PERFORMANCE REVIEW COMMISSION

PERFORMANCE REVIEW REPORT

An assessment of Air Traffic Management in Europe during the calendar year 2002

PRR 6

Version 1

EUROCONTROL

May 2003

Printed by EUROCONTROL, 96, rue de la Fusée, B-1130 Brussels, Belgium, Tel: + 32 2 729 3956, Fax: + 32 2 729 9108.

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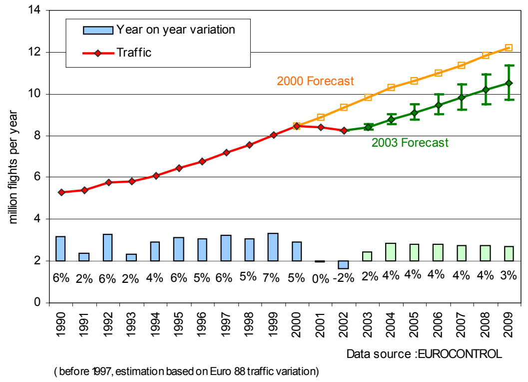
Traffic



Traffic decreased in 2002 for the second consecutive year.

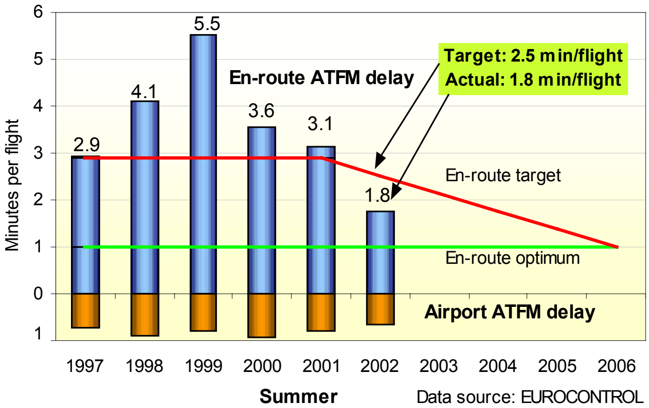
IFR flights: 8.237M (-1.9%)
IFR distance: 6 293M Km(- 1.4%)

Safety

In the absence of key safety indicators, the safety trend is indeterminate.

Fatal Accidents	2001 (24 States)	2002 (provisional)
Total	121	N/A
With direct ATM contribution	2	N/A
Involving commercial aircraft	Runway collision in Milan	Mid-air collision over Überlingen

Delays

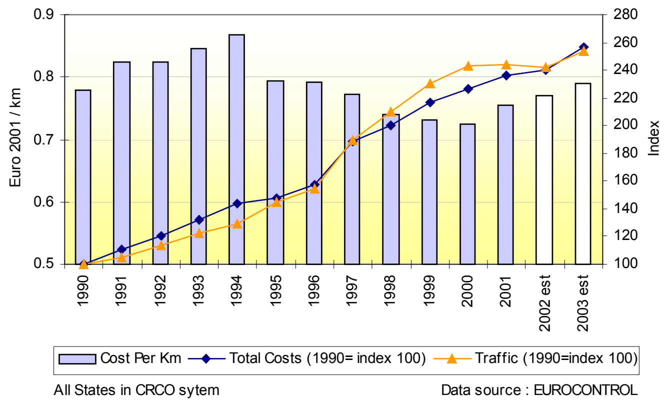


The ATM delay KPI (average en-route ATFM delay per flight in summer: 1.8 min/flight) met the Provisional Council's target of 2.5 min/flight.

Airport ATFM delays (bottom part of the graph) reduced in absolute value but increased in proportion.

Summer en-route ATFM delay		ATFM delay	18.0M min
		En-route ATFM delay	11.9 M min
Target	2.5 min/ flight	En-route delay cost	
Actual	1.8 min/ flight	Airlines:	€ 700-1 000M
Variation	-42%	Passengers:	€ 900-1 100M

Cost-effectiveness



After several years of steady decrease, real unit costs are expected to increase on average +9% from 2000 to 2003.

Real unit costs are high compared to other ATM systems (e.g. US), and growing.

	Real unit cost	
Route charges	€$_{2001}$ 0.77/km	~€5 000M
Terminal costs		~€1 300M

Figure 1: Key Performance Indicators

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EXECUTIVE SUMMARY

Introduction

This sixth Performance Review Report (PRR 6), covering the year 2002, assesses the performance of the European ATM[1] system under four Key Performance Areas (KPA): Safety, Delays, Cost-effectiveness and Flight-efficiency.

Key Performance Indicators (KPI) are shown in Figure 1.

PRR 6 also discusses ATM-airport inter-actions, performance trade-offs, further comparisons of US and European ATM systems, and implications for the Single European Sky (SES).

Traffic

Traffic has decreased for two consecutive years (-1.9% in 2002, -0.6% in 2001). Traffic growth is likely to remain weak in 2003.

Traffic variability (diurnal, weekly, and seasonal) has an influence on ATM performance, and can be predicted to a large extent (Figure 2). Air Navigation Service Providers (ANSP) have a responsibility to adapt to known traffic variability, to consult their customers in order to anticipate changes in future demand and to manage the remaining "volume" risk.

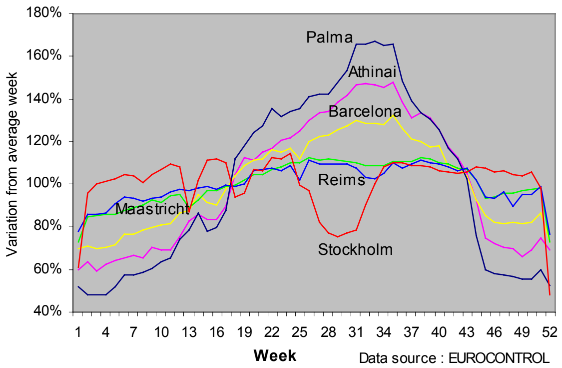


Figure 2: Seasonal traffic variations

[1] ATM: Air Traffic Management, composed of ATC (Air Traffic Control), ATFM (Air Traffic Flow Management), and ASM (Air Space Management).

Safety

Year 2002 saw the first mid-air collision involving commercial airliners in more than 25 years (Überlingen 1/7/2002). This continues a worrying series of ATM related fatal accidents (Paris 2000, Milan 2001). EUROCONTROL and its stakeholders are taking vigorous steps to address the situation (e.g. AGAS).

Safety occurrence reporting is a major element in identifying accident precursors and preventing accidents. There are major shortcomings in incident reporting:

- uneven and variable levels of incident reporting at ANSP level;
- incomplete implementation of safety standard ESARR 2 by States;
- legal impediments to incident reporting in many States;
- poor timeliness of summary reports;
- absence of key safety indicators and corresponding targets;
- poor transparency;
- no systematic detection of safety occurrences in most States.

It is not acceptable that implementation of important safety regulatory requirements such as ESARR 2 is so slow and incomplete. As foreseen in the Single European Sky draft regulation (ANS, art 4), the European Commission will identify and adopt the ESARRs that shall be made mandatory under Community law. This should be done without delay as soon as the regulations enter into force.

Systematic detection using automated tools should be encouraged and possibly even mandated. This would, *inter alia*, help the safety trend to be examined at European level.

A non-punitive culture is necessary to ensure an adequate flow of safety incident reports. The Safety Survey reveals that this is lacking in most States. A uniform European legal framework is desirable.

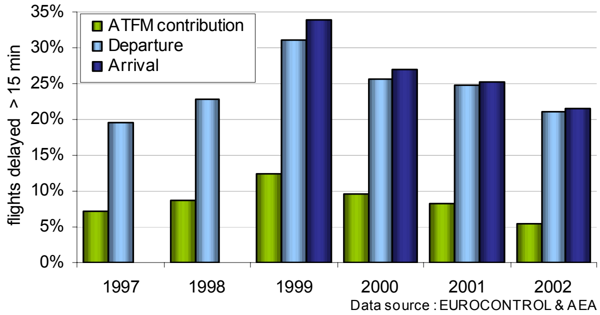
There is a need for strong safety regulation and oversight, based on harmonised standards. The combination of a European safety regulatory framework and regional safety regulation could strike the right balance between the need for harmonisation, efficiency, qualified personnel and understanding of local issues.

States' compliance with safety standards should be public information.

Delays

Air transport delays

ATM related delays in air transport decreased steadily in the past three years (Figure 3).



Flights delayed > 15 min	2001	2002
Average Departure Delay	39 min	39 min
Average Arrival Delay	40 min	39 min

Figure 3: Air transport punctuality

ATFM delays

The ATM delay KPI (average en-route ATFM delay per flight in summer: 1.8 min/flight) met the Provisional Council's target of 2.5 min/flight.

The delay KPI fell by 42% in 2002, due to a combination of traffic reduction, Reduced Vertical Separation (RVSM), new capacity created by ANSPs and better use made of existing capacity with ATFM measures.

En-route ATFM delays would have been close to optimum (1 min/flight) if temporary problems had not been encountered in the United Kingdom. This indicates that the agreed target can be met.

Effective capacity will need to continue to increase in line with forecast traffic growth, so that the delay target is met. Costs do not necessarily need to grow in proportion to capacity (see Trade-offs).

Airport related ATFM delays are increasing in proportion (34%), and need attention.

Providing for some spare en-route capacity (e.g. 5%) would:

- accommodate some uncertainties in traffic forecasts;
- improve safety;
- minimise ATFM delays and related costs;
- allow more tactical ATFM procedures to be introduced;
- allow airport throughput to be maximised through pre-sequencing, while minimising holding at arrival airport and related environmental impact.

However, the cost-benefit analysis remains to be made.

ATFM performance

ATFM performance needs attention. Lost slots and unnecessary regulations generated some 22% of ATFM delays.

Flow is controlled mostly through ground holding in Europe. This is an effective but crude method, which should be complemented by more tactical ATFM measures.

Cost effectiveness

Cost effectiveness is becoming a major issue in European ATM. After several years of steady decrease, average real unit costs (the KPI for cost-effectiveness) are growing by +3% p.a. on average net of inflation (+9.5% from 2000 to 2003, see Figure 1). According to ANSP plans, this trend will continue in the medium-term.

One would expect to see regular efficiency gains leading to a reduction in real unit costs (typically 2-3% p.a.). Real unit costs are therefore growing some 5-6% faster than one would expect.

Furthermore, unit costs are high with reference to other ATM systems (see US-Europe comparison). This indicates that costs need to be curbed.

Notwithstanding its merits, the Route Charges System lacks cost-effectiveness focus and discipline, transparency, incentives to deliver performance, clear performance objectives and effective consultation. Furthermore, unit rates are generally adopted without reference to capacity commitments.

An urgent review of the processes for discussing and adopting unit rates is required.

The new processes should:

- require that complete and transparent data are available;
- have a longer-term focus, with clear performance objectives and business plans to meet them, in addition to a short term focus on next year's unit rates;
- ensure that airspace users and ANSPs are more directly involved in, and accountable for, decisions on capacity and cost plans, and that risks are shared more equitably between them;
- stimulate ANSPs to meet their performance objectives, and do away with the full cost recovery principle if necessary;
- induce ANSPs to objectively review if the various facilities and services are in line with requirements.

Flight-efficiency

Potential flight efficiency gains are estimated to be in the range of 2-5%, corresponding to potential savings of € 200M-€ 1 400M annually. However, trade-offs with other KPAs, except safety, must be considered.

The implementation of RVSM has been beneficial for flight-efficiency as it has reduced fuel burn by 1.7% to 2%, which equates to ~100 000 less flights per year in ECAC airspace.

Airports

Runway capacity is a limitation at key airports, and is likely to remain so. ATM should seek to maximise the use of this finite resource.

Airport ATFM delays tend to originate from a few airports and little progress has been observed in this respect. Relevant bodies, such as the EUROCONTROL Agency, should review progress made in resolving critical airport issues on a regular basis.

Metering and spacing would help maximise runway throughput, while minimising holding requirements and consequential environmental impact. Its implementation may, however, require spare en-route capacity, a more tactical approach to ATFM, and greater co-operation among ANSPs.

Trade-offs

Trade-offs can be made between delays, cost-effectiveness and flight efficiency.

One objective of the ATM 2000+ Strategy is to reduce the total cost per flight. This objective has approximately been met since 2000, with decreasing unit delays compensating for increasing unit costs. Both delays and costs will need to be managed carefully if the objective is to be met in the future (see Figure 4).

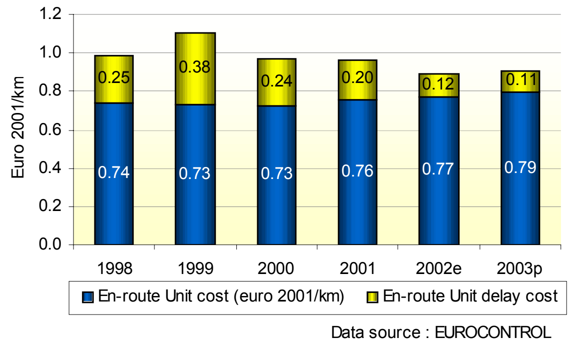


Figure 4: Total unit cost

If resource management is flexible enough to adapt to traffic (with a suitable safety margin), then both cost-effectiveness and delays can be optimised in the short-term, using the same resources more efficiently.

Flexibility of resource allocation is clearly an important factor in ATM performance. However, flexibility also has social implications. Achieving an optimum level of flexibility will be an item for ANSP management and staff to address.

The trade-off between delay and flight efficiency needs to be understood before any rules or incentives are agreed.

US-Europe comparison

The PRC has compared cost-effectiveness of the US and European ATM systems for the year 2001, both at system level and in a sample of en-route centres.

Cost-effectiveness was broken down into three main components (ATCO productivity, employment costs, support costs), using a robust methodological framework.

In the following text, ratios higher than 1 indicate higher performance in the US.

System level

The system-level comparison confirmed earlier findings (c.f. PRR 4). The average cost per flight-hour was 73% higher in Europe than in the US in 2001, resulting from higher ATCO productivity (ratio 1.79), higher employment costs (ratio 0.62) and lower support costs (ratio 1.56) in the US.

Centre level

A detailed comparison of nine en-route centres (Barcelona, Karlsruhe, London, Maastricht, Reims, Rome, Albuquerque, Cleveland and Indianapolis) found similar ratios at centre level. The average cost per flight-hour was 62% higher in the European than in the US sample (ratio 1.62). This can be broken down as follows:

- The ATCO hourly productivity is, on average, 29% higher in the US than in Europe (ratio 1.29). This difference arises principally from flexibility in the use of resources;
- Employment costs of US ATCOs are some 41% higher than in the European sample (ratio 0.71), which is compensated by higher working hours (ratio 1.32), resulting in similar employment costs per hour (ratio 0.94);
- The support cost ratio is 34% higher in the European sample (ratio 1.34). This is a major cause of the overall difference. Both labour and non-labour support costs are consistently higher or equal in the European centres.

As performance ratios are similar at system and centre levels, one can infer they are similar in the rest of the system (terminal services, CNS infrastructure, capital costs and overheads) which will need to be explored in more detail.

Performance drivers

Several underlying performance drivers could be identified and their influence quantified to some extent, namely social and cultural differences, traffic variability and adaptation through flexibility in the use of resources, and ATFM procedures.

As there was no systemic difference in measured complexity indicators between the selected US and European centres, traffic complexity could not be an explanatory factor for the performance difference among the centres studied.

Single European Sky

The conclusions in this report should be taken into account when implementing the Single European Sky (SES):

- A homogeneous legal framework specifying duties and liabilities in the case of delegation of the responsibility to provide ATS should be applicable in all Member States;
- the European Commission should identify and adopt the ESARRs that shall be made mandatory under Community law without delay;
- there is a need for strong safety regulation and oversight, based on harmonised standards. The combination of a European safety regulatory framework and regional safety regulation could strike the right balance between the needs for harmonisation, efficiency, qualified personnel and understanding of local issues;
- implementation measures of the SES should foster enhanced co-operation and interoperability among ANSPs;
- the European Community should adopt implementing rules for the provision of information by ANSPs, building on the Economic Information Disclosure rules adopted by EUROCONTROL, and provide for enforcement;
- implementation measures of the Single European Sky should seek to reduce fragmentation.

1 INTRODUCTION

1.1 About this report

1.1.1 This sixth Performance Review Report (PRR 6) of EUROCONTROL's Performance Review Commission (PRC) presents:

- traffic demand placed on the European Air Traffic Management (ATM) System in 2002 (Chapter 2);
- its response under the following Key Performance Areas: Safety (Chapter 3), Delays (Chapter 4), Cost-effectiveness (Chapter 5), Flight Efficiency (Chapter 6);
- PRC analysis of some critical elements for ATM performance: Terminal areas and Airports (Chapter 7), Trade-offs (Chapter 8), US/Europe comparisons (Chapter 9) and Single European Sky (Chapter 10);
- PRC recommendations submitted for decision to the Permanent Commission, through the Provisional Council (developed after the consultation meeting) and corresponding decisions (Chapter 11);

PRR 6 does not address any civil-military issues.

