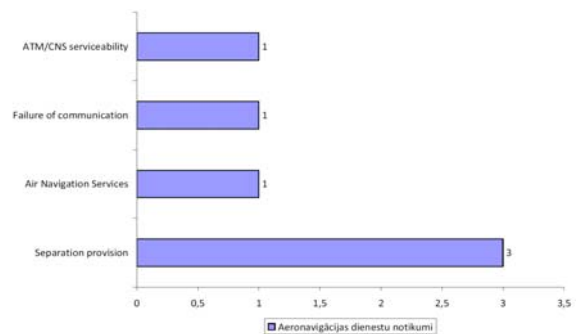
\* Forecast

## Safety

"The Civil Aviation Agency's database shows that for Latvian air navigation services the most common problems have occurred in connection with the provision of separation between aircraft (separation provision). Among these events, there were two serious incidents which took place in Riga FIR."

(Translated from the 2009 Flight Safety Review)

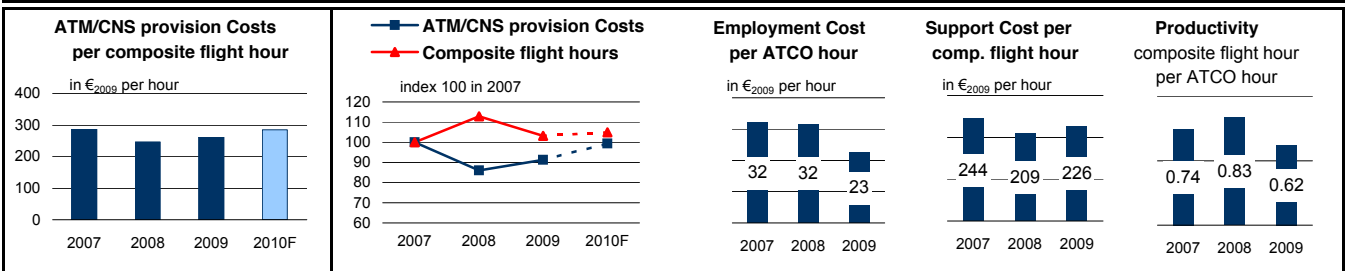
## 9. Attēls: Notikumi – aeronavigācijas dienesti



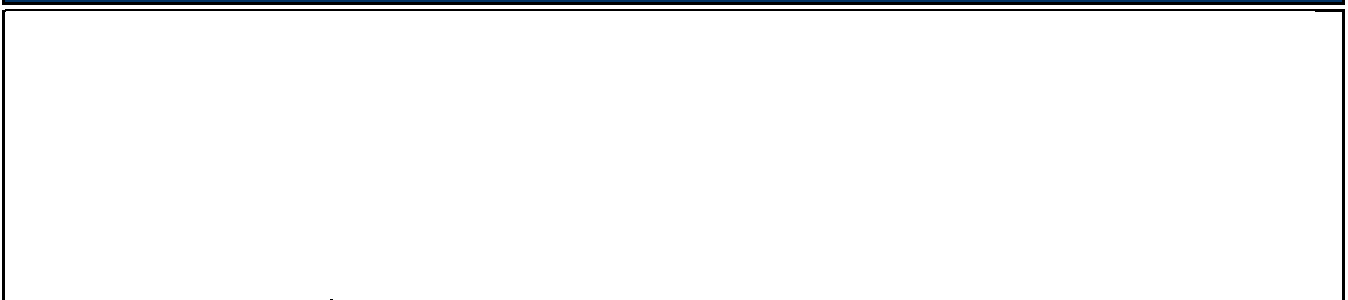
ESARR 2 severity classification.

source: 2009 gada Lidojumu drošības pārskats (Flight Safety Review)

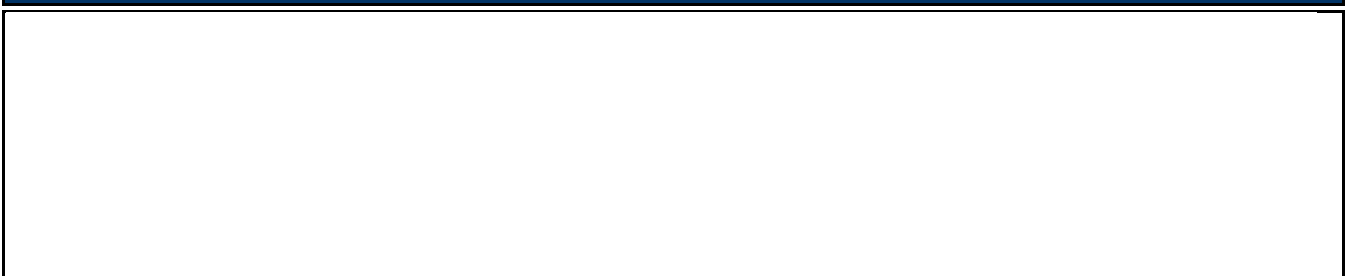
## Cost effectiveness



## En Route ATFM delay

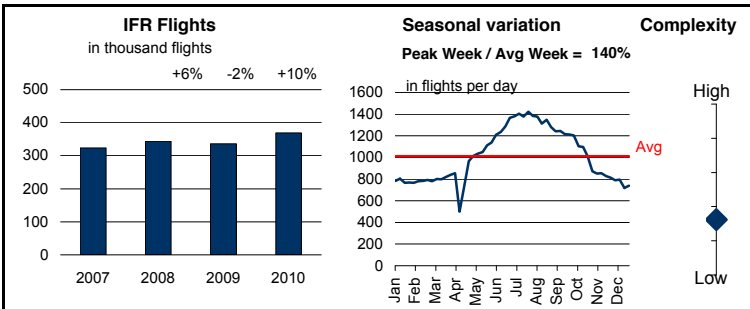


## Airport ATFM delay



## LPS, Slovak Republic

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	344	336	369
IFR flight-hours controlled ('000)	79	76	82
IFR airport movements controlled ('000)	46	39	36
En Route ATFM delays ('000 minutes)	54	19	36
Airport ATFM delays ('000 minutes)	0	0	0
Total Staff	469	471	
ATCOs in OPS	111	101	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	45	46	52*
Capital Investment (million € <sub>2009</sub> )	5	6	7*

\* Forecast

### Safety

During 2009 there have been 322 occurrence reports received and registered by our SMS, which in comparison to 226 reports in 2008 reflects significant improvement in occurrence reporting by 42.5%.

No Serious Incident (severity A) with direct contribution of the LPS SR occurred and no forced service provision cut off was necessary in 2009.

Key Risk Areas in ATM such as Separation Minima Infringement, Unauthorised Penetration of Airspace, Runway Incursion and Level Bust are subject to regular evaluation, assessment and lesson dissemination.

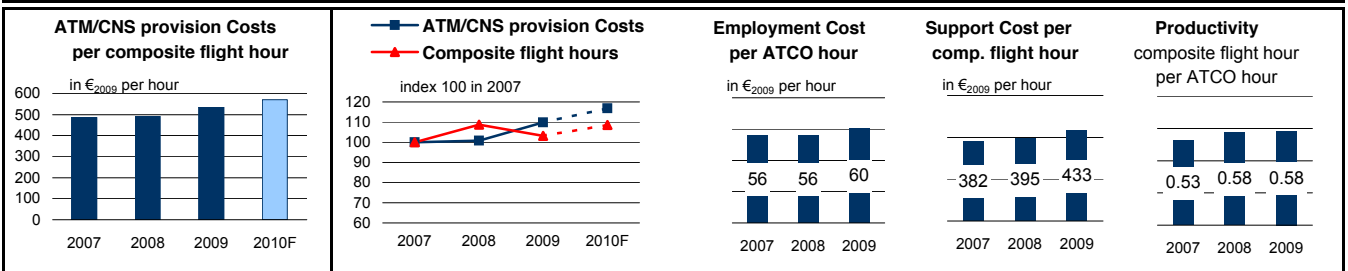
(Source: LPS communication)

Type of Report	2008	2009
Mandatory Report	217	292
Voluntary Report	4	17
Other	5	9
Report based on ASMT	0	4
<b>Total</b>	<b>226</b>	<b>322</b>

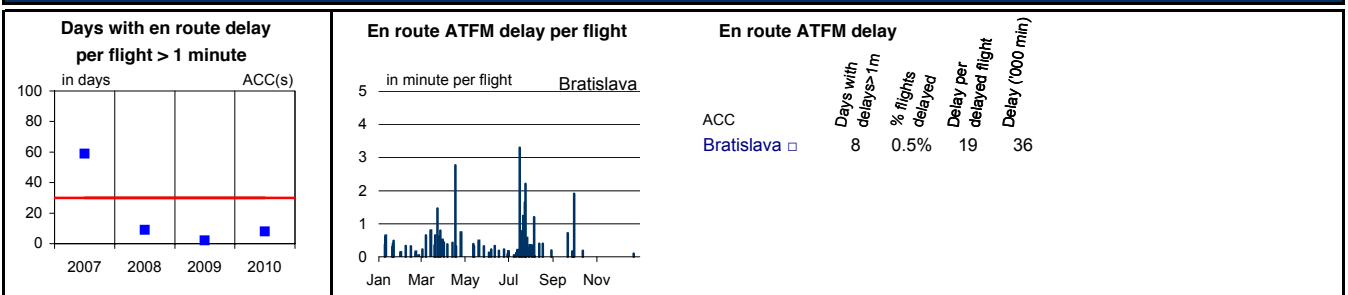
ESSAR 2 severity classification.

(Source: LPS communication)

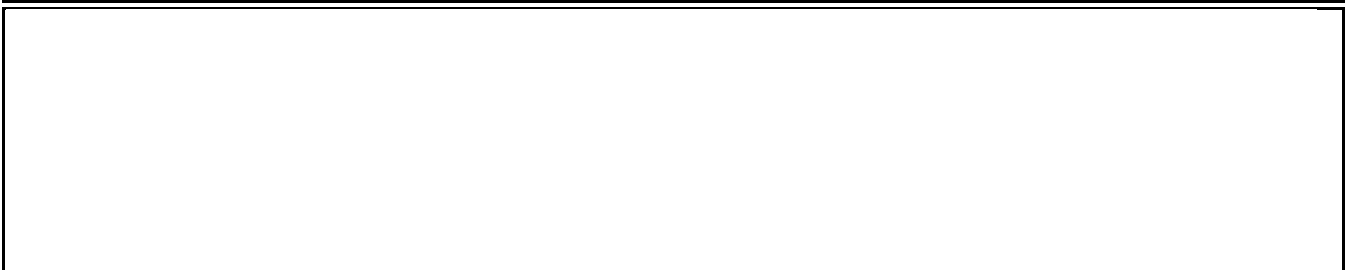
### Cost effectiveness



### En Route ATFM delay

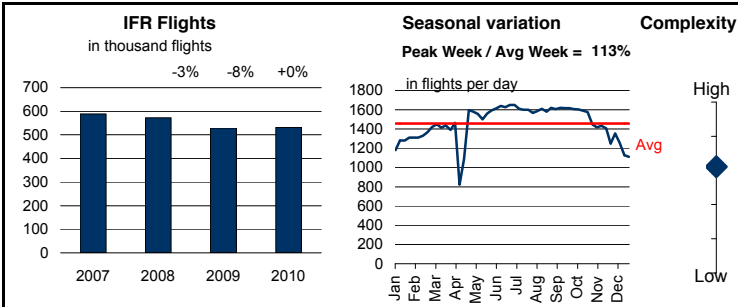


### Airport ATFM delay



## LVNL, Netherlands

### Traffic



### Key data

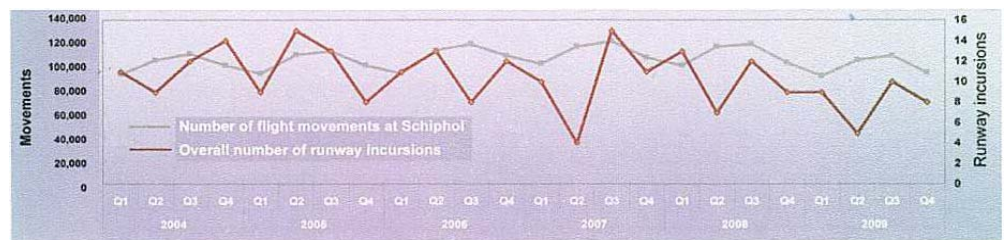
	2008	2009	2010(F)
Total IFR flights controlled ('000)	573	530	532
IFR flight-hours controlled ('000)	152	142	144
IFR airport movements controlled ('000)	496	454	453
En Route ATFM delays ('000 minutes)	26	21	96
Airport ATFM delays ('000 minutes)	545	126	359
Total Staff	1030	927	
ATCOs in OPS	194	177	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	164	180	164*
Capital Investment (million € <sub>2009</sub> )	14	8	19*

\* Forecast

### Safety

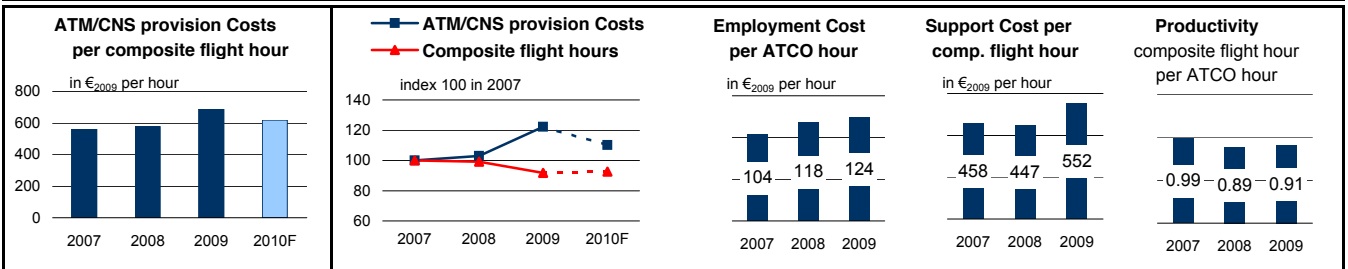
"In 2009, LVNL registered 3,127 reported incidents with relevance for safety, compared to 3,900 in 2008. This decrease was caused by the reduction in the number of flight movements. At Schiphol, one 'runway incursion' took place that was classified as 'serious'."

(ANSP's 2009 annual report).

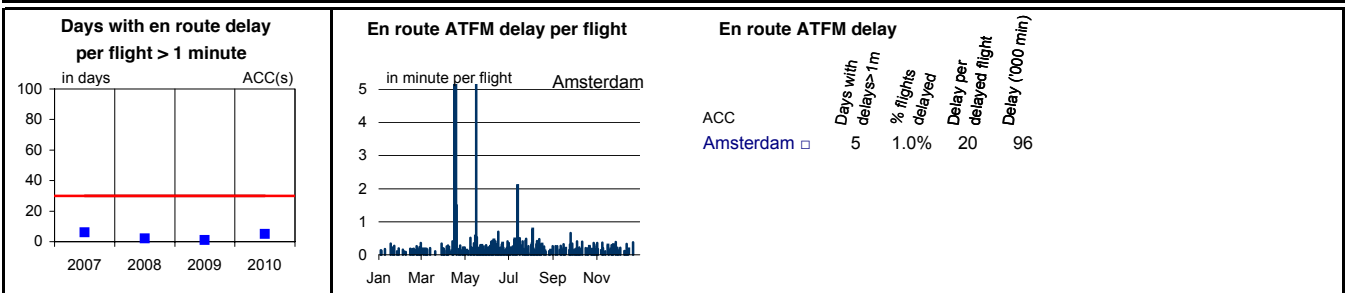


source: ANSP's 2009 annual report

### Cost effectiveness



### En Route ATFM delay

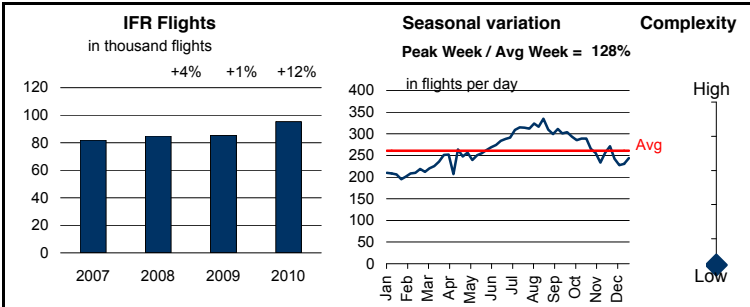


### Airport ATFM delay



## MATS, Malta

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	85	85	95
IFR flight-hours controlled ('000)	41	41	47
IFR airport movements controlled ('000)	30	29	33
En Route ATFM delays ('000 minutes)	0	1	0
Airport ATFM delays ('000 minutes)	0	0	0
Total Staff	151	145	
ATCOs in OPS	52	55	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	13	13	13*
Capital Investment (million € <sub>2009</sub> )	1	6	1*

\* Forecast

### Safety

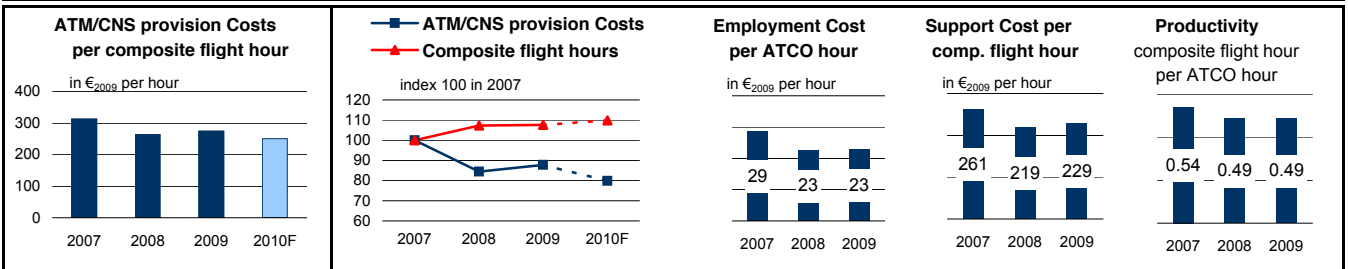
Occurrences for 2010 remained in the same level of 2009 i.e. around 200. The significant occurrences were divided as follows:

- Loss of separation 4
- Bird strike 5
- Laser problems 7
- RWY incursions 2
- RWY excursions 3
- Level busts 2
- CNS occurrences: 31

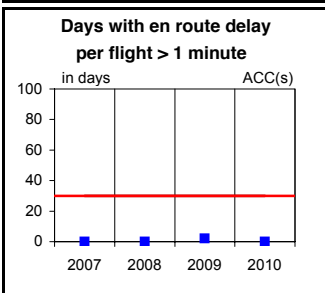
(Source: MATS communication e-mails)

ESARR 2 severity classification.

### Cost effectiveness



### En Route ATFM delay

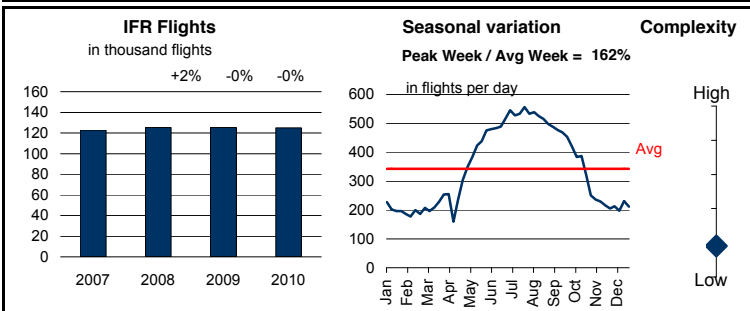


### Airport ATFM delay



## M-NAV, FYROM

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	125	125	125
IFR flight-hours controlled ('000)	21	21	21
IFR airport movements controlled ('000)	14	12	13
En Route ATFM delays ('000 minutes)	0	0	0
Airport ATFM delays ('000 minutes)	0	0	0
Total Staff	292	277	
ATCOs in OPS	62	67	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	11	11	10*
Capital Investment (million € <sub>2009</sub> )	0.3	0.1	0.1*

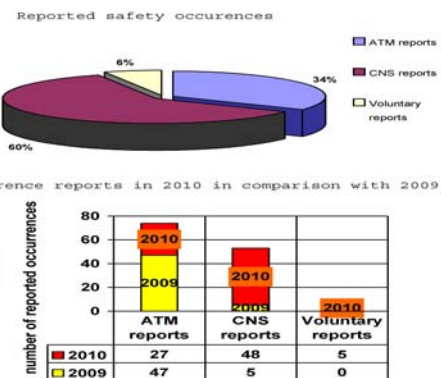
\* Forecast

### Safety

Safety department in 2010 made significant efforts to develop a consistent and robust incident reporting system. All occurrences that are safety-related as well as those which may pose a hazard to the safety of air traffic at M-NAV have to be reported to the Safety Department. They are all investigated by the experts of the safety management units. The sole purpose of this investigation is to detect safety risks in the air traffic management system. This allows us to mitigate them or to eliminate them by taking suitable countermeasures. In 2010 were reported 80 occurrences from which:

- 27 ATM occurrence reports
- 48 CNS occurrence reports and,
- 5 voluntary reports

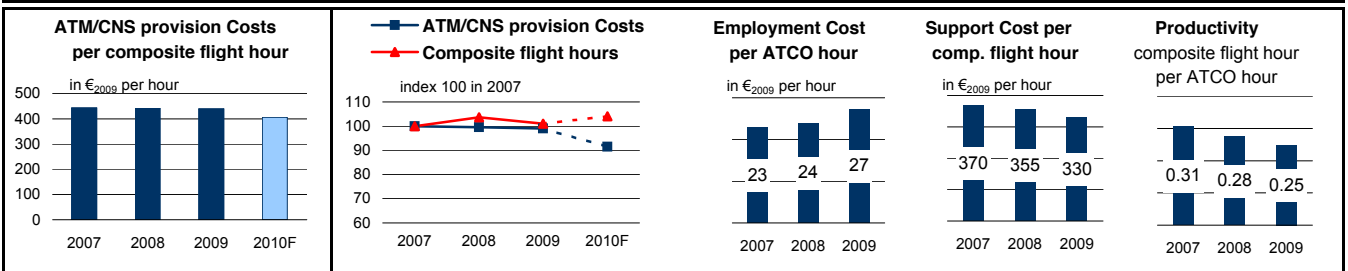
(Source: M-NAV Communication)



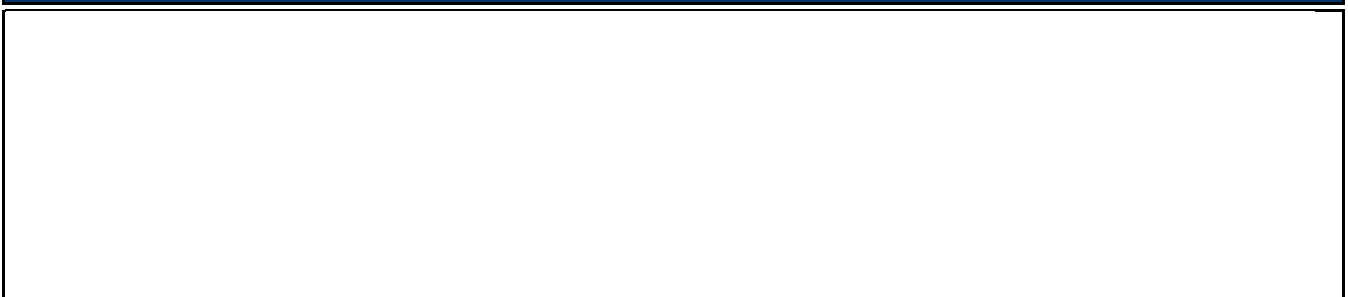
ESARR 2 severity classification.

M-NAV (Source: Communication e-mails)

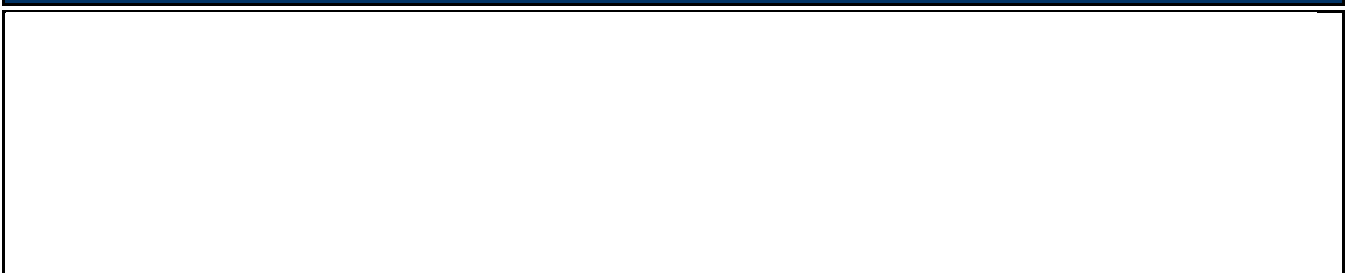
### Cost effectiveness



### En Route ATFM delay

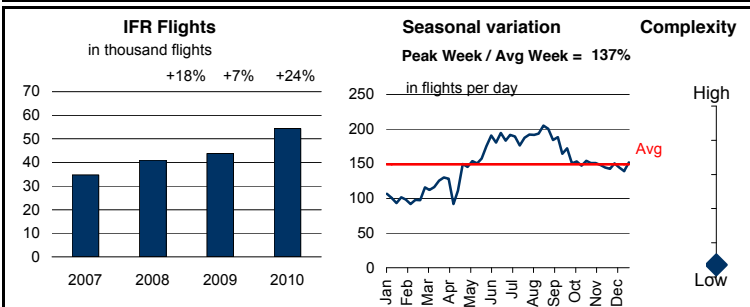


### Airport ATFM delay



## MoldATSA, Moldova

### Traffic



### Key data

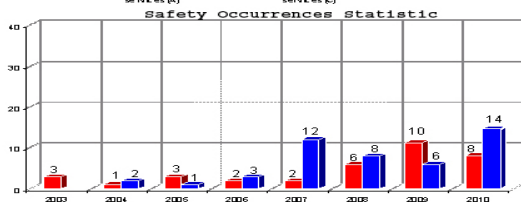
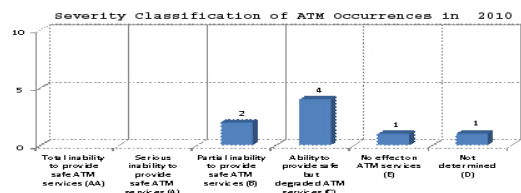
	2008	2009	2010(F)
Total IFR flights controlled ('000)	41	44	54
IFR flight-hours controlled ('000)	10	11	15
IFR airport movements controlled ('000)	13	12	14
En Route ATFM delays ('000 minutes)	0	0	0
Airport ATFM delays ('000 minutes)	0	0	0
Total Staff	304	306	
ATCOs in OPS	56	56	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	6	7	6*
Capital Investment (million € <sub>2009</sub> )	10	2	n/a

\* Forecast

### Safety

In 2010 the Safety and Quality Management Service of MoldATSA received 38 safety occurrences reports. 22 were subject to internal investigation and 8 out of 22 were related to ATM. There were no accidents or serious incidents caused by MoldATSA in 2010 and no malfunctions of technical devices that influenced the safety of flights.

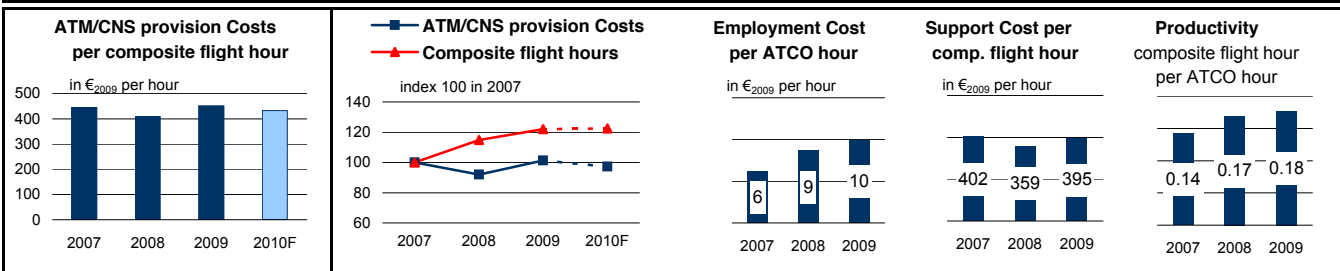
(Source: MoldATSA communication)



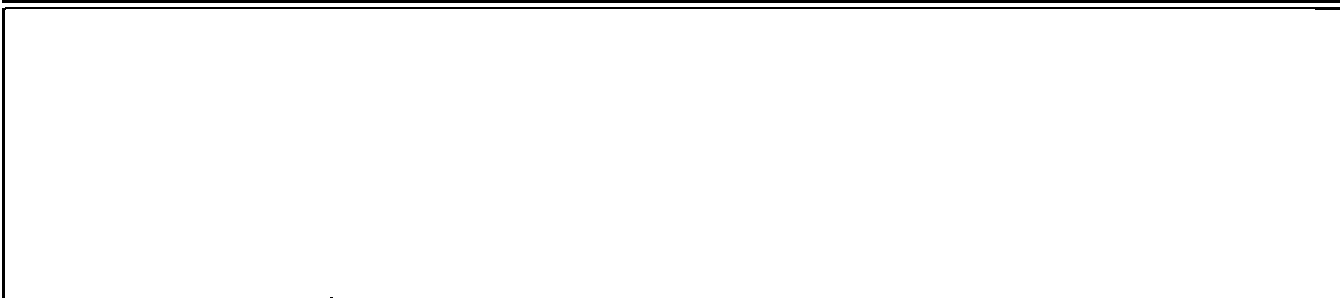
ESARR 2 severity classification.