1.1.2 Unless otherwise indicated, data used in this report refer to the calendar year 2002.

1.2 The Performance Review Commission

1.2.1 The PRC was established by the Permanent Commission of EUROCONTROL in 1998, following adoption of the European Civil Aviation Conference (ECAC) Institutional Strategy (ref. 1). It states 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".*

1.2.2 The PRC is composed of twelve independent members, appointed for two years, renewable once. The PRC's second term of office ended on 31 December 2002 and nine new PRC Members took office on 1 January 2003. PRR 6 has, therefore, been prepared by the current PRC as well as by the previous PRC Members. More information about the PRC is provided on the inside-back cover of this report.

1.3 PRC processes

1.3.1 The PRC reviews ATM performance issues on its own initiative, at the request of the deliberating bodies of EUROCONTROL or of third parties. It prepares annual Performance Review Reports (PRR), benchmarking reports on Air Navigation Service Providers (ANSP), and *ad hoc* reports. The PRC assembles relevant information, consults concerned parties and draws conclusions. The PRC consults the aviation community on these conclusions before submitting recommendations for decision to the Permanent Commission, through the Provisional Council. The PRC monitors actions taken following its recommendations, and updates a status report on the EUROCONTROL web site (www.eurocontrol.int/prc).

1.3.2 The underlying methodology used in PRRs, e.g. Key Performance Areas (KPA) and Indicators (KPI), has been developed in consultation with interested parties. The principal KPAs used to date are Safety, Delays and Cost-effectiveness. For the safety KPA, the PRC uses safety data provided by the Safety Regulation Commission (SRC) and other sources.

1.3.3 The PRC attaches great importance to having open and ongoing consultation with all sectors of the aviation community. PRR 6 has been discussed in open forum with all interested parties at a consultation meeting held on 19 May 2003. The outcome of that meeting has been taken into account when developing the recommendations (see Chapter 11) to the 17th Session of the Provisional Council (July 2003). This report and associated recommendations are submitted six weeks in advance to the Provisional Council, which gives Members sufficient time to consider them.

1.4 PRC work in the International Context

1.4.1 The ratification of the Revised Convention (ref. 2), the accession of the European Community[2] to EUROCONTROL, and the adoption of the Single European Sky (SES) legislative package (ref. 3) will create a new institutional environment for ATM in Europe, whose main purpose is to improve ATM performance.

1.4.2 On a global level, the International Civil Aviation Organisation (ICAO) is currently developing concepts for ATM performance, notably through its ATM Concepts Panel (ATMCP). Five conceptual levels have been identified for ATM performance as shown in Figure 5 below.

1.4.3 The PRC's work on ATM performance in terms of safety, delays and flight-efficiency is particularly relevant for Level 2 - Required ATM System Performance (RASP). The PRC will address other KPAs such as predictability in due course.

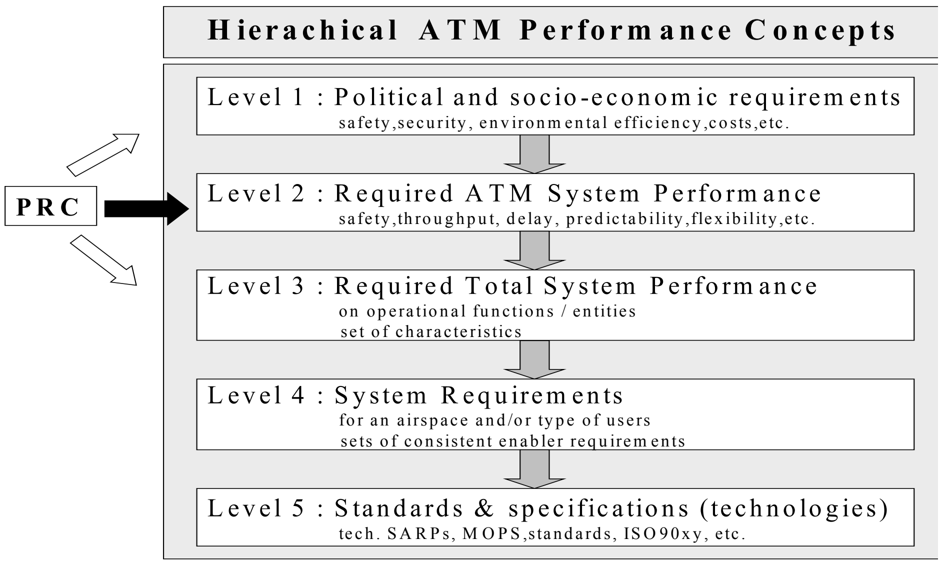


Figure 5: Hierarchy of ATM Performance Concepts

1.5 Further Information

1.5.1 PRC documents, Performance Review Reports and associated recommendations are available from the PRC web site (http://www.eurocontrol.int/prc) or upon request from the Performance Review Unit (PRU), the PRC's supporting unit. The PRU's e-mail address is PRU@eurocontrol.int.

[2] The protocol of the European Community's accession to EUROCONTROL was signed on 8 October 2002

2 TRAFFIC

2.1 Traffic demand

2.1.1 In the wake of slower economic growth and 11 September terrorist events, traffic decreased for the second consecutive year (-1.9% in 2002, -0.6% in 2001). Key traffic indicators are given in Figure 6 for General Air Traffic (GAT) flying under IFR.

Year 2002	Actual	Variation 2001/2002	Forecast	Index 100 in 1990
IFR flights[3]	8.237M	-1.9%	-0.4%	156
IFR flight hours[4]	11.3M	-1.8%	N/A	N/A
Distance flown[5] (Km)	6 293M	-1.4%	N/A	177[6]

Data source: EUROCONTROL

Figure 6: GAT IFR Traffic in Europe

2.1.2 As indicated in Figure 7 (right graph), traffic decreased in the first three quarters of 2002. Recovery started in the last quarter, but traffic in 2002 still remained below 2000 levels.

2.1.3 Forecasts made in 2002 anticipated traffic growth from 2003 onwards, albeit well below levels predicted in 2000 (see Figure 7, left graph). In the light of international events in 2003, these forecasts should be treated with caution.

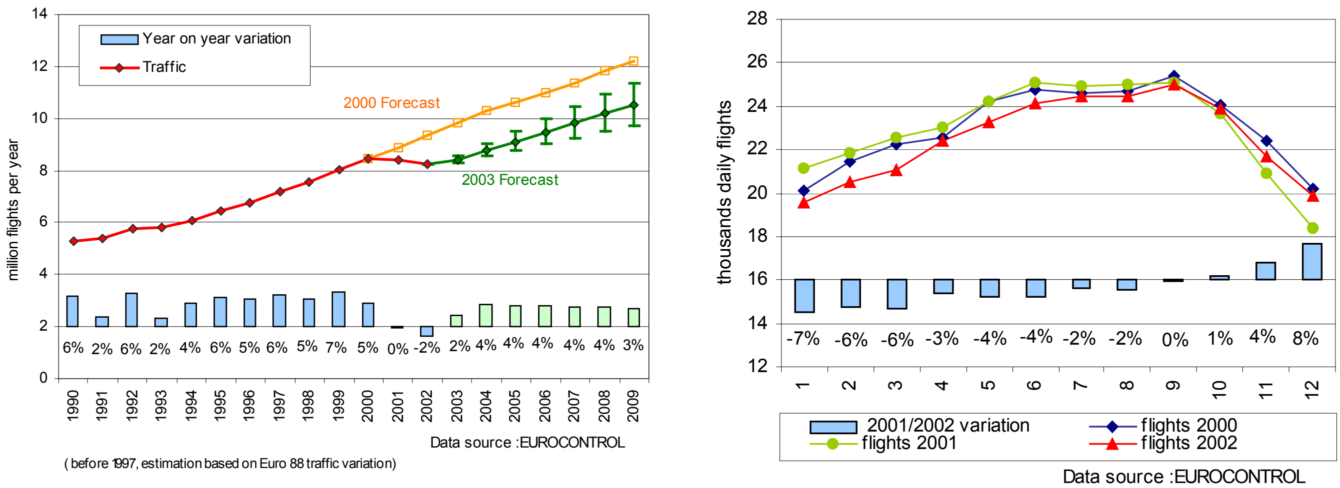


Figure 7: Yearly and monthly traffic variations

2.1.4 However sophisticated, there will always remain some uncertainty in traffic forecast.

3 CFMU Area (see glossary)
4 EUROCONTROL Member States
5 States participating in the Route Charges System in 2002, excluding Santa Maria (see glossary)
6 States participating in the Route Charges System in 1988 (see glossary)

2.2 Traffic variability

2.2.1 Although uncertain, yearly traffic variations (typ. 4.8%)[7] are generally well below seasonal, weekly and diurnal traffic variations (see Figure 8 and Figure 9).

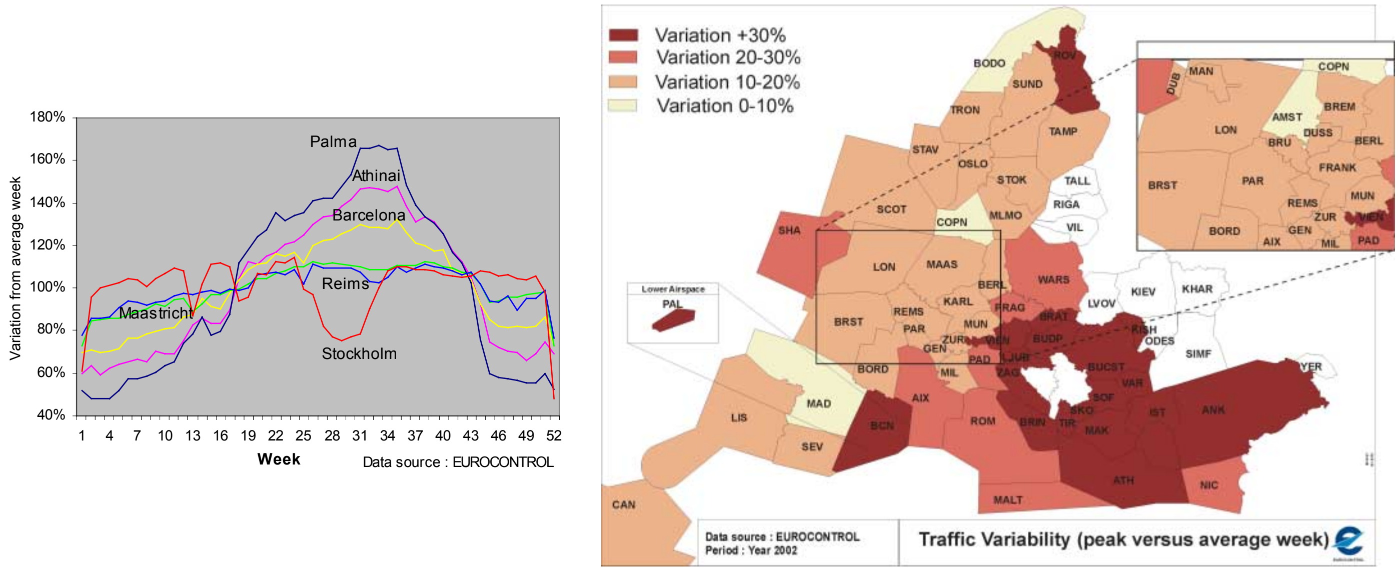


Figure 8: Seasonal traffic variations

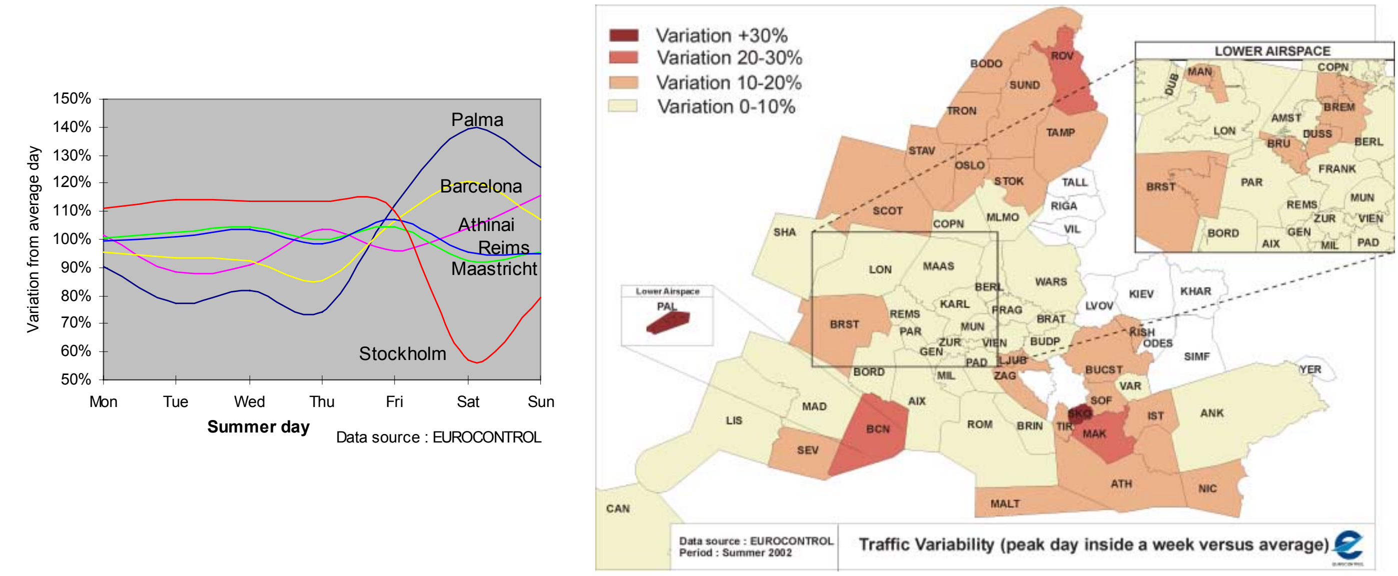


Figure 9: Within week traffic variations

2.2.2 Traffic variations are not controlled by ANSPs, yet can have a strong influence on their performance. Traffic variations are mostly predictable (e.g. Saturday's traffic is always higher in a given centre).

2.2.3 ANSPs have a responsibility to adapt to known traffic variability, to consult their customers in order to anticipate changes in future demand and to manage the remaining "volume" risk.

[7] Traffic grew 4.8% per annum, on average, from 1990 to 2000

2.3 Geographical traffic breakdown

2.3.1 Traffic growth differed significantly across States, with strong growth in south-eastern Europe, as shown in Figure 10. Busiest routes tend to be concentrated in the area delimited by London, Frankfurt, Rome and Paris.

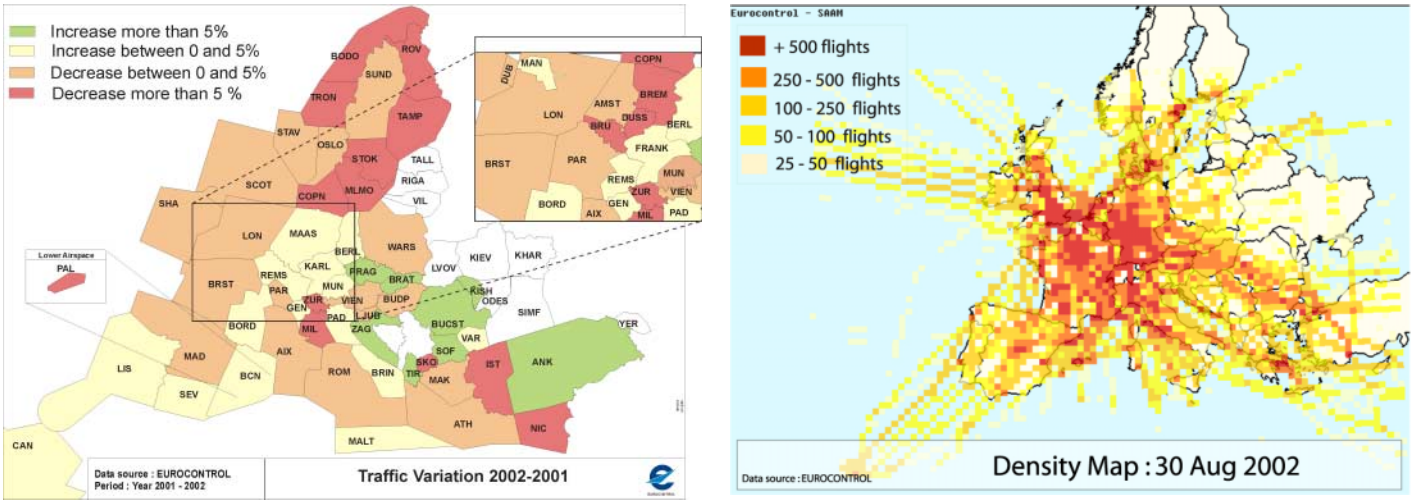


Figure 10: Traffic variations and density

2.3.2 Figure 11 shows marked differences in traffic composition across States. As expected, States with smaller traffic levels have more over-flights, except Norway and Finland.

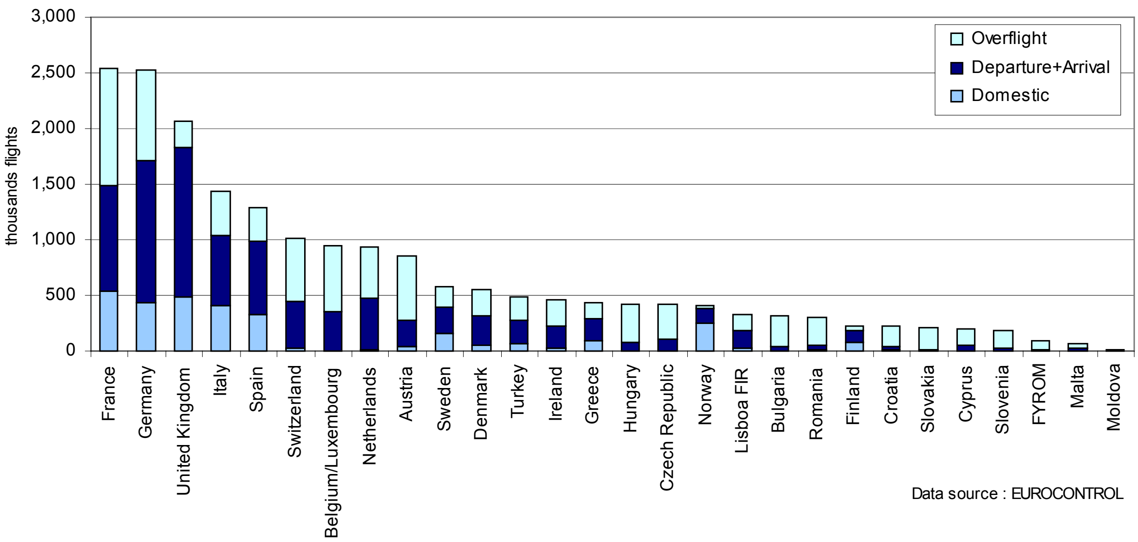


Figure 11: Traffic composition per State

2.4 Breakdown per aircraft operator

2.4.1 The distribution of traffic per aircraft operator is similar to that observed in 2001[8]: the top 100 airlines operate 80% of European flights (see Figure 12).

2.4.2 While national and charter airline traffic decreased, the "low-cost" segment enjoyed high growth (+24% flights). This segment presently constitutes a small part of air traffic, but is expected to increase significantly. Consequent changes in traffic patterns are already visible: more numerous and lighter flights in some areas (e.g. Hurn sector in London).

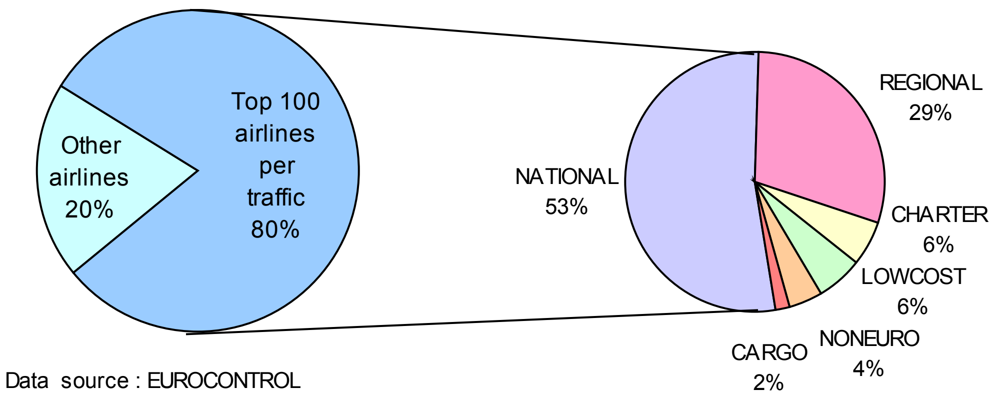


Figure 12: Traffic breakdown per type of operator (Top 100 airlines)

2.5 Conclusions

2.5.1 Traffic growth was negative for the second consecutive year (-1.9% in 2002, -0.6% in 2001).

2.5.2 Traffic variations are mostly predictable, but there will always remain some uncertainty in traffic forecast. ANSPs have a responsibility to adapt to known traffic variability, to consult their customers in order to anticipate changes in future demand and to manage the remaining "volume" risk.

8 See PRR 5, Figure 14 (ref. 11).

3 SAFETY

3.1 Introduction

3.1.1 2002 saw the first mid-air collision in Europe involving two commercial airliners in more than 25 years (Überlingen 1/7/2002). This continues a worrying series of accidents (Paris 2000, Milan and Zurich 2001).

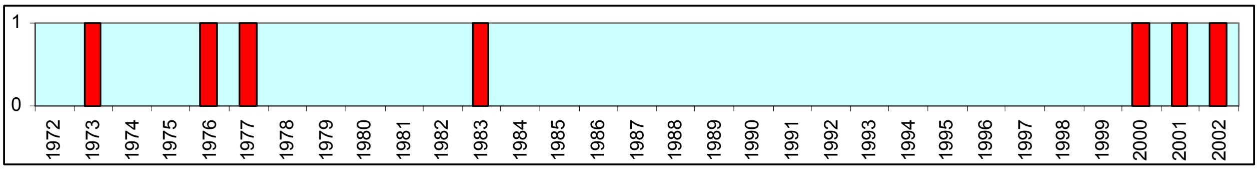
3.1.2 Safety is the first Key Performance Area. This chapter reviews the safety performance of the European ATM system up to year 2001 for all reported safety occurrences and includes year 2002 for publicly known accidents. It also examines factual evidence to ascertain the safety situation in ECAC and analyses some key safety issues.

3.1.3 In performing these analyses, the PRC relies to a large extent on the safety data reported by States as part of the ESARR 2 (ref. 4) process. The timing of this process is such that only data up to year 2001 were available for this report (and initial information on accidents in 2002). This chapter was consulted with the SRC prior to its adoption by the PRC.

3.2 Accidents

Accident statistics

3.2.1 Over the past 30 years, there have been a very small number of fatal accidents with direct ATM contribution involving commercial aircraft (see Figure 13). However, three such accidents in the last three years indicate the need for action. EUROCONTROL, ANSPs and airspace users are taking vigorous steps to address the situation: AGAS (ref. 5), Strategic Safety Action Plan, Action Plan for the Prevention of Runway Incursion, ESARR Implementation Monitoring and Support Programme.



Data source: PRU (2001 and 2002 data still provisional)[9]

Figure 13: Fatal accidents involving air transport (direct ATM contribution)

3.2.2 There were six fatal accidents involving commercial aircraft in ECAC in 2002 (see Figure 14), causing a total number of 101 fatalities, including crew and passengers.

Carrier	Aircraft	Date / Location	Fatalities
Agco Corp.	Canadair CL-604	04.01 / Birmingham, UK	5
Ibertrans Aérea	Embraer 120	14.01 / near Zaldibar, Sp.	3
Tadair	Metro	12.04 / Majorca, Sp.	2
Bashkirskie Avialinii	Tupolev 154	01.07 / Überlingen, D	69
DHL	Boeing 757	01.07 / Überlingen, D	2
Luxair	Fokker 50	06.11 / Luxembourg, L	20

Figure 14: Fatal accidents involving commercial aircraft in ECAC in 2002

9 Pending final reports for formal identification of causes, the interim reports indicate that ATC was a factor for the Milan and Überlingen accidents. The contribution of ATC will be known once the final reports are published.

3.2.3 In the 24 ECAC States (out of 41) which have sent reports to the SRC for year 2001, there were 121 fatal civil aviation accidents, including VFR traffic. The detail and quality of States' reports does not allow the SRC to further separate IFR from VFR categories. Meanwhile, ICAO ADREP data show 28 reported accidents involving aircraft with maximum take-off weight greater than 2.25t. As shown in Figure 15, ATM contribution to accidents is small, but not zero as ideally it should be.

Fatal accidents (24 States, 2001)	
Total	121
ATM direct contribution	2
ATM indirect contribution	2

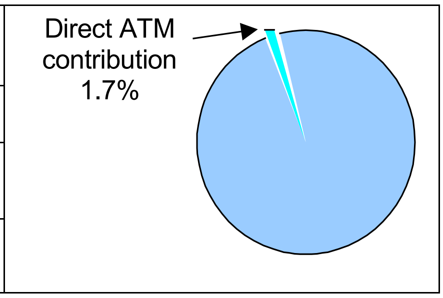
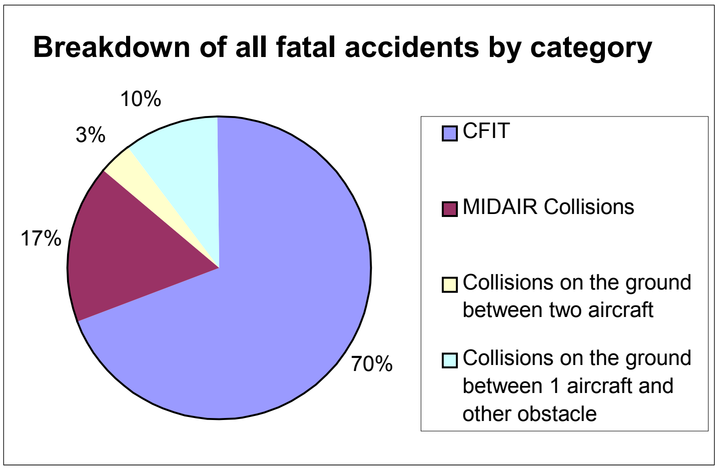


Figure 15: ATM contribution in fatal accidents (24 States, 2001)

Accident causes



Source: SRC annual report (ref. 6)

Figure 16: Breakdown of civil aviation fatal accidents (2001)

3.2.4 As shown in Figure 16, Controlled Flights into Terrain (CFIT) are dominant. Although the main responsibility lies with aircraft operators, national authorities can contribute to enhanced safety by making available optimum approach procedures, landing aids, and safety nets (MSAW[10]).

3.2.5 Mid-air collisions form the second largest fatal accident category (17%, see Figure 16). There were five reported fatal mid-air collisions in 2001, with no IFR implication. In general, most mid-air collisions involve VFR traffic. Incidents are even more numerous and many are not reported. The original “see-and-avoid” concept used in VMC, given present aircraft speeds and density, may need to be complemented using affordable technology[11].

[10] Fourteen States have fully implemented Minimum Safe Altitude Warning (MSAW) and 18 States plan to deploy it. Four States have no plan to implement MSAW. Some more delay is noted in MSAW for final approach implementation as only 7 States have fully implemented it and 16 States plan to deploy it. (Source: CIP Status Report 2002)

[11] The PRC notes that technology enabling pilots to “see” neighbouring traffic is being tested in Europe, the USA and elsewhere. Minimum performance requirements could apply to all aircraft

3.2.6 There are a significant number of reported collisions on the ground (13%), in particular runway incursions, which warrants special attention. There have been two fatal accidents involving commercial traffic on runways (Paris CDG in 2000, Milan-Linate in 2001). The EUROCONTROL Action Plan for the Prevention of Runway Incursion was launched in 2001.

3.3 Incidents

3.3.1 European safety regulatory requirements (ESARR 2) require States to submit annual reports. From these, the SRC derives statistics on accidents, incidents and ATM-specific occurrences. Analysis and conclusions are published in their Annual Report. As this report is not public, an extract is reproduced in Annex 1.

3.3.2 Figure 17 shows two key aspects of incident reporting:

- The number of AIRPROX reports has increased. In general, the number of reports should be as high as possible in order to ensure best possible visibility on accident precursors. Although the number of incident reports has increased in recent years, incident reporting is far from satisfactory in many States.
- Separation minima infringements, which should be as low as possible. The number of such occurrences decreased in 2001, but many States still do not provide adequate reports.

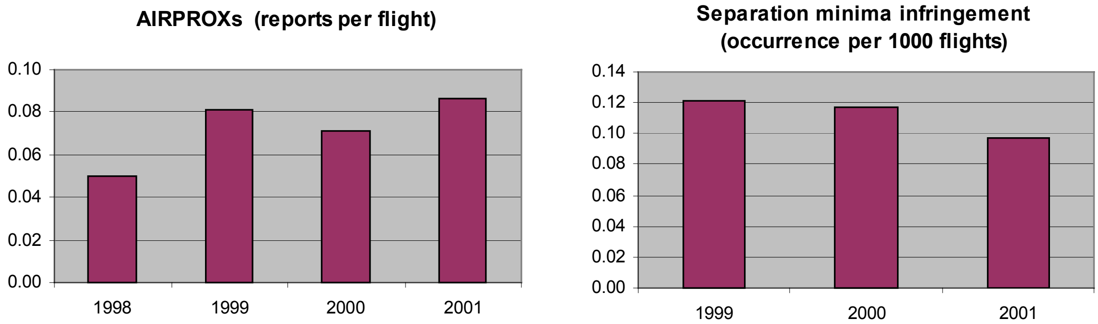


Figure 17: Incidents and separation minima infringement indicators

(Data source: SRC, from States' reports)

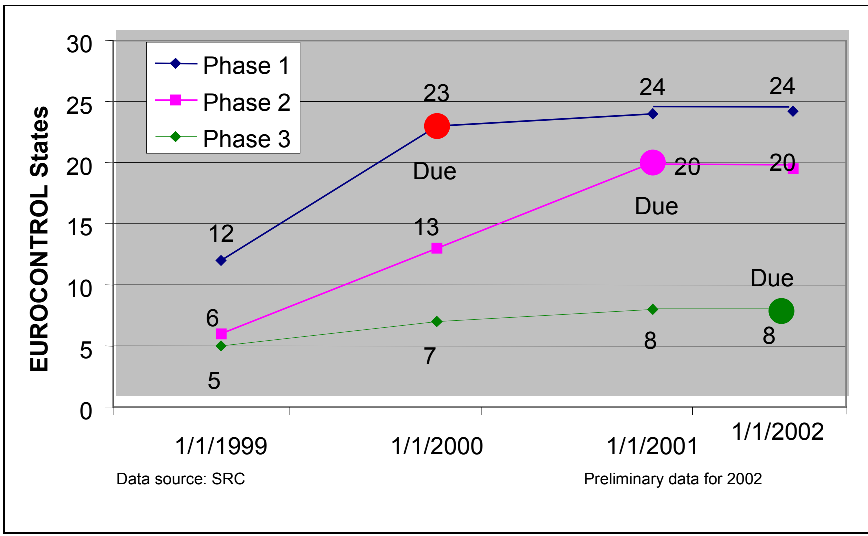
3.3.3 The SRC points out that inconsistencies and incomplete data prevent a truly comprehensive analysis. Until all States report consistently and completely, it is not possible to detect whether safety performance is improving or deteriorating.

3.4 Incident detection and reporting

Implementation of ESARR 2

3.4.1 All phases of ESARR 2 are applicable to EUROCONTROL Member States on a mandatory basis from 1st January 2002. According to official implementation status, implementation of ESARR 2 is late in several States (see Figure 18).

including gliders provided suitable avionics are mass-produced and marketed at an affordable price.



ESARR 2 Phases

Phase 1: Due by 1 Jan 2000
Reporting of accidents and incidents-near collisions

Phase 2: Due by 1 Jan 2001
Reporting of incidents *with a potential to become collisions or near collision.*

Phase 3: Due by 1 Jan 2002.
Reporting of ATM *specific occurrences* having an impact on the ability to provide safe ATM

Figure 18: Official implementation status of ESARR 2 at 1/1/2002

3.4.2 Furthermore, audits conducted under the "ESARR Implementation Monitoring and Support Programme" indicate that effective implementation is often incomplete.

3.4.3 Figure 19 illustrates that only one quarter of all accidents was classified in accordance with ESARR 2. This is a clear example of incomplete implementation of ESARR 2.