(Source: MoldATSA communication)

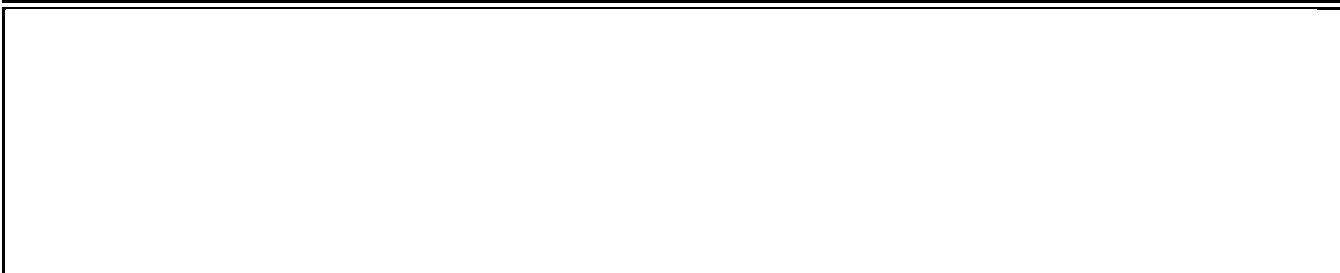
### Cost effectiveness



### En Route ATFM delay

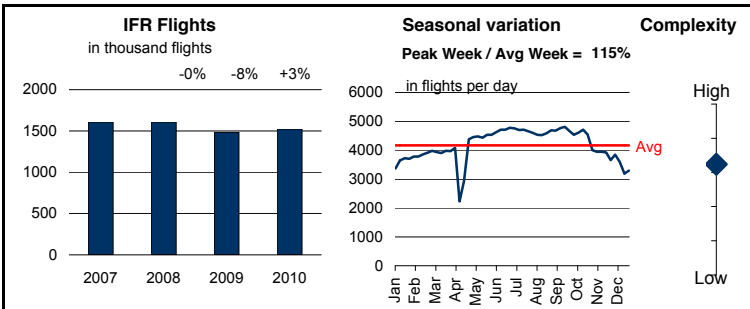


### Airport ATFM delay



## MUAC

### Traffic



### Key data

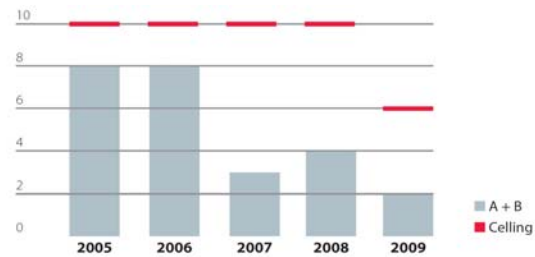
	2008	2009	2010(F)
Total IFR flights controlled ('000)	1608	1485	1522
IFR flight-hours controlled ('000)	581	532	543
IFR airport movements controlled ('000)			
En Route ATFM delays ('000 minutes)	778	74	73
Airport ATFM delays ('000 minutes)	0	0	0
Total Staff	625	666	
ATCOs in OPS	221	218	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	130	135	143*
Capital Investment (million € <sub>2009</sub> )	15	10	12*

\* Forecast

### Safety

"High safety standards were maintained during the reporting period, with the number of major incidents (Category B) reduced to two – down from the figure recorded in 2008.

(ANSP's 2009 annual report).

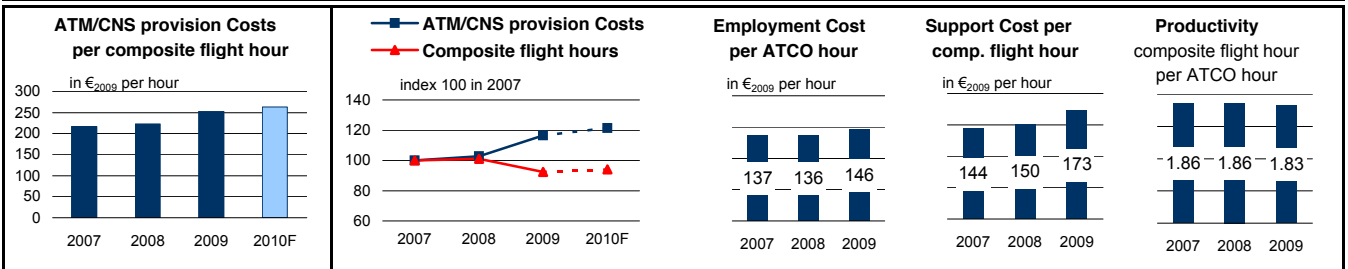


Separation infringements (severity A and B) attributable to MUAC (2005-2009)

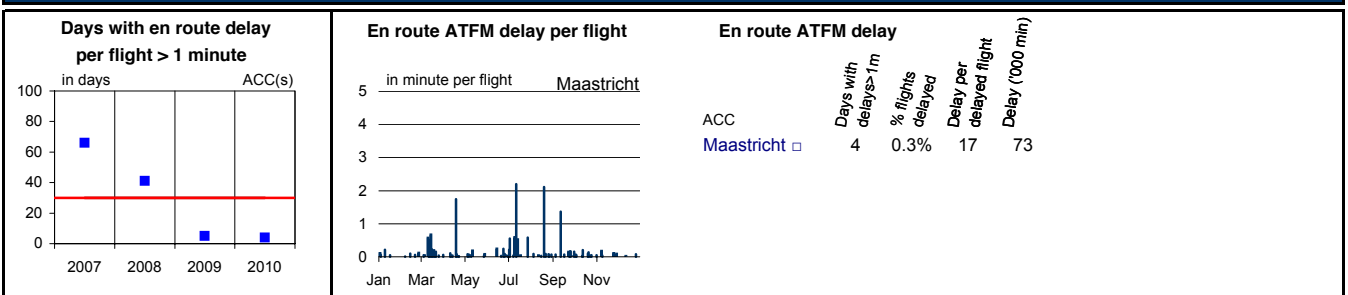
ESARR 2 severity classification.

source : ANSP's 2009 annual report

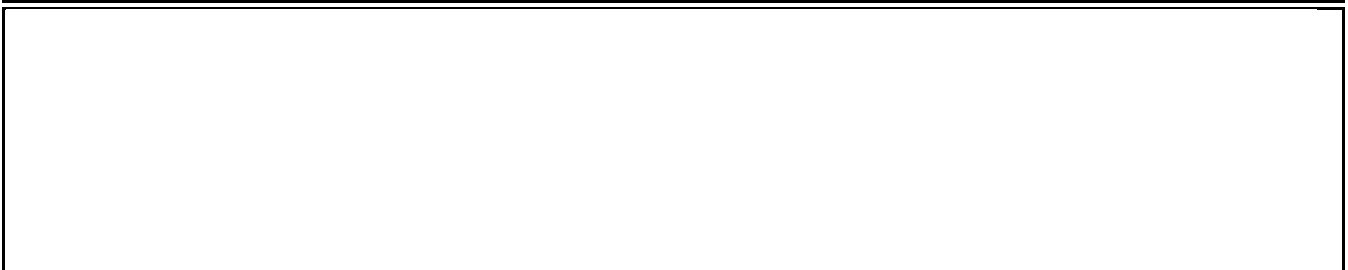
### Cost effectiveness



### En Route ATFM delay

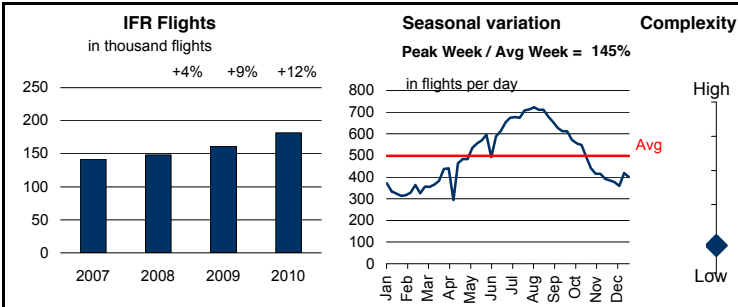


### Airport ATFM delay



## NATA Albania, Albania

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	148	161	181
IFR flight-hours controlled ('000)	32	35	39
IFR airport movements controlled ('000)	20	21	21
En Route ATFM delays ('000 minutes)	12	19	24
Airport ATFM delays ('000 minutes)	0	0	0
Total Staff	231	238	
ATCOs in OPS	41	41	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	14	16	18*
Capital Investment (million € <sub>2009</sub> )	11	8	12*

\* Forecast

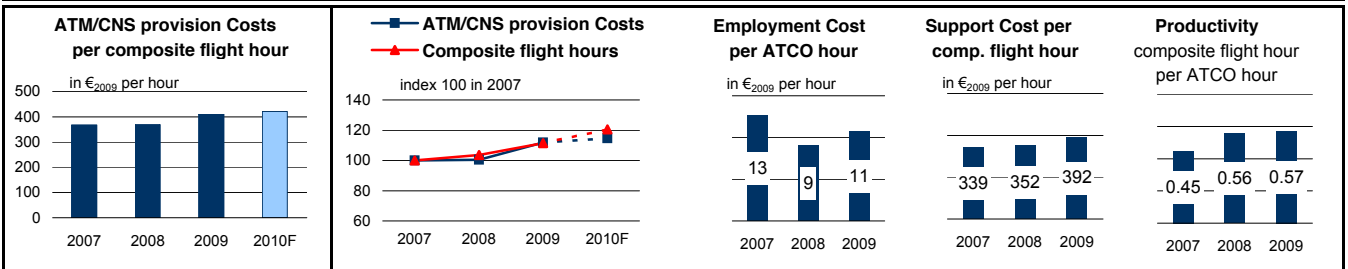
### Safety

Traffic for the Year 2010 in total 181386 Flights. Traffic has grown rapidly over the period compared with 2009 with an increase of 13.51%. For the year 2010, NATA collected 37 ATC occurrence reports and 138 ATC engineering occurrence reports. From 37 ATC occurrence reports 4 of them were Separation Minima Infringements (1) and RWY Incursion (3).

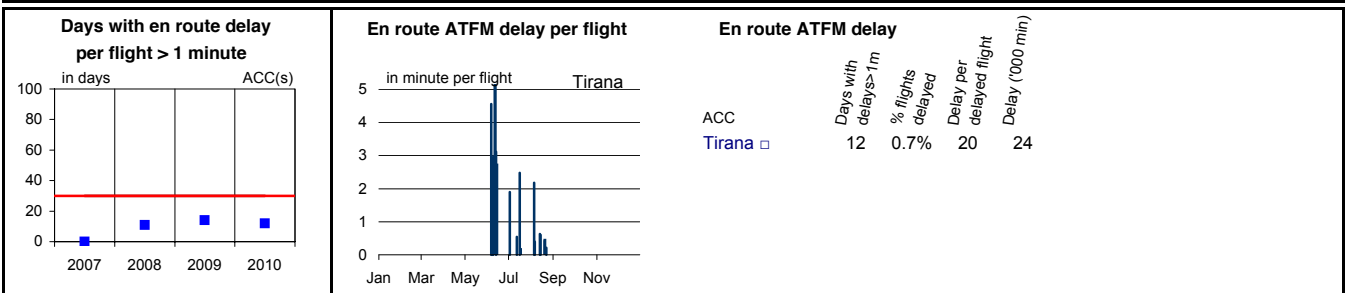
(Source: NATA communication)

ESARR 2 severity classification.

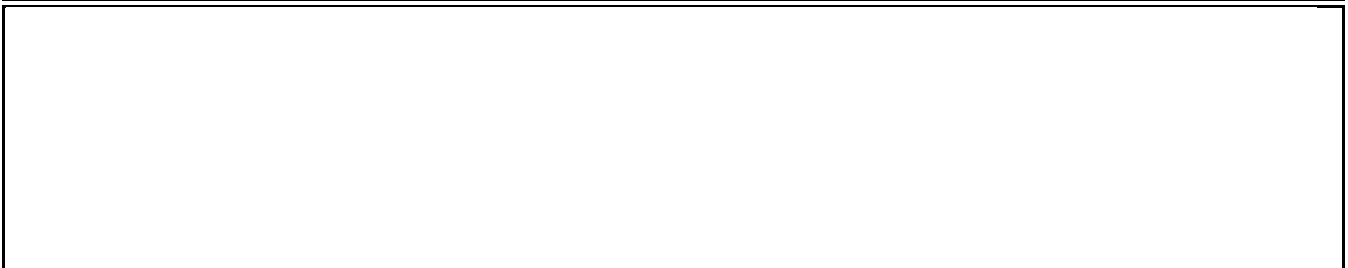
### Cost effectiveness



### En Route ATFM delay

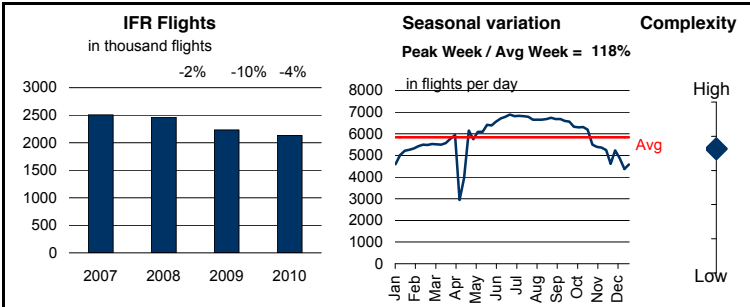


### Airport ATFM delay



# NATS, United Kingdom

## Traffic



## Key data

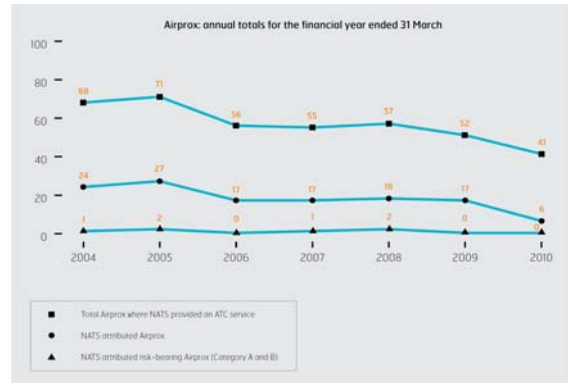
	2008	2009	2010(F)
Total IFR flights controlled ('000)	2466	2230	2133
IFR flight-hours controlled ('000)	1471	1310	1258
IFR airport movements controlled ('000)	1975	1793	1703
En Route ATFM delays ('000 minutes)	1325**	387**	335
Airport ATFM delays ('000 minutes)	1462**	729**	806
Total Staff	5006	4709	
ATCOs in OPS	1377	1413	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	698	687	
Capital Investment (million € <sub>2009</sub> )	162	144	

\* Forecast

## Safety

"We maintained our safety record in the year, with no risk-bearing airprox attributable to NATS."