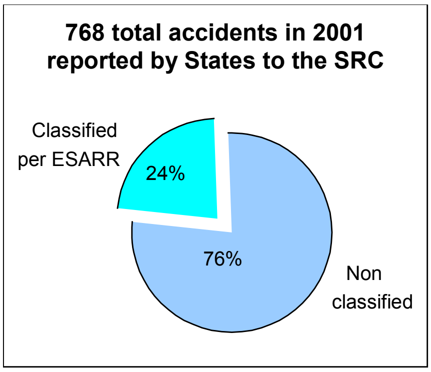


Figure 19: Classification of accidents per ESARR 2

3.4.4 It is not acceptable that implementation of such important safety regulatory requirements as ESARR 2 is so slow and incomplete. As foreseen in the Single European Sky draft regulation (ANS, art 4), the European Commission will identify and adopt the ESARRs that shall be made mandatory under Community law. This should be done without delay as soon as the regulations enter into force.

3.4.5 Furthermore, the status of compliance of individual States with safety regulations has been considered as confidential under the "Publication and Confidentiality Policy" (ref. 7), despite its non-prescriptive wording. The PRC considers that the implementation status of standards by States should be public information and not covered by any confidentiality policy. The status of this policy is currently under review[12].

[12] See information paper PC/03/16/22 (April 2003)

Automated tools

3.4.6 Since detection of all incidents is paramount for a thorough safety assessment and in building reliable safety indicators, automated incident detection should be used to enhance human reporting schemes. Feasibility and safety benefits of automated incident detection and reporting are clearly demonstrated by experience in the United Kingdom (Safety Monitoring Tool) and France (OPERA).

3.4.7 EUROCONTROL has developed the Automated Safety Monitoring Tool (ASMT) for incident detection and reporting, which is now used in Maastricht and will soon be introduced by the Slovak ANS.

3.4.8 The implementation of such automated tools and related procedures should be encouraged and even mandated. A non-punitive culture is essential when introducing such processes.

3.4.9 Common standards and associated classifications have been defined in ESARR 2. EUROCONTROL has developed suitable tools to assist in the analysis and classification of safety occurrences in accordance with ESARR 2, and a few national developments exist as well. There is no reason why the use of such tools should not be generalised, in order to help the proper and full implementation of ESARR 2.

Publication and dissemination of safety reports

3.4.10 Timeliness of safety reports is an important factor in promoting safety. Some States do monitor publication delays (e.g. France). This is a commendable practice and more States should follow suit.

3.4.11 Many reports of accidents and/or serious incidents are available from national authorities only in their national language, which virtually bars dissemination of lessons learnt. ICAO should require final reports, or at least a synopsis, to be issued also in English within a specified time period.

3.5 Safety performance

European safety targets

3.5.1 The ATM 2000+ Strategy safety objective is to "*ensure that the numbers of ATM induced accidents and serious or risk-bearing incidents do not increase and, where possible, decrease*."

3.5.2 The SRC has calculated an associated upper limit for accidents with direct ATM contribution and involving commercial air transport, which is valid only for design purposes and for safety performance monitoring in the long-term. It is no more than 0.623 accidents per year[13].

3.5.3 It is questionable whether this upper limit is politically viable[14]. The ATM 2000+ Strategy objective and associated upper limit should be reviewed[15].

3.5.4 There is no target concerning incidents at present.

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13 SRC POL DOC 1, restricted EUROCONTROL

14 Three accidents every five years would meet the upper limit for accidents with direct ATM contribution and involving commercial air transport.

15 Two recent documents suggest new possible safety targets: "European Aeronautics, A Vision for 2020" (ref. 15) and "ACARE Strategic Research Agenda".

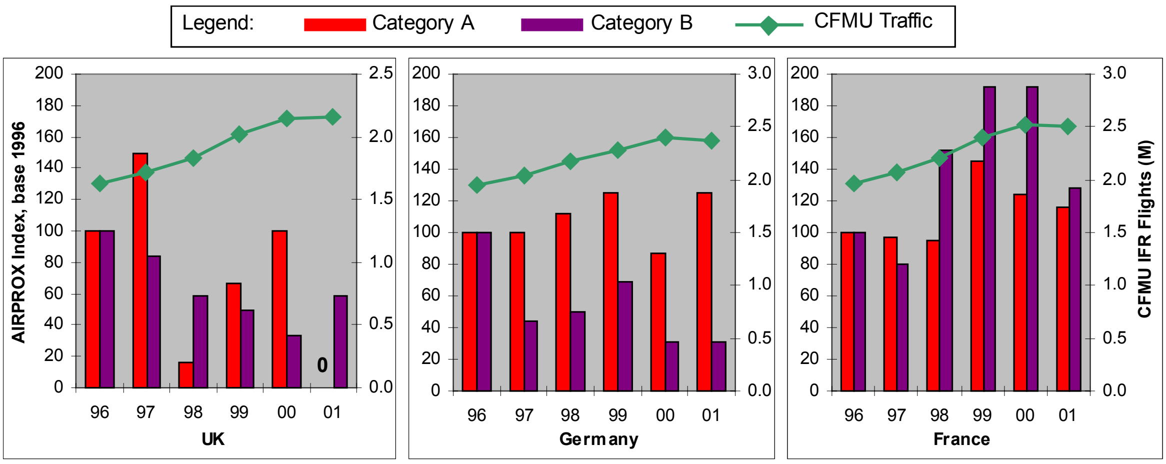
National safety targets and indicators

3.5.5 States should set national targets, as recommended in the SRC Policy DOC 1 and amendment 40 to ICAO Annex 11. The PRC presently has no evidence of whether this is being done.

3.5.6 AIRPROX severity classification criteria are not consistent across States. The application by States of harmonised classification criteria should remedy this situation.

3.5.7 AIRPROX severity classification criteria should be consistent over time in each State. If so, it is relevant to observe the trend of national indices over time.

3.5.8 Although Europe-wide key safety indicators do not exist, some States do publish national indicators. For example, Figure 20 shows official AIRPROX statistics published by the United Kingdom, Germany and France. Indexes for Cat A and B[16] AIRPROX were computed, using year 1996 data as base 100.



Data source: National public reports

Figure 20: National AIRPROX indices (UK, Germany, France)

3.5.9 Weighted sums of consistent trends are also consistent. For illustration purposes only, Figure 21 shows a composite safety indicator for those three States[17]. The PRC considers that the underlying classification schemes are not robust enough for valid conclusions to be drawn from this graph.

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16 AIRPROX A - Risk Of Collision: "The risk classification of an aircraft proximity in which serious risk of collision has existed". AIRPROX B - Safety Not Assured: "The risk classification of an aircraft proximity in which the safety of the aircraft may have been compromised". Source: ICAO DOC 4444.

17 The composite indicator was computed as the sum of yearly national AIRPROX indexes (2/3 Cat A + 1/3 Cat B, with base 100 in 1996), weighted in proportion to national traffic over the period. The corresponding traffic sample represents approximately 40% of the total flight-hours recorded in the CFMU area in 2001.

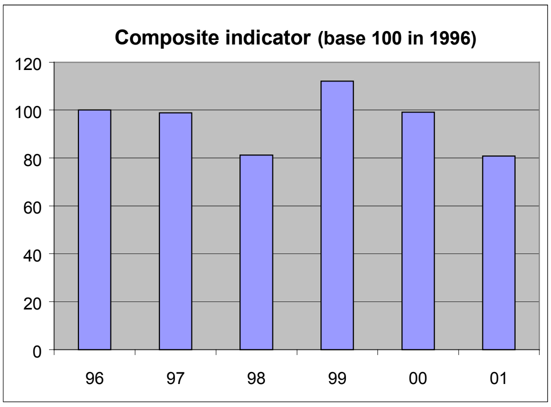

Figure 21: Composite safety indicator for UK, Germany and France

Key safety indicators

3.5.10 The purpose of key safety indicators is to determine whether risk is increasing or decreasing, with enough confidence to allow management decisions to be taken. Key indicators also allow to test whether strategic objectives, in particular the ATM 2000+ Safety objective, are being met.

3.5.11 Upon a PRC recommendation[18], the Provisional Council requested the SRC "*to propose adequate ECAC-level safety performance indicators **before July 2003**, and associated targets at an appropriate juncture, … and to include corresponding indicators in its regular safety reports to the Provisional Council*".

3.5.12 The SRC has defined a large structured set of safety indicators. Only a small set of key safety indicators should be submitted for adoption. Indicators in Figure 17 and Figure 21 are examples of possible key safety indicators. However, robust classification and incident reporting schemes are pre-requisites for the publication of key safety indicators.

3.5.13 In the absence of quantified safety objectives and indicators, it is not clear whether the ECAC safety objective is being met.

3.5.14 Figure 22 presents the current status of European safety targets and indicators.

Safety objective	Key Safety indicators	Safety targets
Qualitative objective in ATM 2000+ Strategy	KPIs to be selected KPIs to be measured	Long-term upper limit for accidents to be reviewed Targets to be set for incidents

Figure 22: European safety targets and indicators

3.6 Safety Survey on legal impediments to non-punitive reporting

3.6.1 The PRC conducted a survey (ref. 8) of legal constraints to Penalty-free ATM Safety Occurrence Reporting in Europe.

3.6.2 Its objectives were to focus on legal constraints and on potential shortfalls in national safety regulations that would not support a "non-punitive" ATM safety occurrence reporting culture. Moreover, the study explored other factors, such as management culture, that might inhibit staff from reporting ATM safety occurrences for fear of being blamed or punished.

[18] See PRR 5, section 3.10.

3.6.3 Questionnaires addressed to service providers, safety regulators, accident investigation boards where applicable, and Air Traffic Controllers' organisations were then followed by interviews with a sample of respondents.

3.6.4 All information provided was treated in confidence, being published only in a de-identified format, except with prior approval. The survey contains frank assessments of safety occurrence reporting as perceived by the people in the front-line.

3.6.5 The following key messages have emerged:

1. In many States, there are significant legal constraints to non-punitive ATM safety occurrence reporting. As a result, many staff feel inhibited from reporting. This is particularly so where States have "Freedom of Information" legislation in place and have not taken steps to protect safety reports from its application.
2. The overwhelming majority of respondents, including non-EU States, saw EU legislative proposals as a major enabler to implement non-punitive reporting.
3. Poor communication between the "people in the field" and the various levels of management in a number of ANSPs is a noteworthy finding.
4. There is a poor perception of safety regulators. Safety regulators were perceived in many States to be weak, with an ill-defined role, often no ATM expertise, with funding constraints and possible conflicts of interest.

3.7 Key risk areas

3.7.1 Thanks to better incident reporting and safety initiatives currently underway, there is progress in awareness of key risk areas[19] and in corrective actions. Some of the most important such issues are:

- *"Runway safety is an issue in Europe and improvements in this field are absolutely necessary."* This was a conclusion of an international workshop on runway incursions organised by EUROCONTROL in September 2002 [20];
- level busts are increasingly quoted as a serious safety issue in some but not all States. As pilot practices are unlikely to differ across borders, it is likely that many level busts pass unnoticed due to lack of suitable detection systems, of awareness or of proper reporting. This tends to reinforce the need for systematic incident detection;
- use of national languages has been identified as a contributory factor in several incidents, and in at least two recent accidents (CDG and Linate). The use of English for international IFR flights and at major international airports would improve the situation;
- prolonged loss of air-ground communication has recently been acknowledged as a potential risk area. The SRC is addressing this matter;
- conflicting ATC and TCAS instructions are a very serious issue;[21] the Überlingen mid-air collision is evidence of that.

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[19] In past reports, the PRC was unable to publish more than anecdotal evidence of key risk areas.

[20] The Agency had initiated a Europe-wide action programme on runway incursions, even before the accident in Milan Linate.

[21] A near mid-air collision happened in Japan in January 2001 in almost identical conditions to the Überlingen accident: TCAS and ATC issued conflicting instructions simultaneously, one pilot followed TCAS, the other ATC. Japan made a specific recommendation to ICAO, but effective action could not be taken in time. Such events, although rare, are not singular and awareness of the problem is still too low.

3.8 Safety regulation and oversight

3.8.1 The findings of the PRC safety survey (ref. 8) concerning national safety regulation can be summarised as follows:

- the necessary national legal tools are not always in place;
- international regulations (ICAO SARPs and EUROCONTROL ESARRs) are not properly or fully implemented in some cases;
- some national safety regulators are inappropriately staffed and funded, or are dependent on the regulated ANSP for funding, expertise and resources;
- adequate separation of regulation and service provision is not properly ensured, especially when the regulator is also involved in service provision.

3.8.2 Safety regulation must be coherent among Member States. Furthermore, safety regulation requires expertise and resources. A minimum size for both the regulator and the regulated organisations seems to be required for efficient safety regulation. Thus, a regional regulator (e.g. Nordic area) is likely to ensure availability of proper resources while maintaining awareness of local issues. However, this must be done within a European regulatory framework to ensure harmonisation.

3.8.3 Implementation of and compliance with regulations must be subject to oversight. The recent ESARR Implementation Monitoring and Support Programme and the ICAO USOAP will provide an overview of State's compliance with standards and requirements. States' compliance with safety regulatory requirements should be public information.

3.8.4 Enforcement through EC legislation[22], when applicable, may also be warranted.

Legal aspects

3.8.5 There is evidence that a well-developed reporting system may be virtually shut down by one legal action. In one State, a legal investigation was initiated on the basis of an incident report that was made under a voluntary occurrence reporting scheme. Consequently, ATCOs refrained from reporting incidents, thus depriving the system of valuable safety information.

3.8.6 The EC draft Directive on Occurrence Reporting, when implemented, may help to improve the reporting flow in many States where significant legal constraints to non-punitive ATM safety occurrence reporting exist.

3.8.7 Moreover, the apportionment of liability can be an obstacle to delegation of responsibility to provide ATS or for building functional airspace blocks[23]. A homogeneous legal framework specifying duties and liabilities in the case of delegation of the responsibility to provide ATS should be applicable in all Member States.

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22 Applicable in the EEA (EU, Norway, Liechtenstein and Iceland) and Switzerland.

23 The Swiss/German situation following the mid-air collision illustrates some of the problems.

3.9 Conclusions

3.9.1 2002 saw the first mid-air collision in Europe involving two commercial airliners in more than 25 years (Überlingen 1/7/2002). This continues a worrying series of ATM related accidents (Paris 2000, Milan 2001). This indicates significant safety issues in ATM. However, EUROCONTROL, ANSPs and airspace users are taking vigorous steps to address the situation: AGAS, Strategic Safety Action Plan, Action Plan for the Prevention of Runway Incursion, ESARR Implementation Monitoring and Support Programme. The PRC supports these initiatives and will closely monitor results.

3.9.2 Safety occurrence reporting is a major element in identifying accident precursors and preventing accidents. There are major shortcomings in incident reporting:

- uneven and variable levels of incident reporting at ANSP level;
- incomplete implementation of ESARR 2 by States;
- legal impediments to incident reporting in many States;
- poor timeliness of summary reports;
- absence of key safety indicators and corresponding targets;
- poor transparency;
- no systematic detection of safety occurrences in most States.

3.9.3 It is not acceptable that implementation of important safety regulatory requirements such as ESARR 2 is so slow and incomplete. As foreseen in the Single European Sky draft regulation (ANS, art 4), the European Commission will identify and adopt the ESARRs that shall be made mandatory under Community law. This should be done without delay as soon as the regulations enter into force.

3.9.4 Systematic detection using automated tools should be encouraged and possibly even mandated. This would, *inter alia*, help the safety trend to be examined at European level.

3.9.5 A non-punitive culture is necessary to ensure an adequate flow of safety incident reports. The Safety Survey reveals that this is lacking in most States. A uniform European legal framework would be desirable.

3.9.6 There is a need for strong safety regulation and oversight, based on harmonised standards. The combination of a European safety regulatory framework and regional safety regulation could strike the right balance between the needs for harmonisation, efficiency, qualified personnel and understanding of local issues.

3.9.7 States' compliance with safety standards should be public information.

3.9.8 ICAO and/or EUROCONTROL should promote the timely dissemination of significant findings from incident reports, in the English language.

4 CAPACITY AND DELAYS

4.1 Introduction

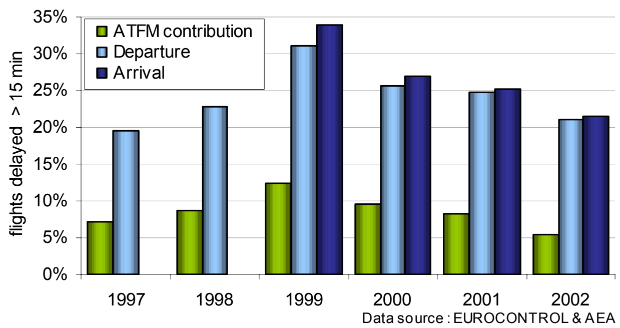
4.1.1 This chapter examines:

- ATM delays in the wider context of air transport delays in section 4.2 (delays measured in relation to flight schedules);
- ATFM delays allocated by the Central Flow Management Unit (CFMU) as a consequence of flow restrictions requested by ANSPs in sections 4.3 to 4.5 (delays measured in relation to flight plans);
- ATC capacity management (section 4.6);
- Key capacity issues and improvements (section 4.7);
- ATFM performance (section 4.8).