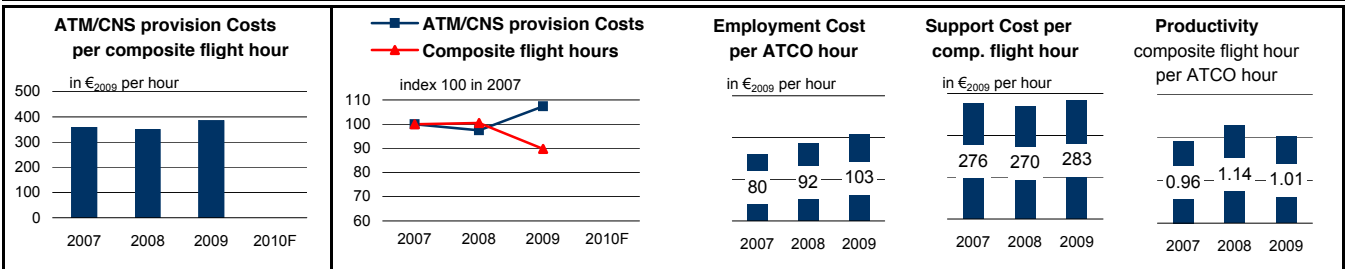
(ANSP's 2010 annual report)



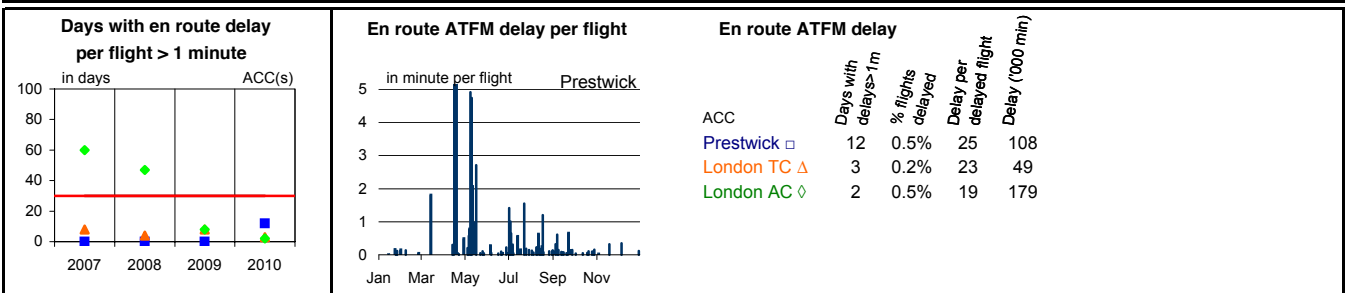
Note: Safety statistics for 2010 include NATS' assessment of the outcome of the UK Airprox Board reviews.  
source: NATS

ESARR 2 compliant severity classification.

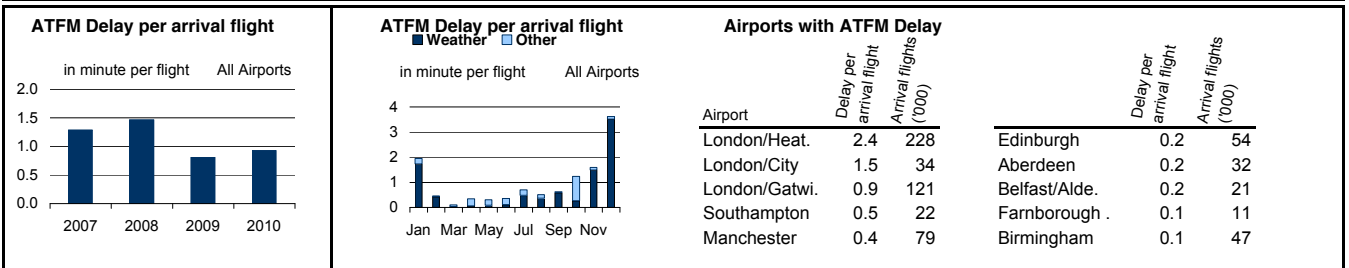
## Cost effectiveness



## En Route ATFM delay



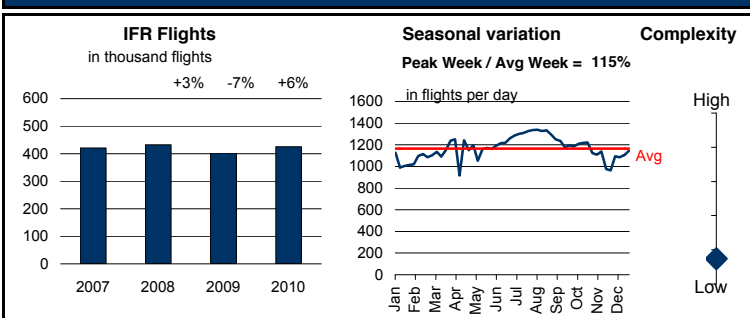
## Airport ATFM delay



\*\* Regulations on traffic volumes EGLL60, EGLL60WX, EGLLBN, EGLLTC, EGLLTCWX have been reclassified as airport

## NAV Portugal (FIR Lisboa), Portugal

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	433	402	426
IFR flight-hours controlled ('000)	276	259	274
IFR airport movements controlled ('000)	274	259	270
En Route ATFM delays ('000 minutes)	82	8	5
Airport ATFM delays ('000 minutes)	100	40	46
Total Staff	725	715	
ATCOs in OPS	198	201	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	147	134	131*
Capital Investment (million € <sub>2009</sub> )	7	10	16*

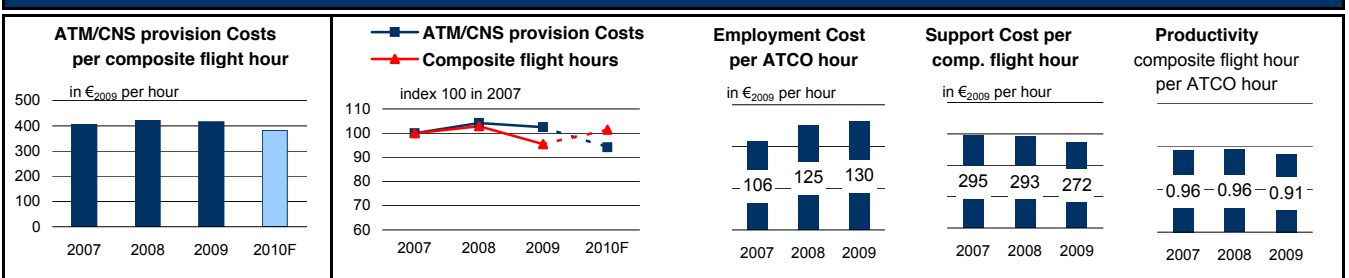
\* Forecast

### Safety

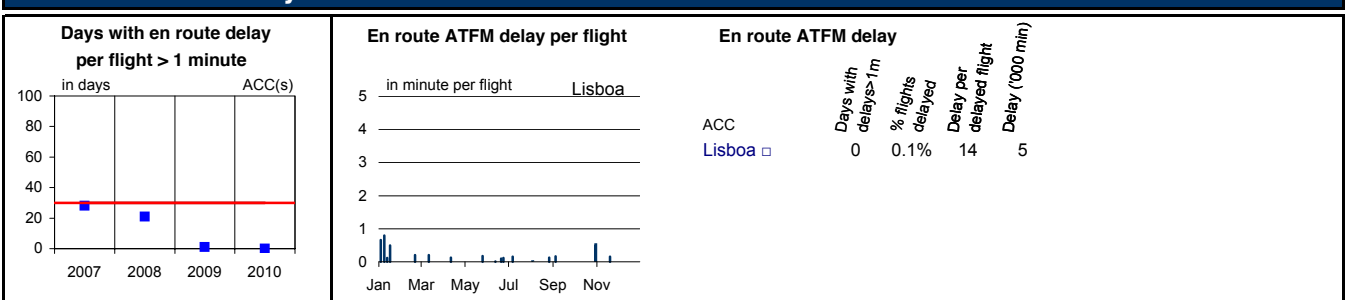
In the Operational Safety area, during 2009, from the 973 safety investigations analyzed, 5 was considered as being ATM directly, being one classified as AIRPROX A - Serious Incident and the other 4 as AIRPROX - B Major Incident, in accordance with the risk grade from Eurocontrol - ESARR 2. This fact, which represents a significant reduction in the number of the same type events when comparing to last year, should be seen as the direct result of the Operational Safety policy, well structured and understood, based basically in the Prevention. (ANSP's 2009 annual report).

ESARR 2 severity classification.

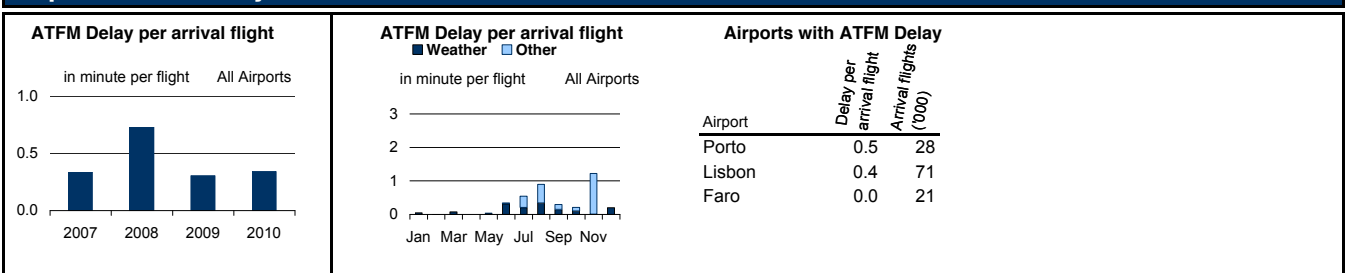
### Cost effectiveness



### En Route ATFM delay

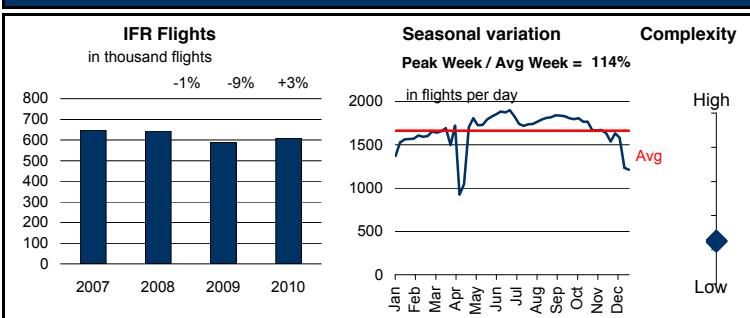


### Airport ATFM delay



## NAVIAIR, Denmark

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	644	587	607
IFR flight-hours controlled ('000)	216	197	204
IFR airport movements controlled ('000)	373	336	349
En Route ATFM delays ('000 minutes)	1231	13	9
Airport ATFM delays ('000 minutes)	177	38	51
Total Staff	675	705	
ATCOs in OPS	192	194	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	107	112	106*
Capital Investment (million € <sub>2009</sub> )	14	16	17*

\* Forecast

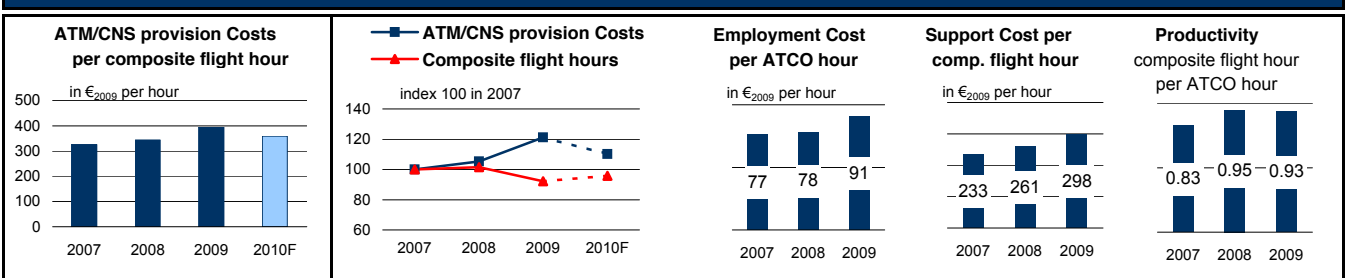
### Safety

The figures of 2010 are:  
 Number of incidents per 100,000 operations in category A, B and C, caused directly by Naviair was 1,05. This is lower than 2009.  
 The availability of ODS was 99.9 percent  
 Availability Radar Coverage was 100.0 percent  
 Availability Radio/Emergency Radio was 100.0 percent.

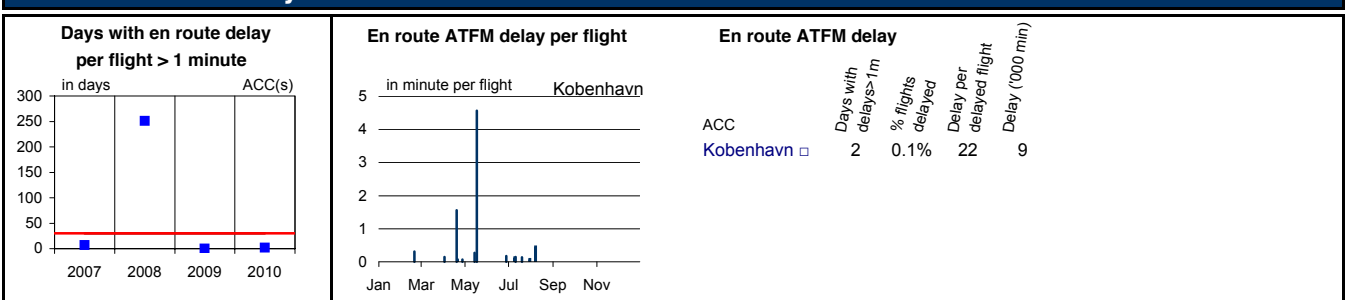
(Source: NAVIAIR communication)

ESSAR 2 severity classification.

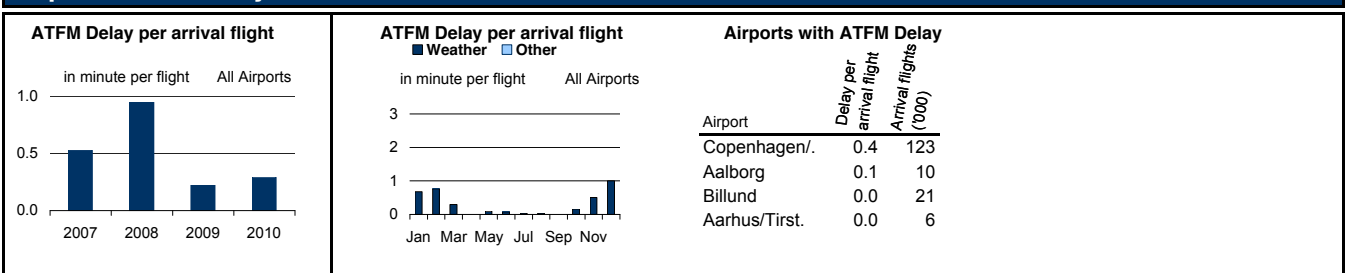
### Cost effectiveness



### En Route ATFM delay



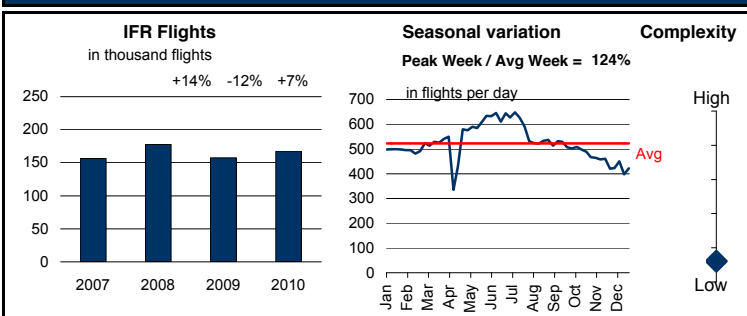
### Airport ATFM delay





## Oro Navigacija, Lithuania

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	178	157	168*
IFR flight-hours controlled ('000)	50	43	46*
IFR airport movements controlled ('000)	46	32	39*
En Route ATFM delays ('000 minutes)	0	0	0
Airport ATFM delays ('000 minutes)	0	0	0
Total Staff	320	312	
ATCOs in OPS	74	80	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	20	18	19*
Capital Investment (million € <sub>2009</sub> )	8	9	4*

\* Forecast

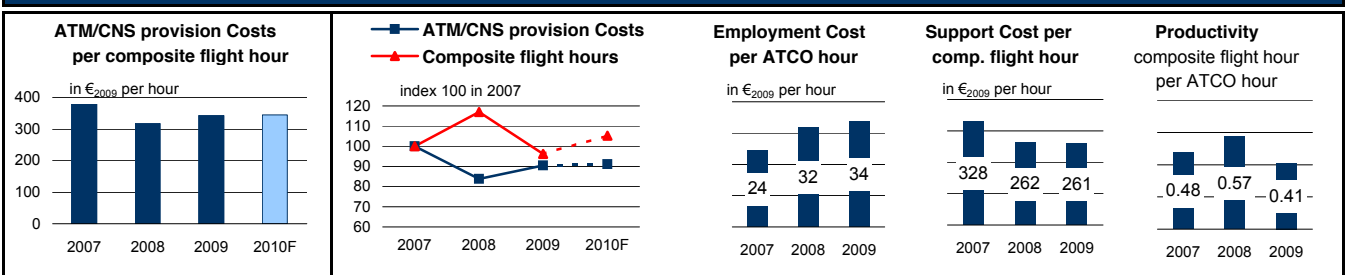
### Safety

In 2009 despite reduction of human resources caused by the crisis we succeeded in performing our major mission of ensuring high level of flight safety.

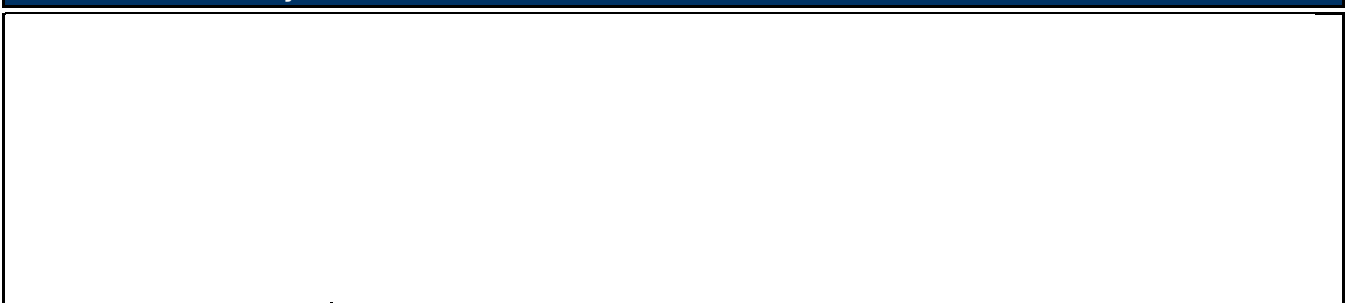
(ANSP's 2009 annual report).

ESARR 2 severity classification.

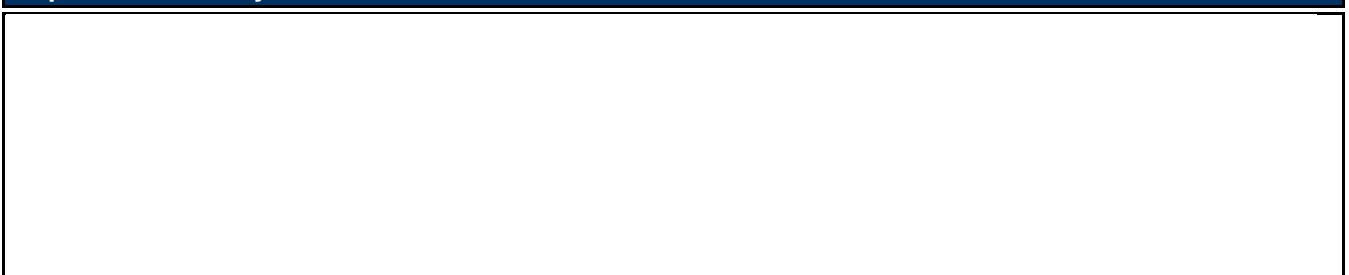
### Cost effectiveness



### En Route ATFM delay

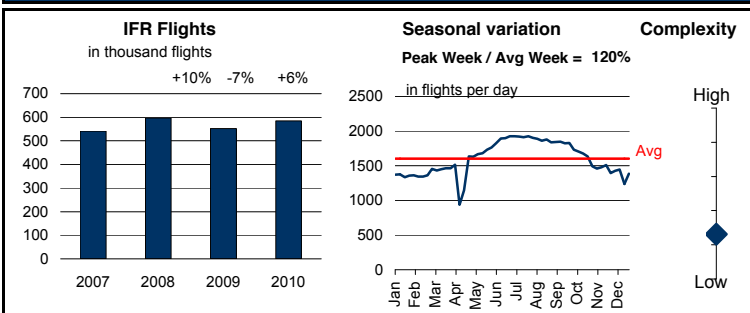


### Airport ATFM delay



## PANSA, Poland

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	596	552	585
IFR flight-hours controlled ('000)	348	325	346
IFR airport movements controlled ('000)	314	293	298
En Route ATFM delays ('000 minutes)	1190	900	659
Airport ATFM delays ('000 minutes)	50	30	19
Total Staff	1612	1689	
ATCOs in OPS	372	384	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	126	118	124*
Capital Investment (million € <sub>2009</sub> )	15	20	25*

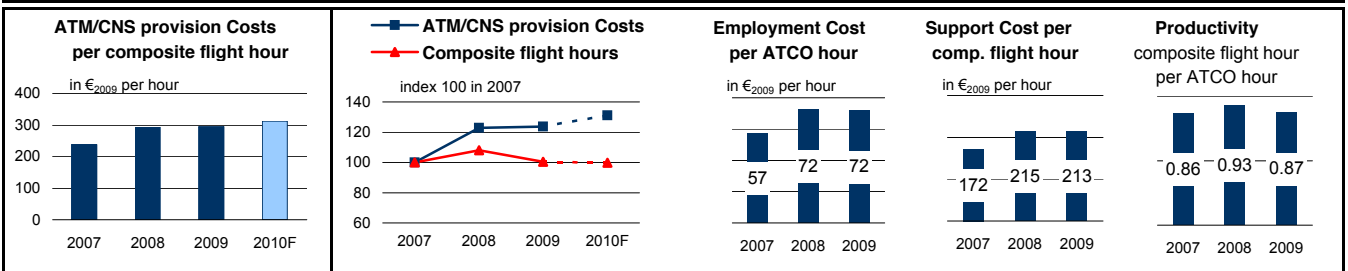
\* Forecast

### Safety

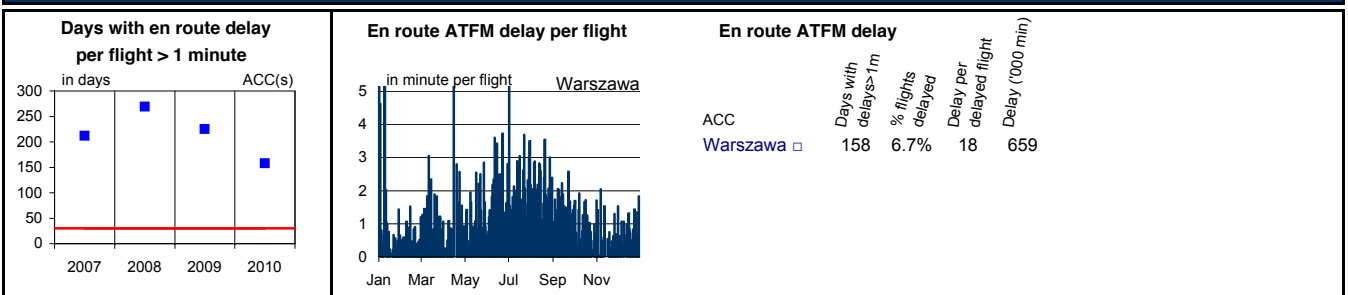
In 2009 PANSA succeeded in delivering on the assumed safety objectives. Sustaining of the preceding year safety level and, where possible, enhancing the safety levels against a backdrop of increasing air traffic volumes and, consequently, preventing accidents in the air and reducing the volume of serious incidents with a direct or indirect ATM system involvement was PANSA's primary goal. If compared to the year before, 2009 saw no air accident with a direct or indirect ATM system involvement and the rate of serious air incidents per 100 000 aircraft movements in 2009 totalled 0.461 in 2009 (cf.: 0.545 in 2008). (ANSP's 2009 annual report)

ESARR 2 severity classification.

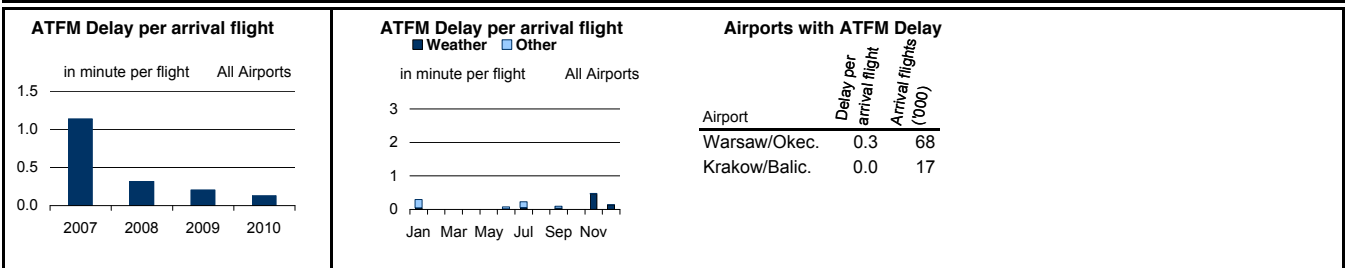
### Cost effectiveness



### En Route ATFM delay

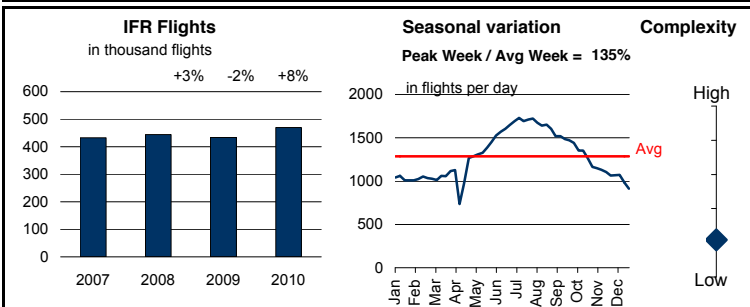


### Airport ATFM delay



## ROMATSA, Romania

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	444	434	470
IFR flight-hours controlled ('000)	271	264	284
IFR airport movements controlled ('000)	159	168	173
En Route ATFM delays ('000 minutes)	0	0	0
Airport ATFM delays ('000 minutes)	1	0	0
Total Staff	1723	1640	
ATCOs in OPS	523	513	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	147	148	139*
Capital Investment (million € <sub>2009</sub> )	18	12	22*

\* Forecast

### Safety

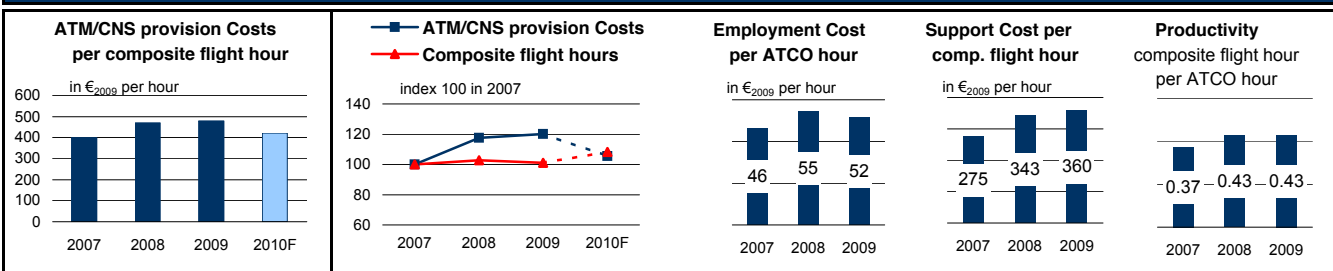
"In 2009 Romatsa was not involved in any safety event of the "accident" or "serious incident" type."  
... "The safety goal of Romatsa for 2009 was achieved."  
(ANSP's 2009 annual report).