4.2 Air transport delays

4.2.1 The percentage of flights delayed for more than 15 minutes is widely used as an indicator of air transport punctuality (on-time performance). Figure 23 (left) shows that there has been an improvement in departure and arrival punctuality in 2002, with 21% of departures delayed for more than 15 minutes (25% in 2001).

4.2.2 Reactionary delay[24] remained the dominant departure delay cause (37%) in 2002. The proportion of ATFM delays reduced to 26% of primary delays (Figure 23, right).



Flights delayed > 15 min	2001	2002
Average Departure Delay	39 min	39 min
Average Arrival Delay	40 min	39 min

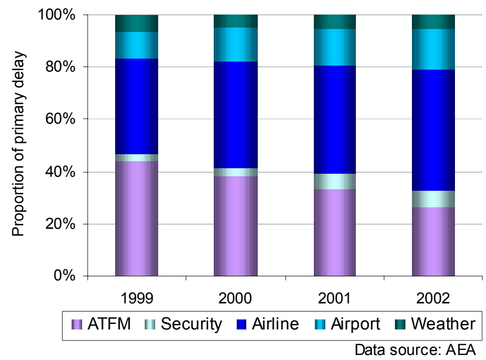


Figure 23: Air Transport punctuality and departure delay causes in primary delays

4.3 ATFM delays

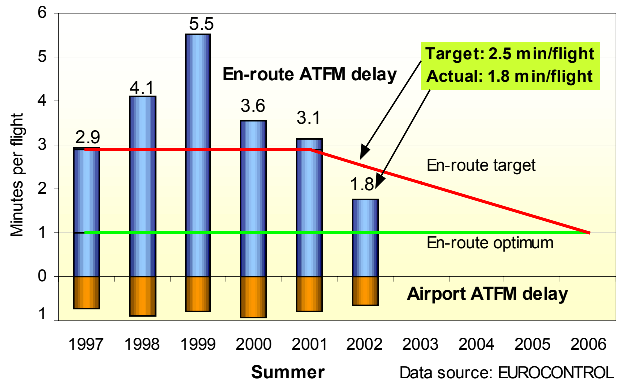
4.3.1 ATM delays can be imposed before departure (ATFM delays), during taxi or in flight. In the absence of precise information on taxi and airborne delays, this section concentrates on ATFM delays, based on CFMU data (ref. 9

4.3.2 ATFM delays are imposed on a given flight at its departure airport, when demand exceeds capacity at any ACC along its route (en-route ATFM delay), or at its origin/destination airport (airport ATFM delay). ATFM delays are allocated according to the congestion point. En-route ATFM delays are reviewed in section 4.4, and airport ATFM delays in section 4.5, with details by airport in section 7.2.

24 Reactionary delays are due to late arrival of aircraft or crew from previous journeys. Primary delays are delays other than reactionary.

ECAC level

4.3.3 The generally agreed Key Performance Indicator (KPI) for en-route delays is the average en-route ATFM delay per flight in the summer period (May to October inclusive), shown in Figure 24. The en-route delay KPI (1.8 min/flight) met the target agreed by the Provisional Council (2.5 min/flight), which is a noteworthy achievement. It would have been close to optimum (1 min/flight), if temporary problems had not been encountered at London ACC (see § 4.7.7 for details).



Summer en-route ATFM delay per flight (KPI)

Target	**2.5 min/flight**
Actual	**1.8 min/flight**
Variation	**-42%**

ATFM delay:	**18.0 M min**
En-route ATFM delay:	**11.9 M min**
En-route delay cost	
Airlines:	**€700 - 1 000M**
Passengers:	**€900 - 1 100M**

Figure 24: ATFM delays: KPI vs. target and associated costs

4.3.4 In 2002, the en-route ATFM delay KPI decreased by 42%. Airport ATFM delays decreased by 11% and accounted for 34% of ATFM delays (25% in 2001). Airport ATFM delays are becoming more prominent.

4.3.5 Estimated costs of en-route ATFM delays (11.9M minutes) to airspace users consequently reduced to € 700-1 000M (€ 1 100-1 700M in 2001, € 1 700-2 800M in 1999). Figure 25 shows key figures for European traffic and ATFM delays.

FULL YEAR (Data Source:Eurocontrol/CFMU,CRCO)								SUMMER (Data Source:Eurocontrol/CFMU)		
Year	Traffic		ATFM delays					Average ATFM delay per flight		
	Average daily traffic	Traffic volume (km) index*	ATFM delays > 15min	Total ATFM delays (min)	Total ATFM delays (index)	En-route ATFM delays (min)	Airport ATFM delays (min)	En-route (min/flight)	Total delay (min/flight)	Target total (min/flight)
1997	19662	100	7%	20.9M	100	15.5M	5.4 M	2.9	3.7	none
1998	20685	107	9%	27.4M	131	21.6M	5.7 M	4.1	5.0	3.5
1999	22062	116	12%	43.3M	207	36.3M	7.0 M	5.5	6.3	none
2000	23068	122	9%	31.8M	152	24.4M	7.4 M	3.6	4.5	3.5
2001	22995	123	8%	27.6M	132	20.8M	6.8 M	3.1	3.9	3.5
2002	22567	121	6%	18.0M	86	11.9M	6.0 M	1.8	2.5	3.2

* For States participating in the EUROCONTROL Routes Charges System in 1997

Figure 25: Key European traffic and delay data

4.4 En-route ATFM delays

4.4.1 Figure 26 shows that, in 2002, 50% of Summer ATFM en-route delays were concentrated in London (compared to 17% in 2001). The backbone of Europe (London, Area North and Area South) contributed to 77% of the ATFM en-route delays in the summer.

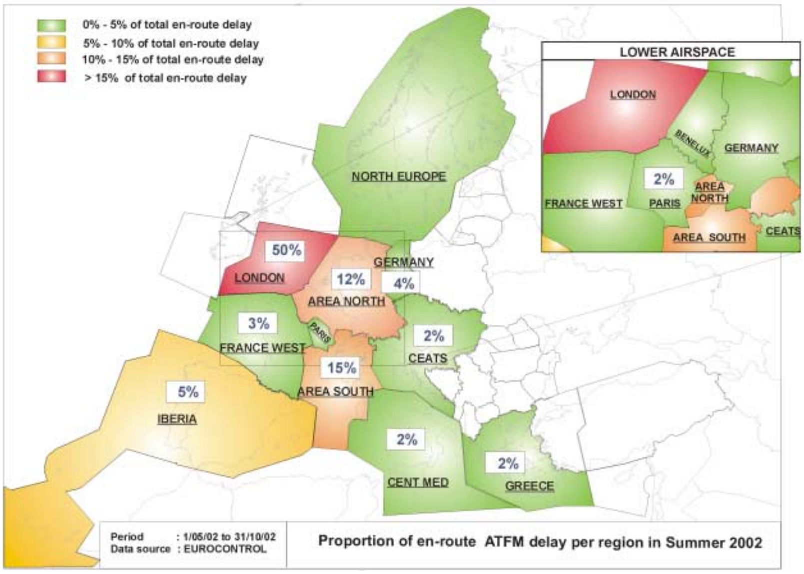


Figure 26: Summer en-route ATFM delays in European regions

4.4.2 Figure 27 shows that en-route ATFM delays were much lower than expected[25] in view of capacity commitments and actual traffic in summer 2002. All European regions, with the exception of London, have shown a reduction in delay when compared to 2001, and exceeded their commitments. This is a substantial achievement.

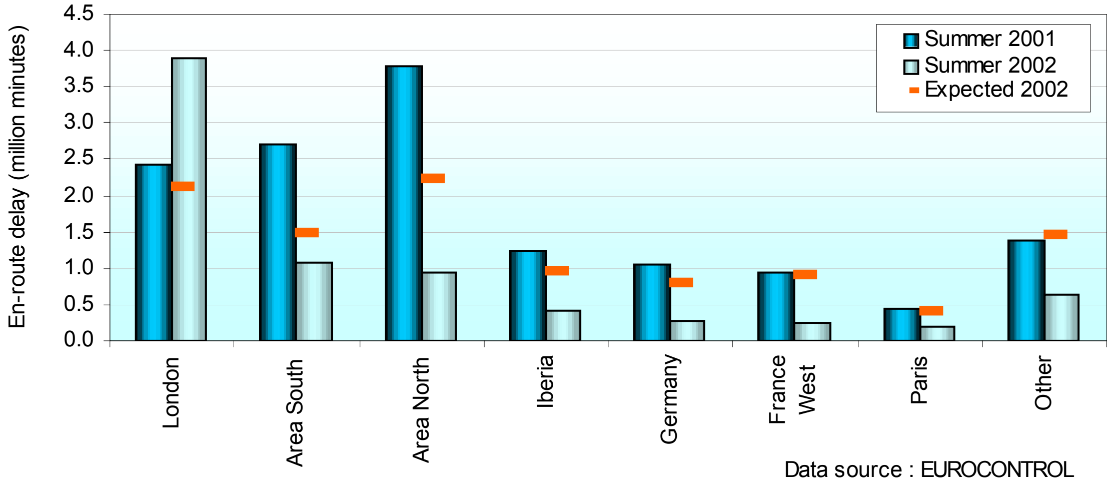


Figure 27: Variation of summer en-route ATFM delays

4.4.3 Area North (see glossary), which was the main problem area in 2001, showed a major improvement in 2002. Delays reduced to approximately a quarter of 2001

25 Corresponding methodology is documented in PRR 5, annex 6.

values, a much better performance than expected. Delays generated in Area South, a major issue in 1999 and 2000, also reduced significantly, and exceeded expectations.

4.4.4 The reduction in en-route ATFM delays (43%) was mostly due to:

- reduced traffic levels (resulting in some 13%[26] less delays);
- reduced Vertical Separation (RVSM) implementation in 41 States in January 2002;
- active capacity management by many ANSPs under EUROCONTROL Agency co-ordination (see section 4.7);
- better use of existing capacity thanks to improved ATFM (e.g. weekly teleconferences).

4.4.5 Results are more contrasted at ACC level, as shown in Figure 28. Few ACCs generated more than 0.8 minute en-route ATFM delay per flight, and therefore contributed more than their share in order to meet the ECAC delay objective in 2002 (2.5 minutes)[27].

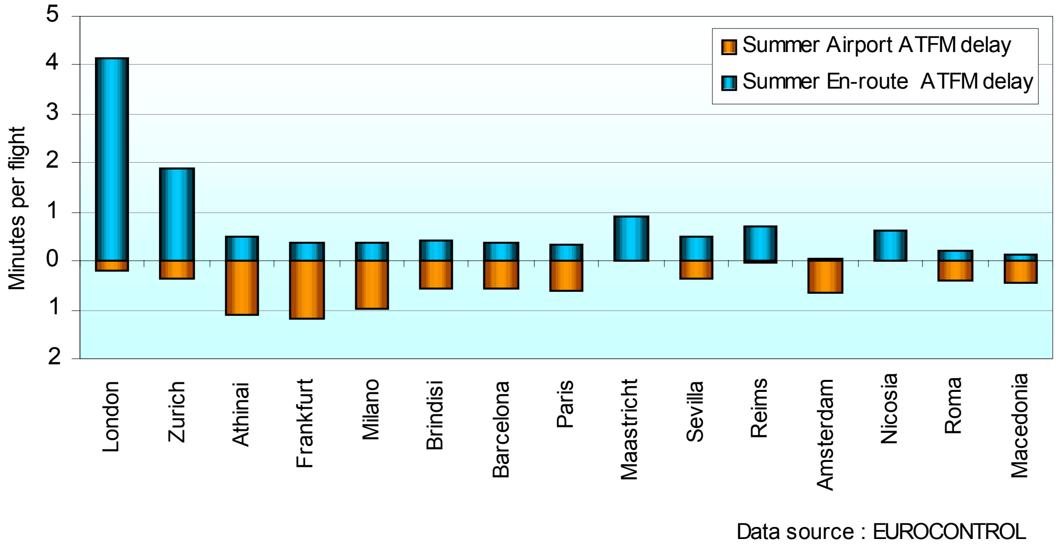


Figure 28: Highest ATFM delays (summer 2002)

4.5 Airport ATFM delays

4.5.1 Figure 28 also shows ATFM delays generated by airports located within given ACCs. Although airport ATFM delay accounted for 34% of ATFM delays overall, they were increasing in proportion (25% in 2001) and dominant in some areas. Further details on airport ATFM delays are given in Chapter 7.

4.5.2 89% of airport ATFM delays were imposed because of constraints at the arrival airports[28].

4.5.3 The distribution of airport ATFM delay causes, namely ATC delay, aerodrome (non-ATC), weather and others, is shown in Figure 29. A more detailed breakdown of airport ATFM delay causes is given in Chapter 7.

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26 An elasticity of 7 has been assumed, which means that a 1% decrease in traffic would result in a 7% decrease in delays.

27 One flight crosses 3.1 ACCs on average.

28 The rest were imposed because of constraints at departure airport, or both departure and arrival airports.

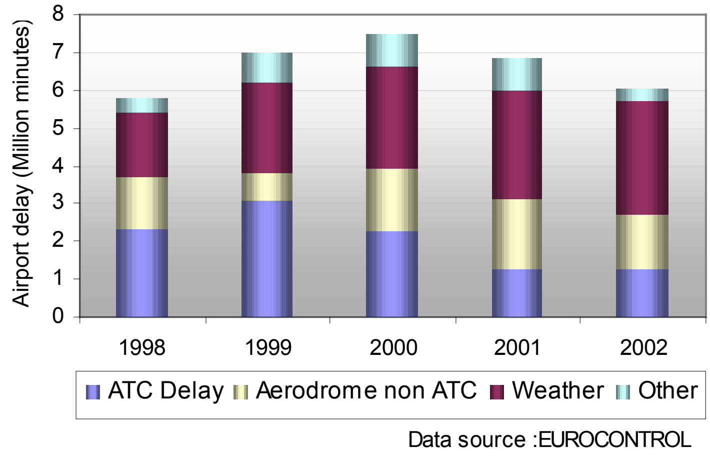


Figure 29: Airport ATFM delay causes

4.5.4 The proportion of airport ATFM delays due to ATC rose slightly in 2002 (21%, up from 18% in 2001). The proportion of delay due to weather has been increasing each year and accounted for almost half of total airport ATFM delay in 2002. This surprising trend may be due to increasingly accurate attribution of ATFM delay causes.

4.6 Medium term capacity management

4.6.1 Medium-term capacity management is a critical process in ATM, due to the "explosive" nature of the traffic/delay relationship (1% more traffic typically generates 7% more en-route delays). Furthermore, there is certain inertia in implementing effective remedial actions. Any mismatch between traffic and capacity results either in indirect costs (i.e. low quality of service, delays) or direct costs (higher route charges than the optimum). Corresponding trade-offs and total direct and indirect costs are discussed in section 8.2.

4.6.2 Europe-wide forward-looking capacity management has progressed in the last three years under EUROCONTROL Agency leadership, and en-route delays are progressively being brought under control. Effective capacity[29] of the European ATM system had lagged behind demand for many years. Significant increases in capacity and the traffic stagnation both helped close the capacity gap in 2002.

4.6.3 The EUROCONTROL medium-term capacity planning process is a step in the right direction. It is however not very robust yet: there were problems in the CHIEF[30] area in 2000, in "Area North" in 2001 (see chapter 4 in PRR 4 (ref. 10) and PRR 5 (ref. 11)) and in the UK in 2002. Furthermore, the process remains non-committal, and disconnected from financial implications. This latter point is discussed in section 5.7.

4.6.4 It is essential that effective capacity continues to increase in line with forecast traffic growth in order to reach and maintain optimum ATFM delay levels. Otherwise, delay costs will increase again.

29 Effective capacity is defined as the traffic volume (km) which the ATM system can handle with a given level of ATFM en-route delay.

30 CHIEF: Switzerland (CH), Italy, Spain (E), France.

4.6.5 Costs do not necessarily need to grow in proportion to capacity if the following can be achieved (see Chapter 9):

- lower support costs;
- better ACC resource utilisation;
- better productivity, and/or
- better network utilisation (improved ATFM/ASM and civil-military co-ordination).

4.6.6 Providing for some spare en-route capacity (e.g. 5%) would:

- accommodate some uncertainties in traffic forecasts;
- improve safety;
- minimise ATFM delays and related costs to users;
- allow more tactical ATFM procedures to be introduced (see section 4.8 below);
- allow airport throughput to be maximised through pre-sequencing, while minimising holding at arrival airport and related environmental impact (see section 7.3).

However, the cost-benefit analysis remains to be made.