Safety indicators	Planned goal	Achieved goal
Number of accidents with Romatsa contribution	0	0
Number of serious incidents with Romatsa contribution	maximum 1	0
Number of major incidents with Romatsa contribution	maximum 3	1

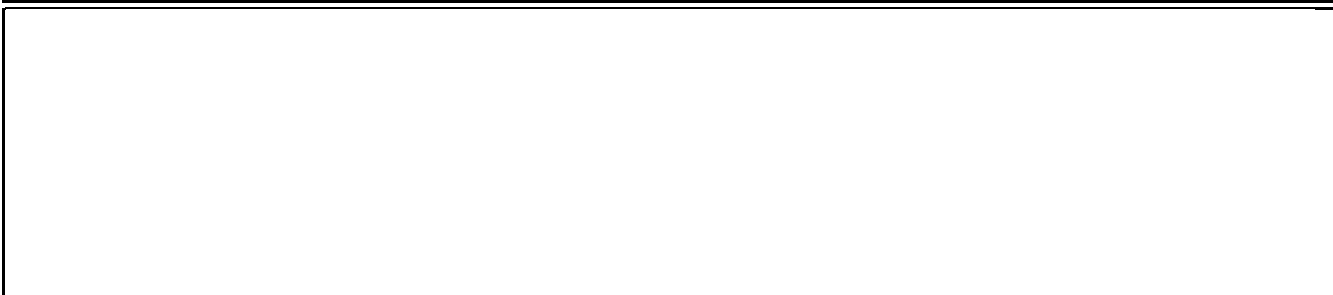
ESARR 2 severity classification.

source: ANSP's 2009 annual report

### Cost effectiveness



### En Route ATFM delay

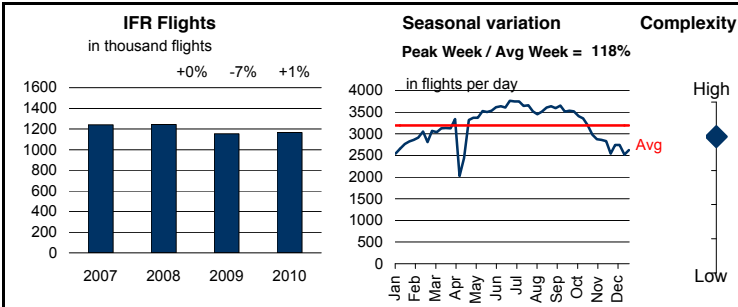


### Airport ATFM delay



# Skyguide, Switzerland

## Traffic



## Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	1244	1155	1165
IFR flight-hours controlled ('000)	354	328	322
IFR airport movements controlled ('000)	485	457	468
En Route ATFM delays ('000 minutes)	941	591	562
Airport ATFM delays ('000 minutes)	422	267	367
Total Staff	1266	1291	
ATCOs in OPS	329	324	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	221	218	218*
Capital Investment (million € <sub>2009</sub> )	40	26	24*

\* Forecast

## Safety

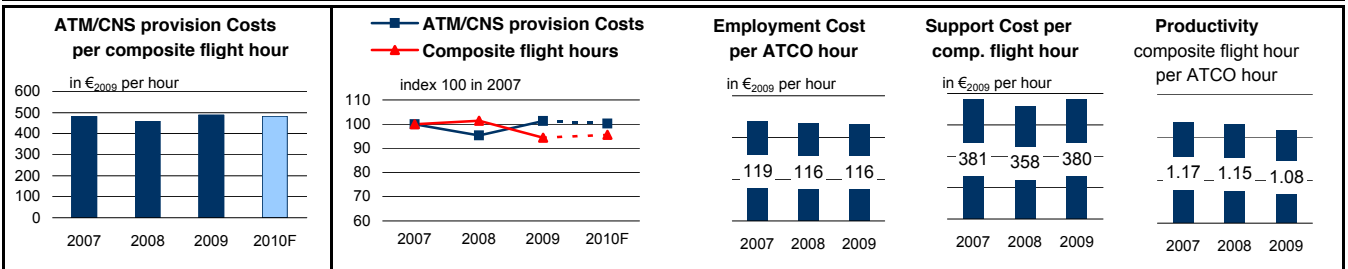
The Swiss AAIB did not investigate on any accident occurred in 2010 where a contribution of our ANSP is foreseen. Several AIRPROX occurred in 2010 are under investigation. However, as all these investigations are still ongoing, it is not possible to formulate any clear statement on our definitive assigned responsibility.

In 2009, the BFU (Switzerland's Federal Aircraft Accident Investigation Bureau) did not have to analyse a single serious incident in which air navigation services might have been involved. The other incidents not classified as serious are investigated by skyguide. Two such incidents occurred in 2009. The number of Category A (serious) and Category B (major) incidents caused by skyguide declined for 2009 compared to the average of the past five years, both in proportion to movements handled and in absolute terms.

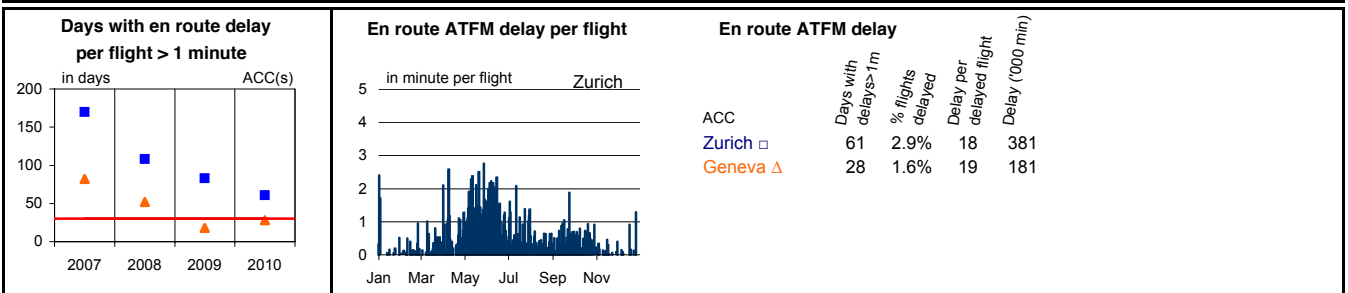
(ANSP's 2009 annual report, Skyguide communication).

ESARR 2 severity classification.

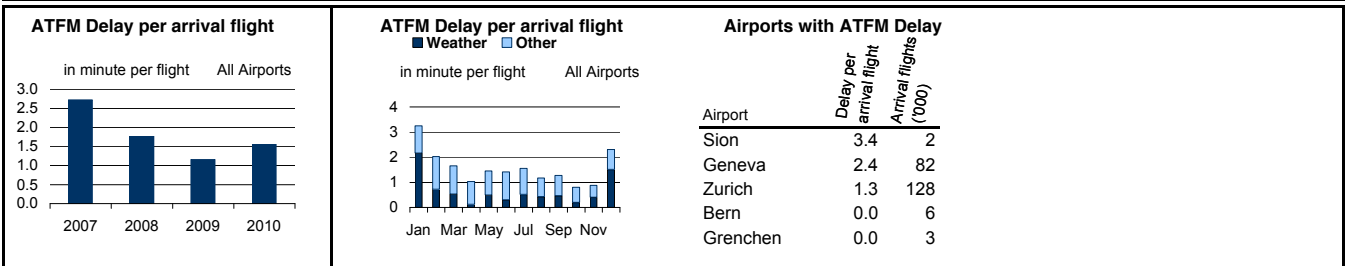
## Cost effectiveness



## En Route ATFM delay

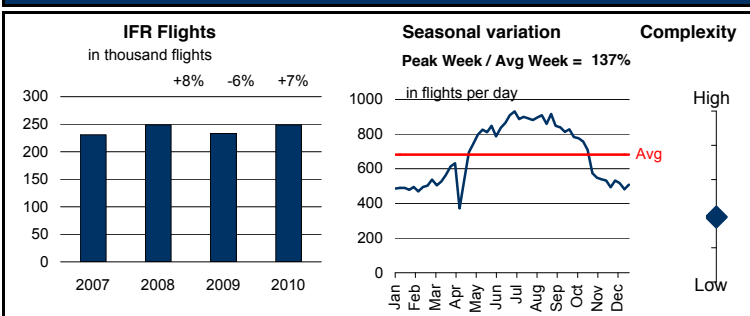


## Airport ATFM delay



## Slovenia Control, Slovenia

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	249	233	249
IFR flight-hours controlled ('000)	41	41	43
IFR airport movements controlled ('000)	45	40	37
En Route ATFM delays ('000 minutes)	8	5	1
Airport ATFM delays ('000 minutes)	2	0	0
Total Staff	210	215	
ATCOs in OPS	82	90	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	24	24	27*
Capital Investment (million € <sub>2009</sub> )	8	8	6*

\* Forecast

### Safety

Slovenia Control recorded a number of 220 safety occurrence reports in 2007, 241 in 2008, 184 in 2009 and 202 in 2010. This indicates that reporting culture within Slovenia Control has reached a constant reporting level with average, expected number of safety occurrence reports to be around 200 per year with variable of ten percent.

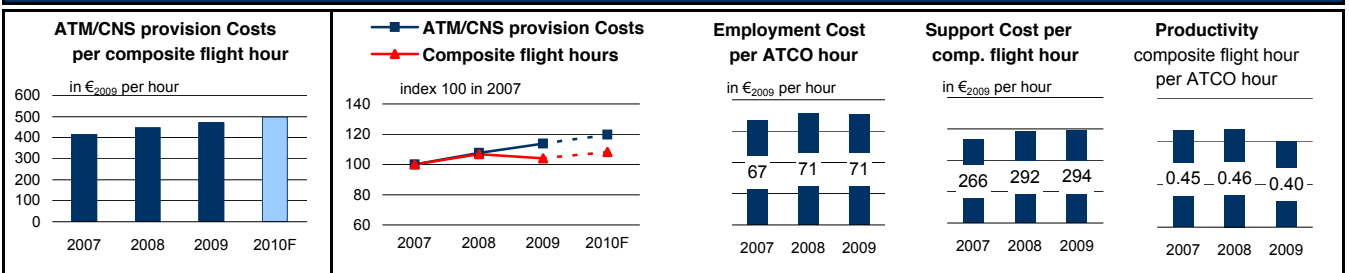
In 2010 no type AA or type A safety occurrence was reported within the framework of Slovenia Control's SMS Reporting process.

The company made an important step concerning safety improvement in april 2010 with completion of Slovenia Control Safety Culture Survey executed in cooperation with Eurocontrol agency.

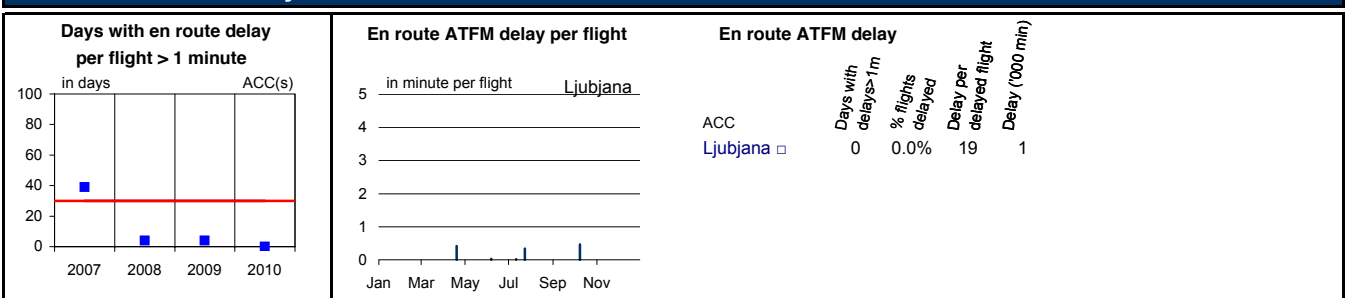
(Source: Slovenia Control communication)

ESARR 2 severity classification.

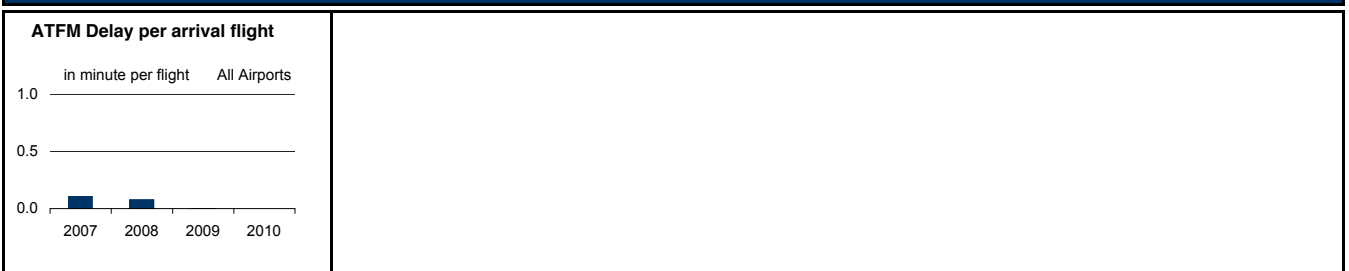
### Cost effectiveness



### En Route ATFM delay

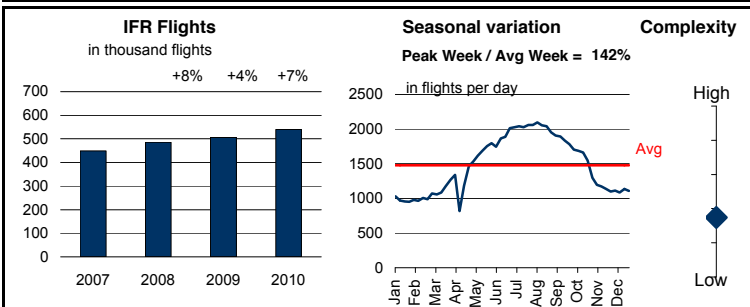


### Airport ATFM delay



# SMATSA, Serbia and Montenegro

## Traffic



## Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	486	506	540
IFR flight-hours controlled ('000)	205	208	217
IFR airport movements controlled ('000)	68	63	70
En Route ATFM delays ('000 minutes)	3	2	5
Airport ATFM delays ('000 minutes)	0	0	0
Total Staff	852	853	
ATCOs in OPS	222	225	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	66	70	68*
Capital Investment (million € <sub>2009</sub> )	22	27	25*

\* Forecast

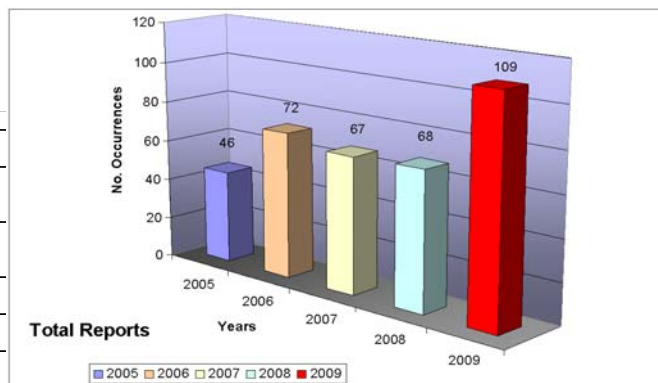
## Safety

SMATSA Safety department is responsible for collecting, analysing, sharing and archiving all safety occurrence data. No accident was induced by ATM.

(Source: SMATSA communication)

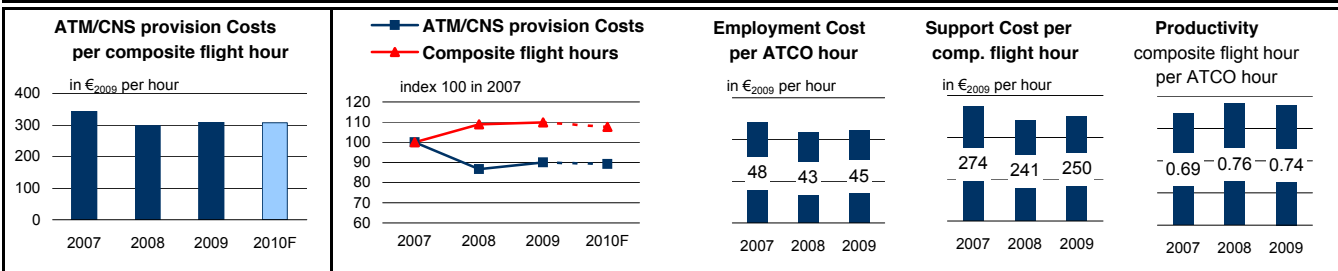
Year	2005	2006	2007	2008	2009
Number of Accidents	2	3	3	6	3
Number of Serious Incidents	2	1	1	2	6
Number of Major Incidents	3	0	5	4	3
RWY Incursion	3	2	1	2	0
Various Incidents	36	66	57	42	97
Total Reports	46	72	67	68	109

ESARR 2 severity classification.

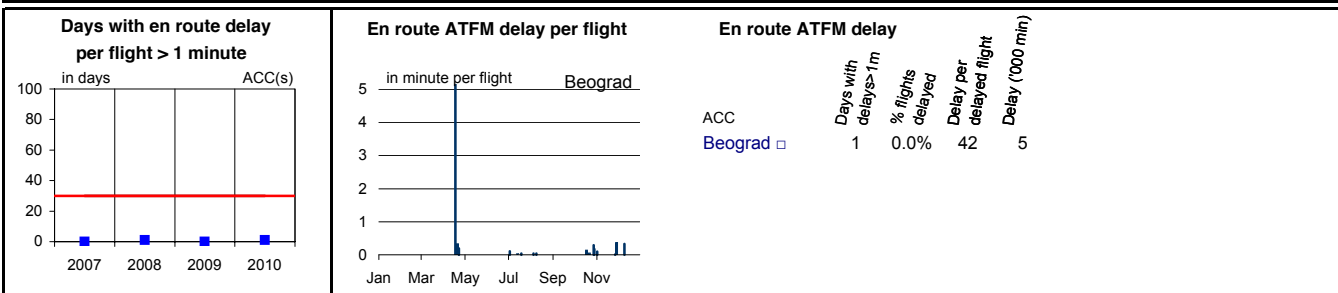


(Source: SMATSA)

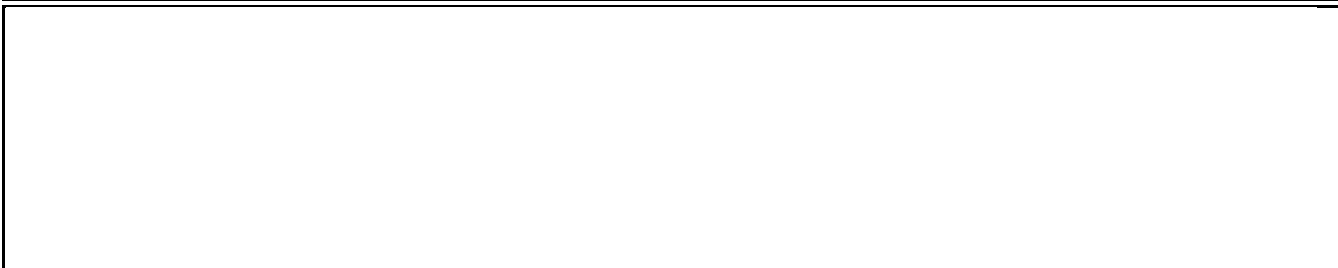
## Cost effectiveness



## En Route ATFM delay

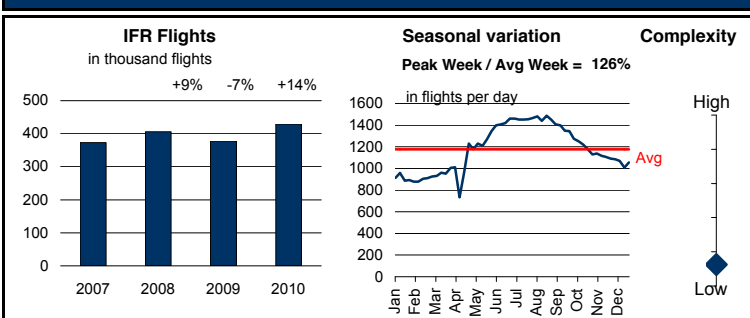


## Airport ATFM delay



## UkSATSE, Ukraine

### Traffic



### Key data

	2008	2009	2010(F)
Total IFR flights controlled ('000)	406	378	429
IFR flight-hours controlled ('000)	333	308	348
IFR airport movements controlled ('000)	192	165	185
En Route ATFM delays ('000 minutes)	0	4	25
Airport ATFM delays ('000 minutes)	0	8	1
Total Staff	5906	5996	
ATCOs in OPS	941	936	n/a
ATM/CNS provision costs (million € <sub>2009</sub> )	124	137	165*
Capital Investment (million € <sub>2009</sub> )	17	10	21*

\* Forecast

### Safety

At the state level the SAA of Ukraine in 2009 had used ICAO classification of occurrences (in accordance with national rules of accident and incident investigation).

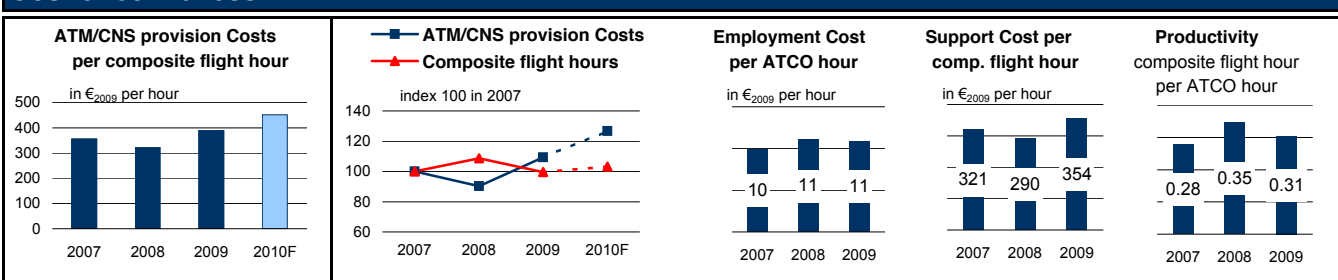
Total number of occurrences in the controlled airspace for 2009 in ATM related only:

- Accident - no;
- Serious incident - 1;
- Incident - no.

(Source: UkSATSE communication)

ESARR 2 severity classification.

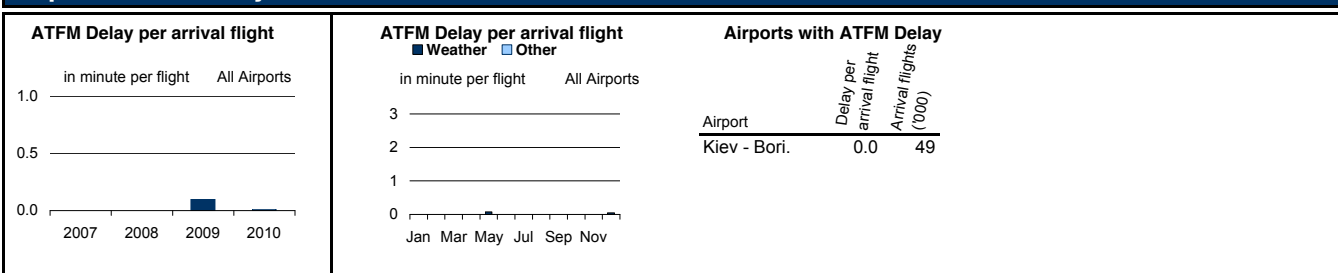
### Cost effectiveness



### En Route ATFM delay



### Airport ATFM delay





## ANNEX XI - GLOSSARY

<b>A-CDM</b>	Airport Collaborative Decision-Making
<b>ACARE</b>	Advisory Council for Aeronautics Research in Europe
<b>ACC</b>	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.
<b>Accident</b>  <b>(ICAO Annex 13)</b>	<p>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 disembarked, in which:</p> <p>a) a person is fatally or seriously injured as a result of:</p> <ul style="list-style-type: none"> <li>• Being in the aircraft, or</li> <li>• Direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or</li> <li>• Direct exposure to jet blast,</li> </ul> <p>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</p> <p>b) the aircraft sustains damage or structural failure which:</p> <ul style="list-style-type: none"> <li>• Adversely affects the structural strength, performance or flight characteristics of the aircraft, and</li> <li>• Would normally require major repair or replacement of the affected component, except for engine failure or damage, when the damage is limited to the engine, its cowlings or accessories, or for damage limited to propellers, wing tips, antennas, tyres, brakes, fairings, small dents or puncture holes in the aircraft skin;</li> </ul> <p>c) the aircraft is missing or completely inaccessible.</p>
<b>ACE Reports</b>	Air Traffic Management Cost-Effectiveness (ACE) Benchmarking Reports
<b>ACI</b>	Airports Council International ( <a href="http://www.aci-europe.org/">http://www.aci-europe.org/</a> )
<b>AEA</b>	Association of European Airlines ( <a href="http://www.aea.be">http://www.aea.be</a> )
<b>Aena</b>	Aeropuertos Españoles y Navegación Aérea, ANS Provider - Spain
<b>Agency</b>	The EUROCONTROL Agency
<b>AIRE</b>	Atlantic Interoperability Initiative to Reduce Emissions
<b>Airspace Infringement</b>	(also known as unauthorised penetration of airspace). The penetration by an aircraft into a portion of airspace without prior permission of the appropriate authorities (when such prior permission is required). EUROCONTROL HEIDI – ESARR 2 taxonomy
<b>Airside</b>	The aircraft movement area (stands, apron, taxiway system, runways etc.) to which access is controlled.
<b>AIS</b>	Aeronautical Information Service
<b>ALAQS</b>	EUROCONTROL Airport Local Air Quality Studies
<b>AMAN</b>	Arrival Management Function
<b>AMC</b>	Airspace Management Cell
<b>ANS</b>	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.
<b>ANS CR</b>	Air Navigation Services of the Czech Republic. ANS Provider - Czech Republic.
<b>ANSB</b>	Air Navigation Services Board
<b>ANSP</b>	Air Navigation Services Provider
<b>AO</b>	Aircraft Operator
<b>AOP</b>	Airport Ops Programme
<b>APP</b>	Approach Control Unit

<b>ARMATS</b>	Armenian Air Traffic Services, ANS Provider - Armenia
<b>ARN</b>	<b>ATS Route Network</b>
<b>ASK</b>	Available seat-kilometres (ASK): Total number of seats available for the transportation of paying passengers multiplied by the number of kilometres flown
<b>ASM</b>	Airspace Management
<b>ASMA</b>	Arrival Sequencing and Metering Area
<b>ASMT</b>	EUROCONTROL Automatic Safety Monitoring Tool
<b>ATC</b>	Air Traffic Control. A service operated by the appropriate authority to promote the safe, orderly and expeditious flow of air traffic.
<b>ATCO</b>	Air Traffic Control Officer
<b>ATFCM</b>	Air Traffic Flow and Capacity Management.
<b>ATFM</b>	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.
<b>ATFM delay (CFMU)</b>	The duration between the last Take-Off time requested by the aircraft operator and the Take-Off slot given by the CFMU.
<b>ATFM Regulation</b>	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”.
<b>ATK</b>	Available tonne kilometres (ATK) is a unit to measure the capacity of an airline. One ATK is equivalent to the capacity to transport one tonne of freight over one kilometre.
<b>ATM</b>	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.
<b>ATMAP</b>	ATM Performance at Airports
<b>ATS</b>	Air Traffic Service. A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service.
<b>Austro Control</b>	Austro Control: Österreichische Gesellschaft für Zivilluftfahrt mbH, ANS Provider - Austria
<b>AVINOR</b>	ANS Provider - Norway
<b>Bad weather</b>	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.
<b>Belgocontrol</b>	ANS Provider - Belgium
<b>BULATSA</b>	Air Traffic Services Authority of Bulgaria. ANS Provider - Bulgaria.
<b>CAA</b>	Civil Aviation Authority
<b>CAEP</b>	ICAO Committee for Aviation Environmental Protection
<b>CANSO</b>	Civil Air Navigation Services Organisation ( <a href="http://www.canso.org">http://www.canso.org</a> )
<b>CDA</b>	Continuous Descent Approach
<b>CDO</b>	Continuous Descent Operation, a collective term which also includes CDA (continuous descent approach).
<b>CDM</b>	Collaborative Decision Making
<b>CDR</b>	Conditional Routes
<b>CE</b>	Critical Elements (of a State’s safety oversight system)
<b>CEF</b>	Capacity Enhancement Function
<b>CFMU</b>	EUROCONTROL Central Flow Management Unit
<b>CIMACT</b>	Civil-Military ATM/ Air defence Coordination Tool
<b>CMA</b>	Continuous Monitoring Approach
<b>CNG</b>	Carbon-Neutral Growth
<b>CNS</b>	Communications, Navigation, Surveillance.
<b>CO<sub>2</sub></b>	Carbon dioxide
<b>Composite flight</b>	En-route flight hours plus IFR airport movements weighted by a factor that reflected the relative