4.7 Key achievements and issues

Reduced Vertical Separation Minima (RVSM)

4.7.1 A major event was the implementation of RVSM on 24 January 2002, providing six additional flight levels above FL285 over 41 States[31]. RVSM has been an enabler for introducing capacity enhancement measures such as route network and sectorisation improvements, bringing significant capacity increases in many ACCs (see Figure 31).

4.7.2 Figure 30 shows the distribution of en-route ATFM delays in upper, lower and ground-unlimited sectors before and after RVSM implementation. RVSM has contributed to delay reduction, mostly in the upper airspace.

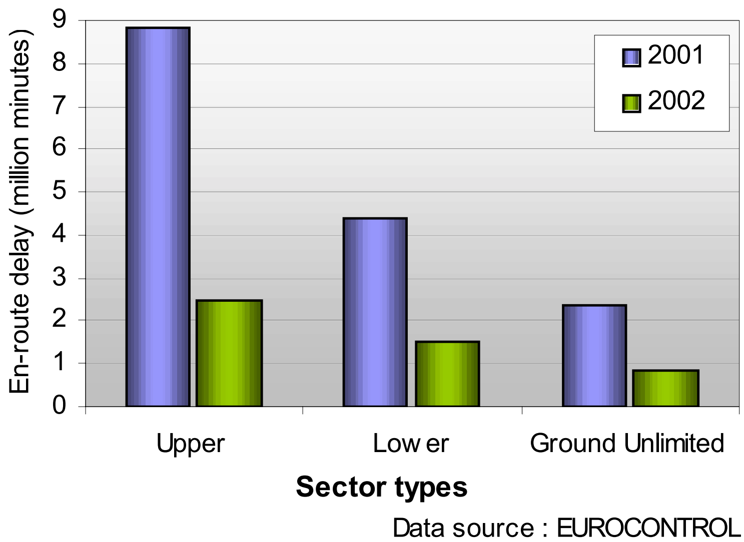


Figure 30: Vertical distribution of ATFM delays[32]

[31] RVSM was introduced on a tactical basis in UK, Germany and Austria in 2001

[32] Analysis based on sectors contributing to 90% of en-route ATFM delay, and excluding London sectors

ANSP improvements

4.7.3 Improvements brought about by RVSM could not have materialised without complementary actions by ANSPs (airspace design, technical improvements, and new ATC sectors).

4.7.4 Figure 31 shows major improvements in most ACCs, which had generated high ATFM delay in summer 2001, and corresponding capacity drivers. London and Zurich ACC were excluded in view of their specific circumstances. Tables of most penalising ACCs and locations can be found in Annex 2.

ACC	Summer ATFM en-route average delay per flight variation 2001/2002	Summer traffic variation 2001/2002	Implemented capacity drivers	Increase in sectors / staff	Increase in sector capacity	Resource utilisation	RVSM
Geneva	-95%	0%	Increased declared sector capacity values. Additional controllers, improved sectorisation with improved sector configuration implemented.	■	■	■	■
Maastricht	-66%	1%	Opening of Brussels High East Sector achieved. Significantly increased values for the majority of sector capacities. Flexible rostering.	■	■	■	■
Madrid	-76%	-1%	Increased declared sector capacities in most sectors. Vertical split of ZMR sector implemented. Improved sectorisation.	■	■		■
Reims	-68%	2%	UE vertical split implemented. Some increases to declared sector capacity values.One additional sector open in max. configuration	■	■		■
Warsaw	-94%	-1%	Opening of two additional sectors in max. configuration (as yet with undefined capacity). All other sectors have increased sector capacity values.	■	■		■
Bordeaux	-71%	2%	Two additional sectors open in maximum configuration.	■			■
Karlsruhe	-96%	5%	Two additional sectors open in maximum configuration. Increased sector capacity values.	■	■	■	■
Bremen*	-78%	-7%	Resource utilisation - no additional capacity was made available, but the capacity was tuned to closely match the demand, providing a more effective utilisation of available resources.			■	
Praha	-70%	8%	Three upper sectors have significantly higher capacities. New route structure implemented. Additional controllers available.	■	■	■	■
Dusseldorf*	-83%	-13%	One sector transferred to Frankfurt ACC.No additional peak capacity made availabe, but capacity tuned to closely match demand.			■	

* Bremen and Dusseldorf are lower ACCs

(Source of text: "European ATC Capacity Report for summer 2002", DSA/CEF, EUROCONTROL, December 2002)

Figure 31: Capacity improvements in various ACCs during 2002

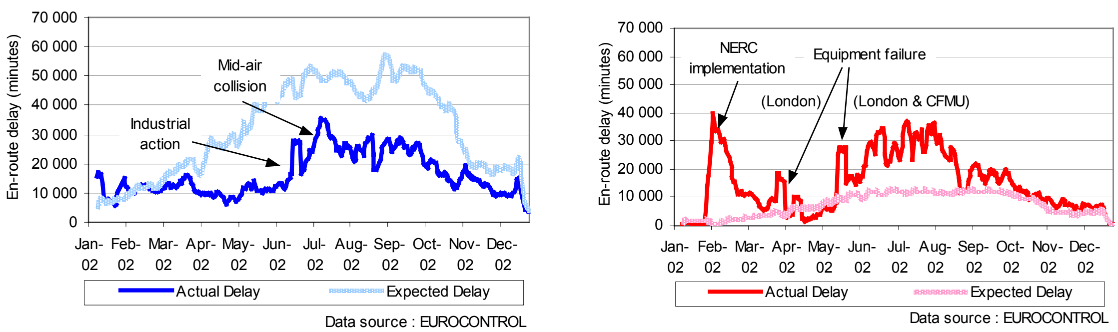
4.7.5 Karlsruhe and Geneva ACCs performed remarkably well in 2002: average delay reduced by 96% and 95% respectively, despite increases in traffic. Both ACCs benefited from a combination of RVSM, airspace structure/route network changes and additional staff/controllers.

4.7.6 It should be noted that some ACCs achieved better performance through more effective resource utilisation, without the need for increases in maximum deployable capacity (e.g. Bremen, Düsseldorf) although other ACCs used a combination of both.

The UK situation

4.7.7 London ACC, the busiest ACC in Europe, moved its centre of operations 130 kilometres to Swanwick in 2002. Figure 32 shows actual and expected delays in London ACC on the right-hand side graph, compared with delays from all other ACCs on the left-hand side. Four periods are clearly visible:

- an expected temporary delay peak following implementation;
- delays as expected until May, with marked effects of two system failures[33];
- much higher delays than expected in summer (staff shortages);
- situation as expected from October onwards.



All ACCs except London

London ACC (same scale)

Figure 32: Actual and expected ATFM en-route delay

4.7.8 The UK situation stands out in 2002. Not only did the UK generate 50% of ATFM delays in summer 2002, but its unit rate was amongst the highest in Europe. Consequently, the PRC met with NATS management to determine whether this was a temporary or lasting issue, and to learn what mitigating actions NATS was taking to improve its performance.

4.7.9 The PRC noted that, despite the problems experienced by NATS in 2002, safety was not compromised. NATS is taking measures to improve its capacity, and forecasts a delay of 1.5 min/flight for 2003. Moreover, the UK's unit rate is now decreasing under economic regulation (see section 5.3)

4.7.10 The PRC considers that UK delays in 2002 were caused by a number of problems:

- simultaneous changes to location, hardware and software with implementation of the new London ACC. While this may not necessarily be best practice, the transition is now over;
- temporary lower staff productivity and availability, which resulted in staffing shortages, and lower capacity. Both aspects are being addressed, but will take some time to be fully resolved;
- failures of the UK Flight Data Processing (FDP) system. NATS has corrected the initial problems and the robustness of this essential system appears to be under control. However, its replacement appears to be several years away.

4.7.11 The actions in progress suggest that the performance of London ACC will improve in the short term. Strong measures have been taken and it remains to be seen whether these are sufficient to meet demand in the medium-term.

[33] One failure was exacerbated by a CFMU system failure on the same day.

4.8 ATFM performance

Use of ATC capacity and protection of ATC sectors

4.8.1 Air Traffic Flow Management (ATFM) seeks to protect ATC sectors and airports against traffic demand in excess of declared capacity, whilst making best use of existing capacity (see Figure 33).

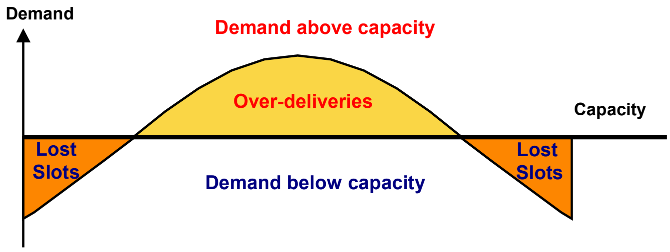


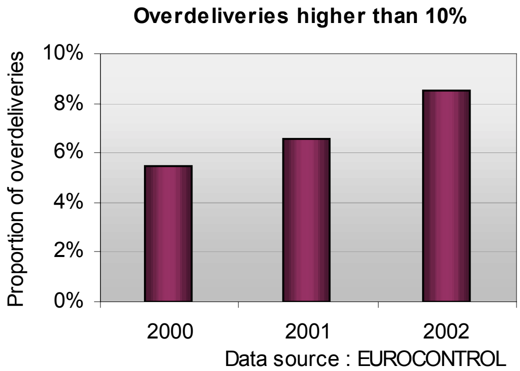
Figure 33: Over-deliveries and lost slots

4.8.2 There are two key factors when examining the performance of the ATFM system[34]:

- The degree of protection against excess demand. This can be measured with the number of over-deliveries[35];
- Capacity utilisation: this can be measured by delays due to lost ATFM slots and unnecessary ATFM regulations.

Over-deliveries (degree of protection to ATC units)

4.8.3 Figure 34 (left) shows that the measured proportion of over-deliveries has almost doubled in two years. Although this could be related to better detection of over-deliveries with the introduction of the ETFMS[36], or to additional flights being allowed on a tactical basis without prejudicing safety, underlying issues need to be better understood.



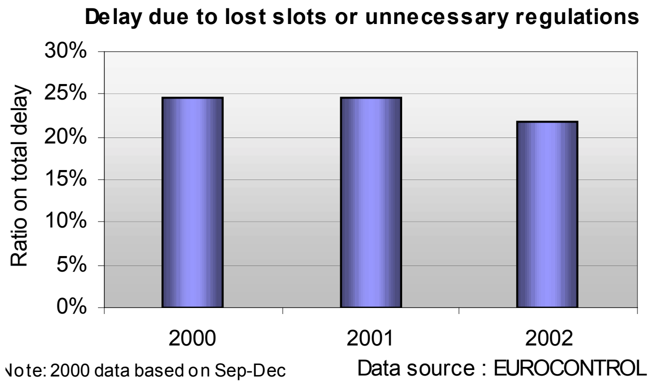


Figure 34: Over-deliveries and delays due to lost slots and unnecessary regulations

34 ATFM slots are issued some two hours before departure. Inevitable perturbations to the plan and breaches of ATFM rules result in bunching (over-deliveries) and empty space (lost slots).

35 An over-delivery occurs when the actual number of aircraft that enters the sector during a particular period exceeds the regulated capacity. An over-delivery does not necessarily result in an overload. An overload occurs when an ATCO reports that he/she has had to handle more traffic than he/she considers to be safe.

36 Enhanced Traffic Flow Management System. ETFMS gathers radar data in order to present a Europe-wide actual traffic picture to flow managers.

Delays due to lost slots and unnecessary regulations (capacity utilisation)

4.8.4 As shown in Figure 34 (right), ATFM delays due to lost slots and unnecessary regulations remained high, although decreasing slightly (21.8% of total ATFM delays, vs. 24.7% in 2001*).* Abuse of ATFM regulations has a negative impact on ATFM performance.

Compliance with ATFM slots

4.8.5 Lack of adherence to ATFM slots (by ATC and Aircraft Operators) has a negative impact on ATFM performance (over-deliveries). Figure 35 shows that the proportion of non-adherence to ATFM slots remained high (22.1%) in 2002.

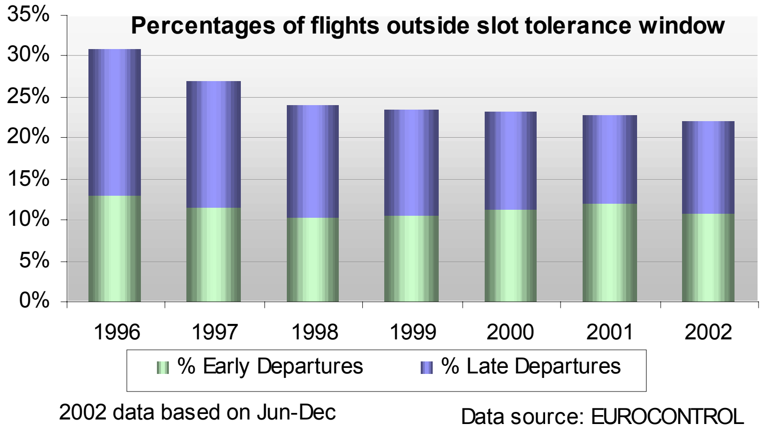


Figure 35: Non-adherence to ATFM slots

4.8.6 Figure 36 shows the most frequent non-adherence reports for airports and airlines (ranked by percentage of non-compliance for their traffic and by number of non-compliant slots for their traffic).

Non-compliance with ATFM slots				
Airline	By percentage	Airline	By absolute values	
Malev	41%	Lufthansa	19 941	19%
AIR One	32%	British Airways	13 384	23%
Spanair	27%	Air France	13 270	24%
Iberia	26%	Alitalia	9 263	25%
Air 2000	26%	Iberia	8 033	26%

Non-compliance with ATFM slots				
Airport	By percentage	Airport	By absolute values	
Budapest	52%	Paris/CDG	14 377	31%
Faro	48%	London Heathrow	12 286	28%
Madrid	32%	Frankfurt	10 369	29%
Milano/Linate	32%	Amsterdam	7 045	17%
Malaga	32%	Manchester	6 874	31%

data based on Jun-Dec

Figure 36: Top airports and airlines in non-adherence reports

Key improvements and issues in ATFM

4.8.7 Significant changes have been introduced in the European ATFM organisation and procedures during the last two years. The CFMU Network Management Cell was created in 2001 and reinforced in 2002 with additional staff and enhanced tools.

4.8.8 Alternative ATFM measures are being developed[37]. However, many are advisory (e.g. flight level capping, alternative routing), leaving the final decision at the ANSP level and to the airline operators. This reduces their effectiveness.

4.8.9 Further to a PRC recommendation in PRR 3 (ref. 12) and to the independent ATFM Report (ref. 13), the EUROCONTROL Agency has developed an ATFM action plan. It introduces the concept of capacity-demand balancing, adding capacity management to flow management (ATFCM strategy).

4.8.10 However, ATFM performance has shortcomings in both of its key indicators. Over-deliveries are significant and increasing (over 8% of cases with 10% over-deliveries or more). At the same time, lost slots and unnecessary regulations generate some 22% of ATFM delays.

4.8.11 Flow is controlled mostly through ground holding in Europe. This is an effective, but relatively coarse filter for excess demand. Ground holding is well suited for cases of large excess demand, less so for the majority of cases where demand and capacity nearly coincide[38]. Seeking to control flows in sectors with typical transit times of 10 minutes, using ill-respected 15 minutes take-off slots allocated several hours before the event and based on crude flight plan information, is bound to have limitations. Finer ATFM tools, such as en-route sequencing and metering, should therefore complement ATFM take-off slots. Otherwise, both wastage of airport/airspace capacity and excessive delays[39] can be expected.

4.8.12 In the US, a more tactical approach to ATFM is applied, with ground delays only being used as a last resort. During the US-Europe ACC comparison (see § 9.3.18), it became clear that progressive refinement of flow management methods played a large role in the doubling of US ARTCC capacity in the last 25 years.

4.8.13 The PRC considers that more tactical ATFM measures need to complement the current ATFM measures based on ground holding.

4.8.14 This would entail profound changes in European ATM and may take years to implement. However, in view of the likely gains, it would be a worthwhile effort.

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37 For instance, Karlsruhe completely revised flow management procedures in full co-ordination with CFMU and neighbours.

38 Demand and capacity nearly coincide in most cases of high demand, thanks to airport slot co-ordination, whereby no more flights are scheduled than the airport can accept.

39 ATFM delays where flows are controlled through ground holding (e.g. Frankfurt arrivals), or airborne delays where flows are controlled through airborne holding (e.g. London arrivals).

4.9 Conclusions

4.9.1 The KPI for ATFM delay (1.8 min/flight) met the Provisional Council's target (2.5 min/flight) and would have been close to optimum (1 min/flight) if temporary problems had not been encountered in the UK.

1.1.2 The delay KPI fell by 42% in 2002, due to a combination of traffic reduction, Reduced Vertical Separation, new capacity created by ANSPs and better use made of existing capacity with ATFM measures.