<b>hour</b>	importance of terminal and en-route costs in the cost base (see ACE reports)
<b>CODA</b>	EUROCONTROL Central Office for Delay Analysis
<b>CRCO</b>	EUROCONTROL Central Route Charges Office
<b>Croatia Control</b>	Hrvatska kontrola zračne plovidbe d.o.o. ANS Provider - Croatia,
<b>CSA</b>	Comprehensive system Approach (USOAP Cycle)
<b>CTOT</b>	Calculated Take-Off Time
<b>DCAC Cyprus</b>	Department of Civil Aviation of Cyprus. ANS Provider - Cyprus.
<b>DFS</b>	DFS Deutsche Flugsicherung GmbH, ANS Provider - Germany
<b>DGCA</b>	Directors General of Civil Aviation
<b>DHMi</b>	Devlet Hava Meydanlari Isletmesi Genel Müdürlüğü (DHMi), General Directorate of State Airports Authority, Turkey. ANS Provider – Turkey.
<b>DLTA</b>	Difference from Long-Term Average metric. It is designed to measure relative change in time-based performance (e.g. flight time) normalised by selected criteria (origin, destination, aircraft type, etc.) for which sufficient data are available. The analysis compares actual performance for each flight of a given city pair with the long term average (i.e. average between 2003 and 2009) for that city pair.
<b>DMAN</b>	Departure Management Functions
<b>DSNA</b>	Direction des Services de la Navigation Aérienne. ANS Provider - France
<b>EAD</b>	European AIS Database
<b>EANS</b>	Estonian Air Navigation Services. ANS Provider – Estonia.
<b>EAPPRI</b>	European Action Plan for the Prevention of Runway Incursions
<b>EASA</b>	European Aviation Safety Agency
<b>EATM</b>	European Air Traffic Management (EUROCONTROL)
<b>EC</b>	European Commission
<b>ECAA</b>	European Common Aviation Area. This is a multilateral agreement signed in December 2005 by the European Community and 9 partners (Albania, Bosnia and Herzegovina, Croatia, FYROM, Iceland, Montenegro, Norway, Serbia, the United Nations Interim Administration Mission in Kosovo). The ECAA commits the signatories to continue harmonising with EU legislation. More details are available on the EC website: <a href="http://ec.europa.eu/transport/air_portal/international/doc/com_2006_0113_en.pdf">http://ec.europa.eu/transport/air_portal/international/doc/com_2006_0113_en.pdf</a>
<b>ECAC</b>	European Civil Aviation Conference.
<b>ECCAIRS</b>	European accident and incident database
<b>ECR</b>	European Central Repository (for safety-related occurrences)
<b>EEA</b>	European Economic Area (EU Member States + Iceland, Norway and Lichtenstein)
<b>EEA</b>	European Environmental Agency
<b>Effective capacity</b>	The traffic level that can be handled with optimum delay (cf. PRR 5 (2001) Annex 6)
<b>ENAV</b>	Ente Nazionale di Assistenza al Volo (ENAV). ANS Provider - Italy
<b>ERA</b>	European Regional Airlines Association ( <a href="http://www.eraa.org">http://www.eraa.org</a> )
<b>ESARR</b> <b>ESARR 1</b> <b>ESARR 2</b> <b>ESARR 3</b> <b>ESARR 4</b> <b>ESARR 5</b> <b>ESARR 6</b>	EUROCONTROL Safety Regulatory Requirement “Safety Oversight in ATM” “Reporting and Analysis of Safety Occurrences in ATM” “Use of Safety Management Systems by ATM Service Providers” “Risk Assessment and Mitigation in ATM” “Safety Regulatory Requirement for ATM Services' Personnel” “Safety Regulatory Requirement for Software in ATM Systems”
<b>ESIMS</b>	ESARR Support Implementation & Monitoring Programme
<b>ESRA (2008)</b>	European Statistical Reference Area (see STATFOR Reports)  Albania Austria, Belgium, Bosnia-Herzegovina Bulgaria, Canary Islands, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, FYROM, Germany, Greece, Hungary, Ireland, Italy, Lisbon FIR, Luxembourg, Malta, Moldova, Montenegro, Netherlands, Norway, Poland, Romania, Santa Maria FIR, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom
<b>ESSIP</b>	European Single Sky Implementation plan
<b>ETS</b>	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.
<b>EU</b>	European Union
<b>EUROCONTROL</b>	The European Organisation for the Safety of Air Navigation. It comprises Member States and the Agency.
<b>EUROCONTROL Member States</b>	Thirty-eight Member States on 31 December 2010. Albania, Armenia, Austria, Belgium, Bosnia and 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, FYROM, Turkey, Ukraine and United Kingdom.  Latvia became the 39 <sup>th</sup> Member State on 01 January 2011.
<b>EUROCONTROL Route Charges System</b>	A regional cost-recovery system that funds air navigation facilities and services and supports Air Traffic Management developments. It is operated by the EUROCONTROL Central Route Charges Office (CRCO), based in Brussels. <a href="http://www.eurocontrol.int/crco">www.eurocontrol.int/crco</a>
<b>EUROSTAT</b>	The Statistical Office of the European Community
<b>FAB</b>	Functional Airspace Blocks
<b>FINAVIA</b>	ANS provider – Finland
<b>FIR</b>	Flight Information Region. An airspace of defined dimensions within which flight information service and alerting service are provided.
<b>FL</b>	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.
<b>FMP</b>	Flow Management Position
<b>FPSP</b>	Flight Plan Service Providers
<b>FUA</b>	Flexible Use of Airspace
<b>FYROM</b>	Former Yugoslav Republic of Macedonia
<b>GAT</b>	General Air Traffic. Encompasses all flights conducted in accordance with the rules and procedures of ICAO.PRR 2010 uses the same classification of GAT IFR traffic as STATFOR:
<b>GDP</b>	Gross Domestic Product
<b>General Aviation</b>	All civil aviation operations other than scheduled air services and non-scheduled air transport operations for remuneration or hire.
<b>GHG</b>	Greenhouse gases.
<b>HCAA</b>	Hellenic Civil Aviation Authority. ANS Provider - Greece
<b>HungaroControl</b>	ANS Provider - Hungary
<b>H<sub>2</sub>O</b>	Water vapour (contrails and cirrus clouds in the context of greenhouses gases – Ch. 9 PRR 2010)
<b>IAA</b>	Irish Aviation Authority. ANS Provider - Ireland
<b>IATA</b>	International Air Transport Association ( <a href="http://www.iata.org">www.iata.org</a> )
<b>ICAO</b>	International Civil Aviation Organization
<b>IFR</b>	Instrument Flight Rules. Properly equipped aircraft are allowed to fly under bad-weather conditions following instrument flight rules.
<b>Inadequate Separation</b>	In the absence of prescribed separation minima, a situation in which aircraft were perceived to pass too close to each other for pilots to ensure safe separation (e.g. VFR and IFR flights perceived to pass too close to each other in airspace Class D or E). EUROCONTROL HEIDI – ESARR 2 taxonomy).
<b>Incident (ICAO Annex 13)</b>	An occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation.
<b>Incident Category A (ICAO Doc 4444)</b>	A serious incident: AIRPROX - Risk Of Collision: “The risk classification of an aircraft proximity in which serious risk of collision has existed”.
<b>Incident Category B (ICAO Doc 4444)</b>	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”.
<b>Interested parties</b>	Government regulatory bodies, Air Navigation Service Providers, Airport authorities, Airspace users, International civil aviation organisations, EUROCONTROL Agency, the advisory bodies to the Permanent Commission, European Commission, representatives of airspace users, airports and

	staff organisations and other agencies or international organisations which may contribute to the work of the PRC.
<b>IPCC</b>	Intergovernmental Panel on Climate change
<b>JRC</b>	EC Joint Research Centre
<b>Just culture</b>	The EUROCONTROL definition of “just culture”, also adopted by other European aviation stakeholders, is a culture in which “ <i>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.</i> ”
<b>KPA</b>	Key Performance Area
<b>KPI</b>	Key Performance Indicator
<b>LAQ</b>	Local Air Quality
<b>LARA</b>	Local And sub-Regional Airspace management support system
<b>LCIP</b>	Please see LSSIP
<b>LFV</b>	Luftfartsverket. ANS Provider - Sweden.
<b>LGS</b>	SJSC Latvijas Gaisa Satiksme (LGS). ANS Provider - Latvia
<b>Long haul traffic</b>	Traffic flow, for which every airport-to-airport distance is more than 4000km
<b>LOT</b>	Landing and Take-off Cycle
<b>LPS</b>	Letové Prevádzkové Služby. ANS Provider - Slovak Republic
<b>LSSIP</b>	Local Single Sky ImPlementation plans/reports (formerly Local Convergence and Implementation Plans)
<b>LVNL</b>	Luchtverkeersleiding Nederland. ANS Provider - Netherlands
<b>M-NAV</b>	Civil Aviation Authority of the Former Yugoslav Republic of Macedonia. ANS Provider – FYROM.
<b>Maastricht UAC</b>	The EUROCONTROL Upper Area Centre (UAC) Maastricht. It provides ATS in the upper airspace of Belgium, Luxembourg, Netherlands and Northern Germany.
<b>MATS</b>	Malta Air Traffic Services Ltd. ANS Provider - Malta
<b>MET</b>	Meteorological Services for Air Navigation
<b>MIL</b>	Military flights
<b>MoldATSA</b>	Moldavian Air Traffic Services Authority. ANS Provider - Moldova
<b>MTOW</b>	Maximum Take-off Weight
<b>MUAC</b>	Maastricht Upper Area Control Centre, EUROCONTROL
<b>NAAP</b>	Noise Abatement Approach Procedures
<b>NADP</b>	Noise Abatement Departure Procedures
<b>NAOP</b>	Noise Abatement Operational Procedures
<b>NATA Albania</b>	National Air Traffic Agency. ANS Provider - Albania
<b>NATS</b>	National Air Traffic Services. ANS Provider - United Kingdom
<b>NAV Portugal</b>	Navegação Aérea de Portugal – NAV Portugal, E.P.E.
<b>NAVIAIR</b>	Naviair, Air Navigation Services. ANS Provider – Denmark
<b>NERL</b>	NATS (En Route) Limited
<b>NM</b>	Nautical mile (1.852 km)
<b>NM</b>	Network Manager
<b>NO<sub>2</sub></b>	Nitrogen dioxide
<b>NO<sub>x</sub></b>	Oxides of Nitrogen
<b>NSA</b>	National supervisory Authorities
<b>Occurrence (Source: ESARR 2)</b>	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.
<b>OPS</b>	Operational Services
<b>Organisation</b>	See “EUROCONTROL”.
<b>Oro Navigacija</b>	State Enterprise Oro Navigacija. ANS Provider - Lithuania

<b>Passenger Load factor</b>	Revenue passenger-kilometres (RPK) divided by the number of available seat-kilometres (ASK).
<b>PANSA</b>	Polish Air Navigation Services Agency. ANS Provider - Poland
<b>PC</b>	Provisional Council of EUROCONTROL
<b>Permanent Commission</b>	The governing body of EUROCONTROL. It is responsible for formulating the Organisation's general policy.
<b>PI</b>	Performance Indicator
<b>PM10</b>	Particulate Matter, with an aerodynamic diameter of less than 10 micrometers
<b>PRB</b>	Performance Review Body of the Single European Sky
<b>PRC</b>	Performance Review Commission
<b>Primary Delay</b>	A delay other than reactionary
<b>PRISMIL</b>	Pan-European Repository of Information Supporting Civil-Military Performance Measurements.
<b>Productivity</b>	Hourly productivity is measured as Flight-hours per ATCO-hour (see ACE reports)
<b>PRR</b>	Performance Review Report (i.e. PRR 2010 covering the calendar year 2010)
<b>PRU</b>	Performance Review Unit
<b>R&amp;D</b>	Research & Development
<b>RAD</b>	Route availability document
<b>Reactionary delay</b>	Delay caused by late arrival of aircraft or crew from previous journeys
<b>Revised Convention</b>	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.
<b>ROMATSA</b>	Romanian Air Traffic Services Administration. ANS Provider - Romania
<b>RPI</b>	First Reference Period (2012-2014) of the SES Performance Scheme
<b>RPK</b>	Revenue passenger-kilometre (RPK): One fare-paying passenger transported one kilometre.
<b>RTA</b>	Required Time of Arrival
<b>RTK</b>	Revenue Tonne Kilometre
<b>RI (Runway incursion)</b>	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).
<b>RVSM</b>	Reduced Vertical Separation Minima
<b>SARPs</b>	Standards and Recommended Practices (ICAO)
<b>SM</b>	<b>Separation Minima</b> 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).
<b>SMI</b>	<b>Separation minima infringement:</b> A situation in which prescribed separation minima were not maintained between aircraft.
<b>Serious incident (ICAO Annex 13)</b>	An incident involving circumstances indicating that an accident nearly occurred.
<b>SES</b>	Single European Sky (EU)
<b>SESAR</b>	The Single European Sky ATM Research programme
<b>Severity</b>	The severity of an accident is expressed according to: <ul style="list-style-type: none"> <li>the <i>level of damage</i> to the aircraft (ICAO Annex 13 identifies four levels: destroyed; substantially destroyed, slightly damaged and no damage);</li> <li>the <i>type and number of injuries</i> (ICAO Annex 13 identifies three levels of injuries: fatal, serious and minor/none).</li> </ul> PRRs focus on Severity A (Serious Incident) and Severity B (Major Incident).
<b>Skyguide</b>	ANS Provider - Switzerland
<b>Slot (ATFM)</b>	A take-off time window assigned to an IFR flight for ATFM purposes

<b>Slovenia Control</b>	ANS Provider - Slovenia
<b>SMATSA</b>	Serbia and Montenegro Air Traffic Services Agency
<b>SMI</b>	Separation minima infringement.
<b>SO<sub>x</sub></b>	Sulphur oxide gases
<b>SRC</b>	Safety Regulation Commission
<b>SRU</b>	Safety Regulation Unit
<b>SSC</b>	Single Sky Committee
<b>STATFOR</b>	EUROCONTROL Statistics & Forecasts Service
<b>SUA</b>	Special Use Airspace
<b>Summer period</b>	May to October inclusive
<b>Taxi-in</b>	The time from touch-down to arrival block time.
<b>Taxi-out</b>	The time from off-block to take-off, including eventual holding before take-off.
<b>TC</b>	Terminal Control
<b>TCAS</b>	Traffic and Collision Avoidance System
<b>TMA</b>	Terminal manoeuvring area
<b>UAC</b>	Upper Airspace Area Control Centre
<b>UK CAA</b>	United Kingdom Civil Aviation Authority
<b>UK NATS</b>	United Kingdom National Air Traffic Services
<b>UkSATSE</b>	Ukrainian State Air Traffic Service Enterprise. ANS Provider - Ukraine
<b>Unauthorised penetration of airspace</b>	(also known as Airspace Infringement). The penetration by an aircraft into a portion of airspace without prior permission of the appropriate authorities (when such prior permission is required). EUROCONTROL HEIDI – ESARR 2 taxonomy
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>UR</b>	Unit Rate
<b>USD</b>	US dollar
<b>USOAP</b>	ICAO Universal Safety Oversight Audit Programme
<b>VFR</b>	Visual Flight Rules
<b>WAFC</b>	World Area Forecast Centre



## ANNEX XII - REFERENCES

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<http://www.EUROCONTROL.int/prc>*

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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 holds 5 plenary meetings a year, in addition to taskforce and ad hoc meetings. The PRC also holds consultation meetings with stakeholders on specific subjects.

The PRC consists of 12 Members, including the Chairman and Vice-Chairman:

Mr. John Arscott <b>Chairman</b>	Dr. Ricardo Genova
Mr. Ralf Berghof	Mr. Mustafa Kilic
Mr. Carlo Bernasconi	Mr. Keld Ludvigsen
Mr. Hannes Bjurström	Mr. Juan Revuelta
Mr. Jean-Yves Delhayé	Mr. Jaime Valadares
Mr. Dragan Draganov	

PRC Members must have senior 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](mailto:PRU@eurocontrol.int).

The PRC can be contacted via the PRU or through its website <http://www.eurocontrol.int/prc>.

### 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 [www.eurocontrol.int/prc](http://www.eurocontrol.int/prc) where copies can also be ordered.

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