4.9.3 Consequently, the costs of ATFM delays to airspace users were reduced to € 700-€ 1 000M compared to € 1 100-€ 1 700M in 2001.

4.9.4 Effective capacity will need to continue to increase in line with forecast traffic growth. Costs do not necessarily need to grow in proportion to capacity (see Trade-offs).

4.9.5 Airport ATFM delays are increasing in proportion (34%) and need attention.

4.9.6 Providing for some spare en-route capacity (e.g. 5%) would:

- accommodate some uncertainties in traffic forecasts;
- improve safety;
- minimise ATFM delays and related costs to users;
- allow more tactical ATFM procedures to be introduced;
- allow airport throughput to be maximised through pre-sequencing, while minimising holding at arrival airport and related environmental impact.

However, the cost-benefit analysis remains to be made.

4.9.7 The PRC considers that more tactical ATFM measures need to complement ATFM measures based on ground holding.

4.9.8 Implementing the above conclusions would require reinforced co-operation among ANSPs, which implementation measures of the Single European Sky legislation should foster.

5 COST-EFFECTIVENESS

5.1 Introduction

5.1.1 Cost effectiveness is the PRC's third Key Performance Area. It is becoming even more important in the light of current difficulties experienced by the air transport industry.

5.1.2 The PRC has developed a methodology for analysing ATM cost-effectiveness and validated it with ANSPs (ref. 14). Cost-effectiveness is measured as cost per unit of output (flight-hours, distance, or flights controlled). In view of data available, analysis in this report is limited to Route Charges[40] and uses "Real[41] unit cost-per km[42]" as the Key Performance Indicator. Data are actual costs until 2001, and forecasts beyond that year[43].

5.1.3 Cost-effectiveness is examined at ECAC and State levels in sections 5.2 and 5.3, based on Route Charges data. EUROCONTROL Agency costs are discussed in section 5.4.

5.1.4 It is now possible to analyse and compare ANSP cost-effectiveness following the adoption of Rules for Economic Information Disclosure (EID, ref. 15) by the Permanent Commission in November 2001. Results of the first benchmarking of European ANSPs for year 2001 (ref. 16) will be published shortly after this report. Related aggregate information is given in section 5.5.

5.1.5 Future performance can be anticipated from forward-looking information submitted by States. This is examined in section 5.6. Merits and limitations of the Route Charges System are discussed in section 5.7.

5.2 Key Performance Indicators (ECAC level)

Real unit cost

5.2.1 After several years of steady decrease, the KPI for cost-effectiveness (average real unit costs, net of inflation) has been growing since 2000 (see Figure 37). Year 2001 data and latest forecasts for 2002 and 2003 confirm the growing trend of unit costs highlighted in PRR 5 (ref. 11) as shown in Figure 38 (+5% in real terms from 2001 to 2003).

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40 Information on terminal costs (not revenues) is given in Figure 48.

41 Real costs are deflated to account for inflation.

42 Costs per km are obtained by dividing the en-route costs (including EUROCONTROL costs), as declared by the States to the enlarged Committee for Route Charges, by the number of kilometres computed by the CRCO. This is considered as a better cost-effectiveness measure of ATM performance than the unit rate used for charging purposes. First, the value for a given year is not affected by over or under-recovery in the previous year. Second, the measure is not influenced by aircraft weight.

43 Final cost data for 2002 were available after adoption of this report

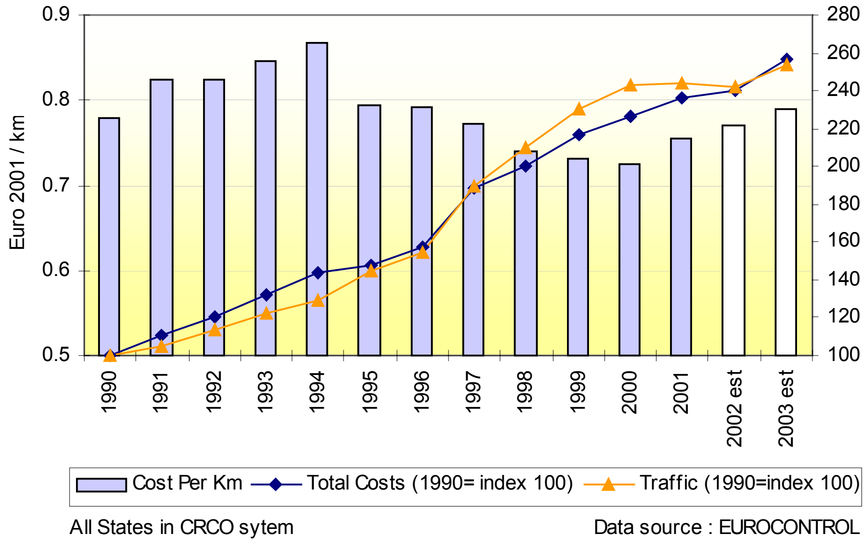

Figure 37: Unit cost per km (KPI), total costs and traffic

5.2.2 Figure 38 shows key figures for EUROCONTROL Member States.

	1999	2000	2001	2002P[44]	2003P	01/00[45]	03/01[46]
Contracting States	**28**	**28**	**29**	**30**	**30**	**28**	**29**
Total en-route costs (Million Euro)	**4 187**	**4 477**	**4 783**	**4 968**	**5 371**	**7%**	**12%**
National costs	3 830	4 077	4 354	4 523	4 881	7%	12%
EUROCONTROL Maastricht[47]	78	85	97	108	117	14%	21%
EUROCONTROL Agency[48]	279	316	332	337	373	5%	12%
Kilometres (million)	**5 982**	**6 310**	**6 327**	**6 293**	**6 580**	**0%**	**3%**
Unit cost (Euro/km)	**0.70**	**0.71**	**0.76**	**0.79**	**0.82**	**7%**	**8%**
Price index[49]	1.038	1.060	1.086	1.111	1.121	4.6%	3.2%
Real unit cost (Euro 2001/km)	**0.73**	**0.73**	**0.76**	**0.77**	**0.79**	**4%**	**5%**

Figure 38: Key figures

Unit rates

5.2.3 The weighted average unit rate[50] has increased even more than unit costs (+18% from 2001 to 2003) as a result of the adjustment mechanism and inflation. In 1999, over-recoveries of € 117M were recorded and therefore deducted from the costs to be recovered in 2001. Inversely, the downturn of traffic in 2001 resulted in under-recoveries of € 153M, of which € 127M were carried forward to 2003 [51].

44 P: planned.
45 Evolution computed for the 28 States participating in the Route Charges System in 2000.
46 Evolution computed for the 29 States participating in the Route Charges System in 2001.
47 Extracted from national cost bases of the four States.
48 Excluding Maastricht UAC.
49 EUROSTAT MUIC: Monetary Union Index of Consumer Price.
50 Under the current full cost-recovery regime, the unit rate is computed by dividing the forecast costs by the forecast number of service units. At the end of the year the differences between the charges collected and the actual costs is recorded and is carried forward to the year n+2.
51 By enlarged Commission decision dated 7 October 2002, States are allowed to spread their under-recoveries for 2001 over their cost-bases for 2003 to 2006. Eleven States have done so.

5.3 Real unit costs per State

5.3.1 Figure 39 shows the 2000 and 2001 unit costs for each State and the projected 2003 unit costs (red lines), based on the information declared by the States for the establishment of the 2003 unit rate. It should be noted that actual costs for the year 2002 will only be available at the end of 2003 and are therefore not shown in Figure 39[52].

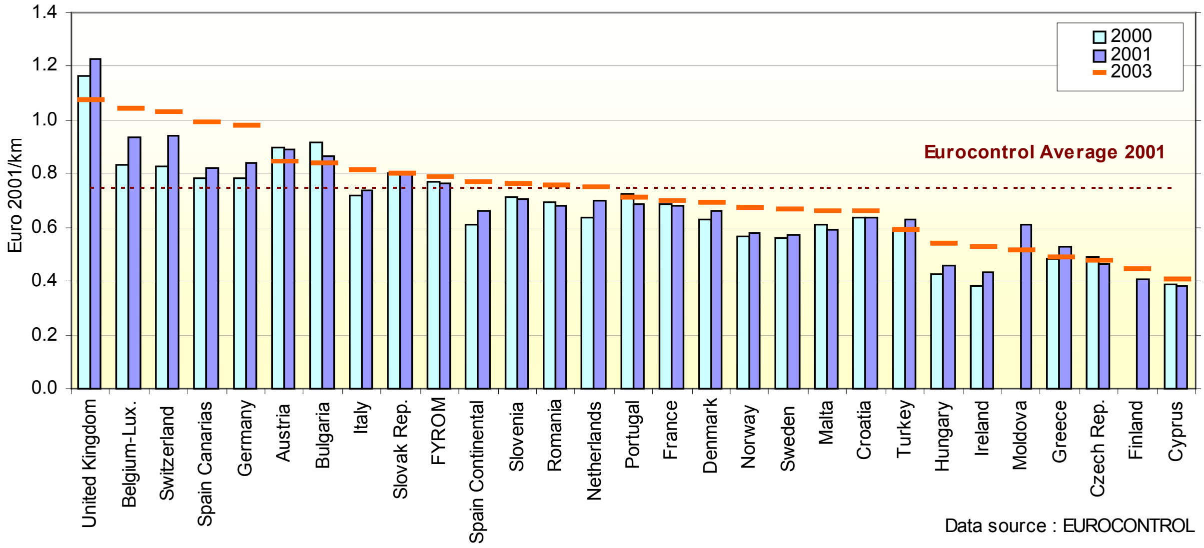

Figure 39: Unit costs per State

5.3.2 Unit costs have increased in the majority of States in 2001 and further increases are expected in 2003.

5.3.3 The overall comparison of 2003 unit costs with 2000 values shows an increase in the unit costs in all but seven States. The most significant increases in real unit costs are observed in Ireland (+38%), Hungary (+28%), Spain and Belgium (+26%), Germany and Switzerland (+25%). Downward revision of traffic does not in itself explain these increases. Significant increases in total costs appear to be the main drivers, as can be observed in Figure 40.

Country	Variation 2003/2000		
	Traffic (km)	Deflated Cost (€2001)	Real unit costs (€2001/km)
Ireland	1%	39%	38%
Hungary	5%	33%	28%
Spain Canarias	3%	31%	27%
Spain Continental	6%	34%	26%
Belgium-Luxembourg	-4%	20%	26%
Germany	-1%	24%	25%
Switzerland	-4%	20%	25%

Figure 40: Major cost increases (2000-2003)

5.3.4 It is disappointing to see that out of the five States that were identified in previous PRRs for their relative good performance, all but France have significantly increased their unit costs. It is to be hoped that this is pure coincidence.

52 Only partial information is displayed for Moldova and Finland. They joined the Route Charges System in 2001 and in 2002, respectively.

5.3.5 It is, however, more encouraging to look at the performance of the States that were identified in PRR 5 (ref. 11) for their relatively high costs. All those countries except Romania are among the few where unit costs are expected to decrease:

- unit costs in Austria (6th highest in 2003) have been decreasing in the last few years and Austria states clearly its objectives to continue in that direction;
- the decrease of unit costs in Turkey is mainly the result of the expected suppression in 2002 of a levy paid to the national government (Treasury). Ignoring this one-off effect, Turkey's national cost base has increased by 32% between 2000 and 2003 in current Euro terms. Staff costs have increased by 50% over the same period. The economic situation and the high inflation in Turkey do not appear to justify in itself such an increase of the costs expressed in Euro. Further, Turkey has not yet taken action (1) to implement a proper cost accounting system, and (2) to revisit the allocation of costs, as recommended in 2001 following an audit conducted by the Central Route Charges Office (CRCO) at the enlarged Committee's request;
- costs in Portugal and in Bulgaria appear to level off. However, neither of these two States provided the enlarged Committee for Route Charges with 5-year projections;
- Romania was also identified in PRR5 as having relatively high costs compared to its traffic complexity. It is particularly disappointing to note that it not only foresees an additional cost increase of 22% between 2000 and 2003, but it is also one of the few States which did not provide any comments to the enlarged Committee.

5.3.6 The EUROCONTROL Principles allow States to opt for the alternative charging mechanism, using price capping rather than cost-recovery. The United Kingdom has applied this new regime since April 2001. The unit rate of the UK National Air Traffic Services (NATS) is subject to a price cap set by the UK CAA economic regulator for a period of 5 years [2001-2005]. The price cap, which had initially been set at RPI-5%,[53] has been revised following the downturn of traffic. The charge cap for the last three years of the licence [2003-2005] will be based on RPI-2% and the risk associated with traffic volume will be shared equally between NATS and its airspace users.[54]

5.3.7 According to the projections submitted by NATS to the enlarged Committee, costs are expected to decrease by 11% between 2001 and 2003 as a result of the actions taken. In 2003, NATS anticipates to generate a margin (pre-financing) of 100 to 150 million Euro (16% to 21%) on its en-route activities, depending on the traffic level.

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[53] RPI: Retail Price Index. RPI-5%: a reduction of 5% per year in real terms (net of inflation).

[54] This was subject to the condition that NATS receives an injection of £130M from the government and from the British Airports Authority (BAA) (£65M each). This condition is now met (comprising £10M in equity and £120m in subordinated loans). BAA is acquiring a 4% stake in NATS and is appointing two members to the NATS board.

5.4 EUROCONTROL costs

Agency costs (excluding Maastricht and CRCO)

5.4.1 EUROCONTROL Agency costs (€ 332M in 2001, see Figure 41) represented some 7% of the total en-route costs. These costs are included in the cost base of the Member States and therefore in the route charges paid by airspace users.

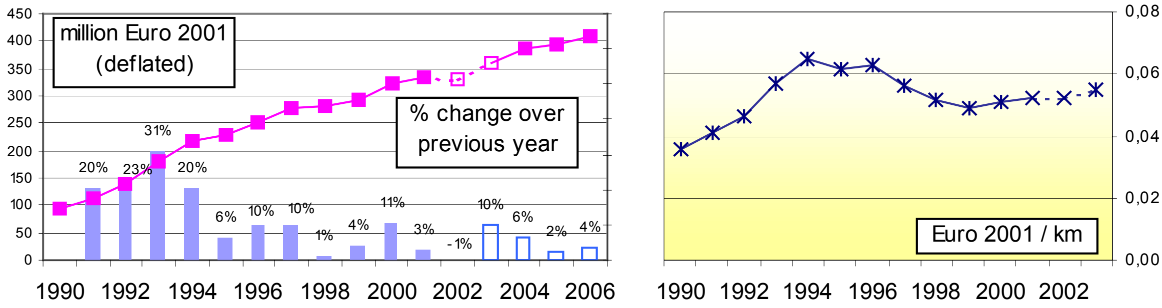
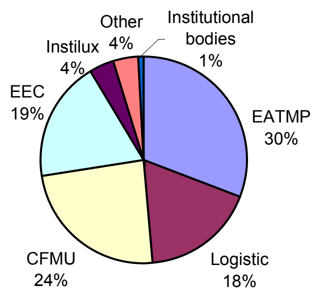


Figure 41: Evolution of EUROCONTROL Agency costs (Part I and IX)

5.4.2 EUROCONTROL Agency costs are expected to rise by 9% in real terms between 2001 and 2003 (see Figure 42[55]). The PRC intends to review EUROCONTROL Agency costs in more detail, starting with the highest budget (EATMP).



Establishment	Yearly cost (M€)				Variation
	2000	2001	2002	2003	2003/2001
EATMP	105	103	106	114	11%
Logistic	57	58	60	61	4%
CFMU	75	80	78	94	19%
EEC	59	63	59	61	-3%
Instilux	13	13	13	13	-3%
Other*	6	13	17	23	81%
Institutional bodies	2	3	4	7	159%
Total	316	332	337	373	12%
Price Index	1.060	1.086	1.111	1.121	3%
Deflated cost	323	332	329	362	9%

* Concern mainly the balance of pensions

Figure 42: Breakdown of EUROCONTROL Agency costs per entity

EUROCONTROL Central Route Charges Office costs

5.4.3 In 2002, the route charges collection costs of the CRCO were € 19.1M, i.e. 0.40% of the total amount billed (see Figure 43). The most relevant benchmark for CRCO performance would be such ratios for comparable cost recovery institutions.

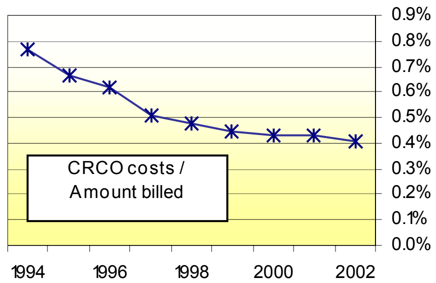


Figure 43: CRCO costs / amount billed

55 Increase under "others" mainly relates to the pension scheme (€ 11M in 2001, € 23M in 2003).

EUROCONTROL Maastricht Costs

5.4.4 Maastricht UAC provides air traffic services in the upper airspace of four States: Belgium, Luxembourg, the Netherlands and Northern Germany. Costs of Maastricht UAC are borne by the four States.

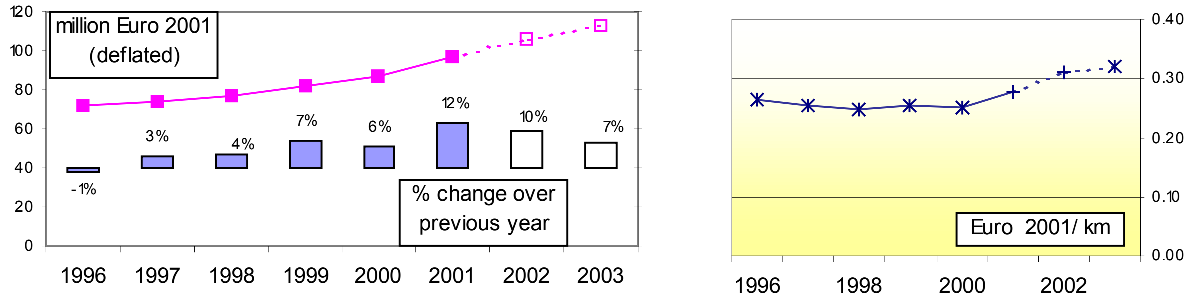


Figure 44: Evolution of EUROCONTROL Maastricht costs

5.4.5 The unit cost for the Maastricht UAC was € 0.28 per kilometre in 2001, an increase of 10% over 2000 (see Figure 44). Although this remains significantly below the European average (€ 0.76 per km, see Figure 39) it should be noted that both figures are not comparable. The Maastricht total cost does not include the costs of MET services, Surveillance (Radar) and Navigation infrastructure, which are borne by the delegating States. A comparison of Maastricht ACC with similar en-route centres can be found in the US-Europe ACC comparison (ref. 24).

5.5 Information disclosure from ANSPs (2001 data)

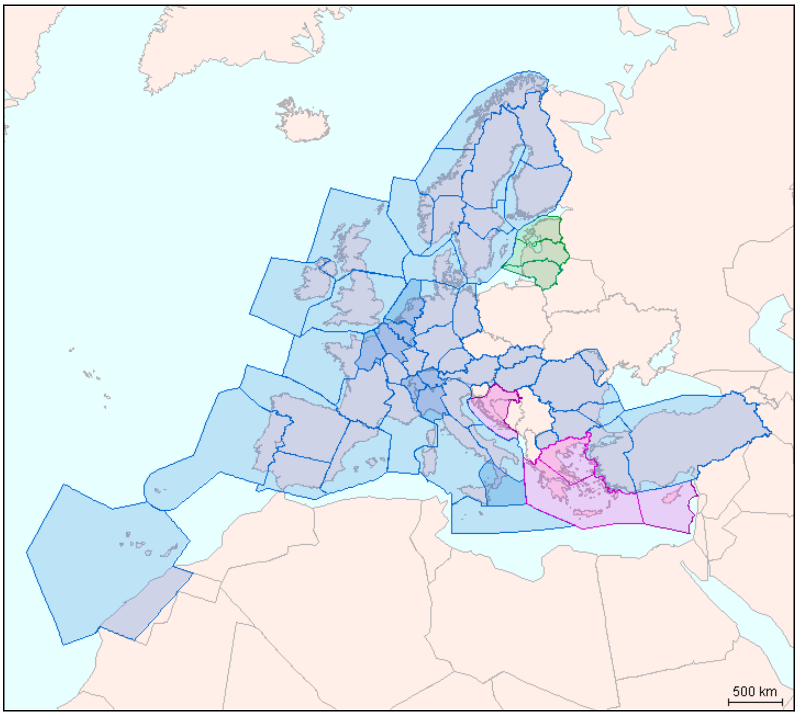
5.5.1 Yearly submission of information by ANSPs as per the Economic Information Disclosure (EID) specification is mandatory in EUROCONTROL Member States from 2001 onwards (Decision No. 88 of the Permanent Commission).

5.5.2 Information disclosure is of direct benefit to ANSPs and their regulators as it provides essential management information. Best practice can be identified and promoted using benchmarking. Moreover, information disclosure is an essential component of a performance review system that ensures ANS cost-effectiveness and effective consultation processes. It supports the target setting and performance processes.

5.5.3 There is a need to ensure full compliance with the information disclosure requirements. The implementation rules of the draft SES ANS provision regulation (Article 14e) should build upon these requirements and be adopted as soon as possible.

5.5.4 All but three ANSPs of EUROCONTROL States [HCAA (Greece), DCAC (Cyprus) and Croatia Control] complied with these requirements for year 2001.

5.5.5 In addition, the three Baltic States provided information on a voluntary basis. As a result, information from 29 ANSPs (ACE 2001 ANSPs, see Figure 45 and glossary) forms the basis for the ACE 2001 Data Benchmarking Report (ref. 16) which will be published in autumn 2003. Aggregated information from that report is given below.



- Area: 10.8M km²
- 58 ACCs opening 508 sectors at max. configuration
- 158 APPs
- 341 TWRs
- 70 AFIS units
- Compliant EUROCONTROL Member States
- Non compliant EUROCONTROL Member States
- Information provided on a voluntary basis (Baltic States)

Figure 45: ACE 2001 ANSPs

High level operational data (29 ACE 2001 ANSPs)

5.5.6 The size of the controlled area for the reporting ANSPs is 10.8M km². It comprises 58 Area Control Centres (ACC) opening some 600 sectors at maximum configuration, 157 approach units (APP), 341 towers (TWR), and 70 AFIS units (see glossary for definitions).

5.5.7 In 2001, these ANSPs controlled approximately 8.1M IFR flights and some 10.2M flight-hours over a total distance of 6 709M km. They employed approximately 44 600 staff[56], of which some 12 760 were air traffic controllers working in operations (ATCOs in OPS). Of these, some 7 730 worked in ACCs. The remaining 5 030 worked in APP and TWR, handling some 14.5M IFR and 5M VFR airport movements.

5.5.8 Figure 46 summarises some key operational ratios.

Total ANS flight hours per total ATCO in OPS	800
En-route flight hours per ATCO in OPS working hour	0.91
IFR airport movements per terminal ATCO in OPS	2 890

Figure 46: Key operational ratios (2001)

[56] Excluding EUROCONTROL HQ staff.

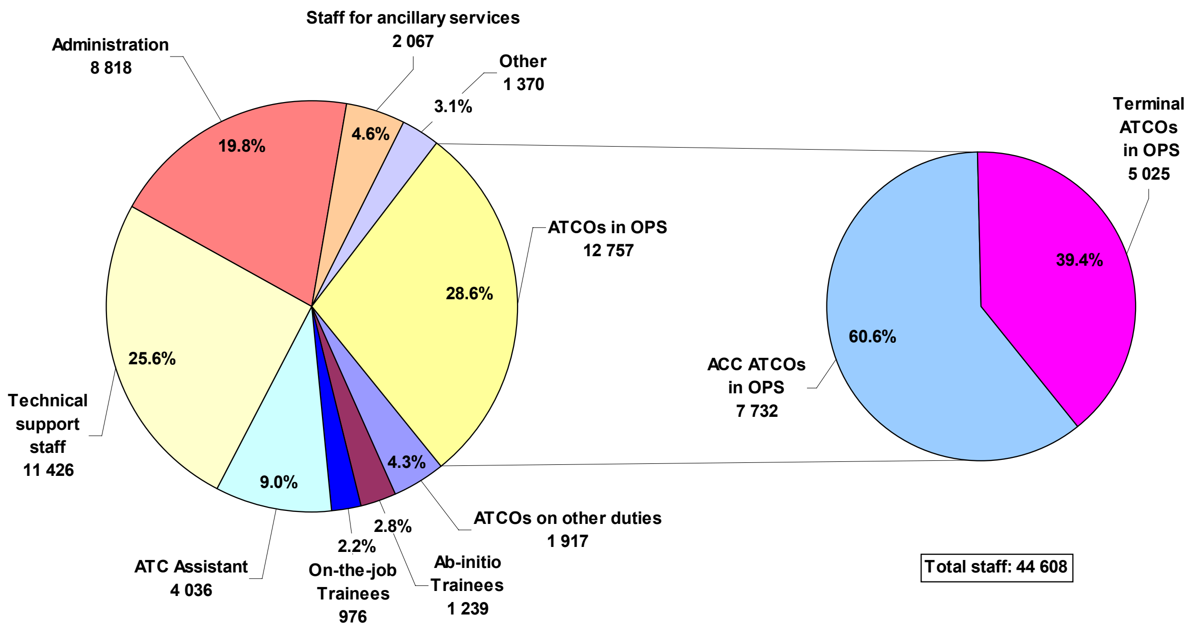


Figure 47: Breakdown of staff (ACE 2001 ANSPs)

5.5.9 Figure 47 shows that for every front line ATCO in OPS, nearly three additional staff were needed, including one technical support staff member. The support staff ratio (total staff divided by ATCO in OPS) is high at around 3.5.

High level financial data (29 ACE 2001 ANSPs)

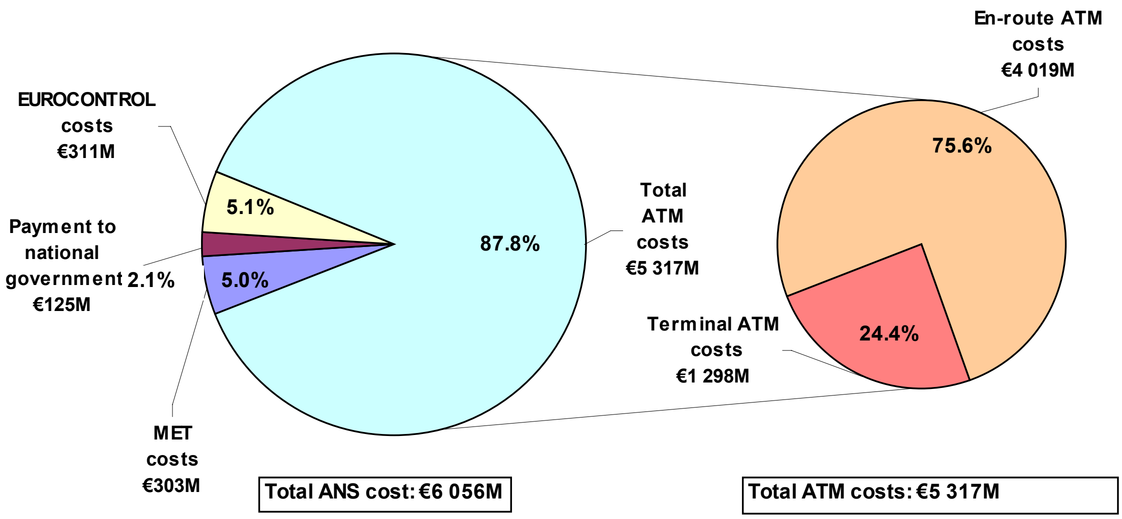


Figure 48: Breakdown of total ANS costs (ACE 2001 ANSPs)

5.5.10 Total ANS system costs were some € 6 060M, distributed as shown in Figure 48. The majority (87.8%) is directly related to ATM provision, and the bulk of this (75.6%) is accounted for by en-route services. MET costs amount to € 303M (5.0% of the total ANS costs) and are mostly allocated to en-route.

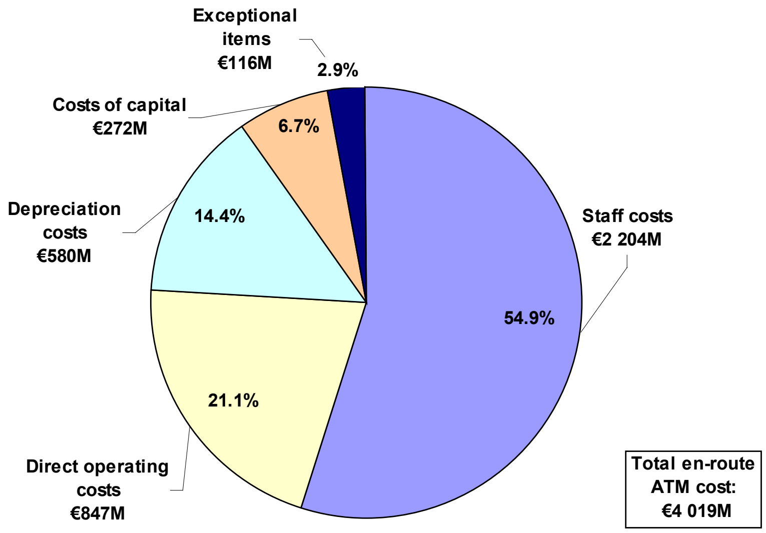


Figure 49: Breakdown of en-route ATM provision costs (ACE 2001 ANSPs)

5.5.11 Figure 49 shows a more detailed breakdown of en-route ATM provision costs. Operating expenses (staff costs plus direct operating costs) represent 76.0%. Capital related expenses comprise depreciation charges (14.4%) and cost of capital (6.7%). Exceptional items accounted for 2.9%.

5.5.12 Figure 50 below shows consolidated balance sheet items for the ACE 2001 ANSPs.

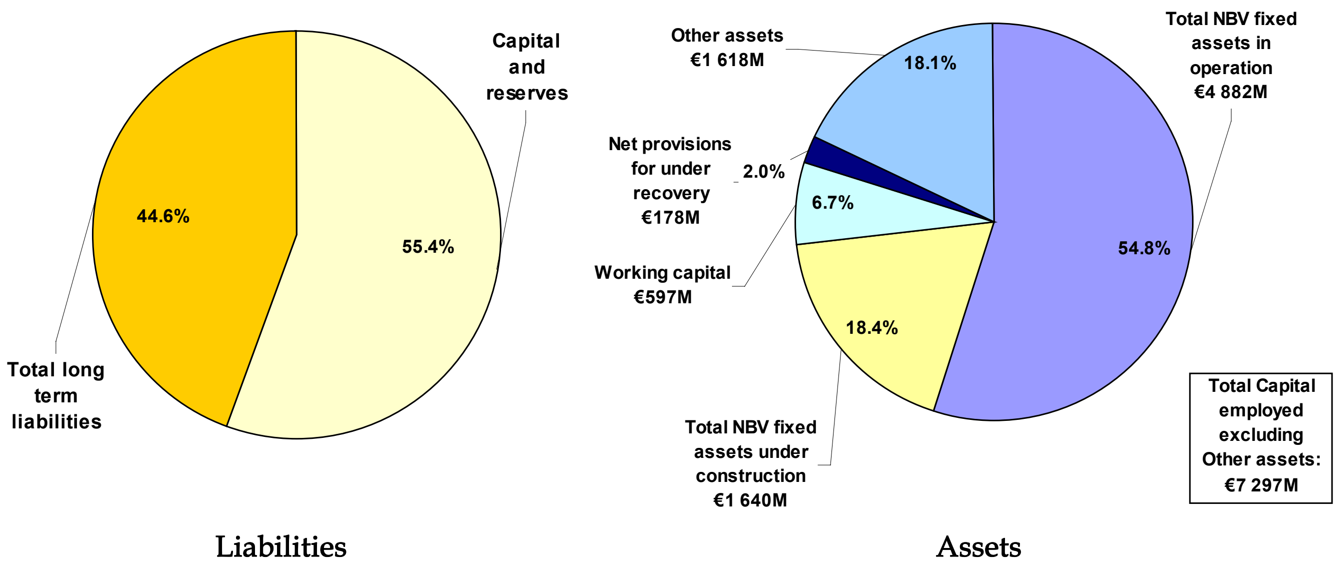


Figure 50: Assets and liabilities (ACE 2001 ANSPs)

5.5.13 Figure 51 below summarises key financial ratios:

		Comments
Total ANS costs per IFR flight	€ 708	Excluding MET
Total MET costs per IFR flight	€ 37	
Total ANS costs per thousand km	€ 858	Excluding MET
Total ANS revenues per total capital employed, excluding "other assets"	0.84	Airline industry: approx. 1
Total ANS revenues per NBV[57] of fixed assets in operation	1.27	Airline industry: approx. 1.1
Proportion of fixed assets in operation (NBV)	75%	25% of fixed assets in construction
Average remaining life of assets in operation	6.2 years	Assets in operation are at half of their accounting life, assuming depreciation over 10–12 years on average

Figure 51: Key financial ratios (2001)

5.6 Forward looking projections (2001-2006)

5.6.1 For route charges purposes, States are required to provide forward-looking projections of costs and traffic forecast. However, only half of States[58] comply with this basic requirement, as shown in Figure 52.

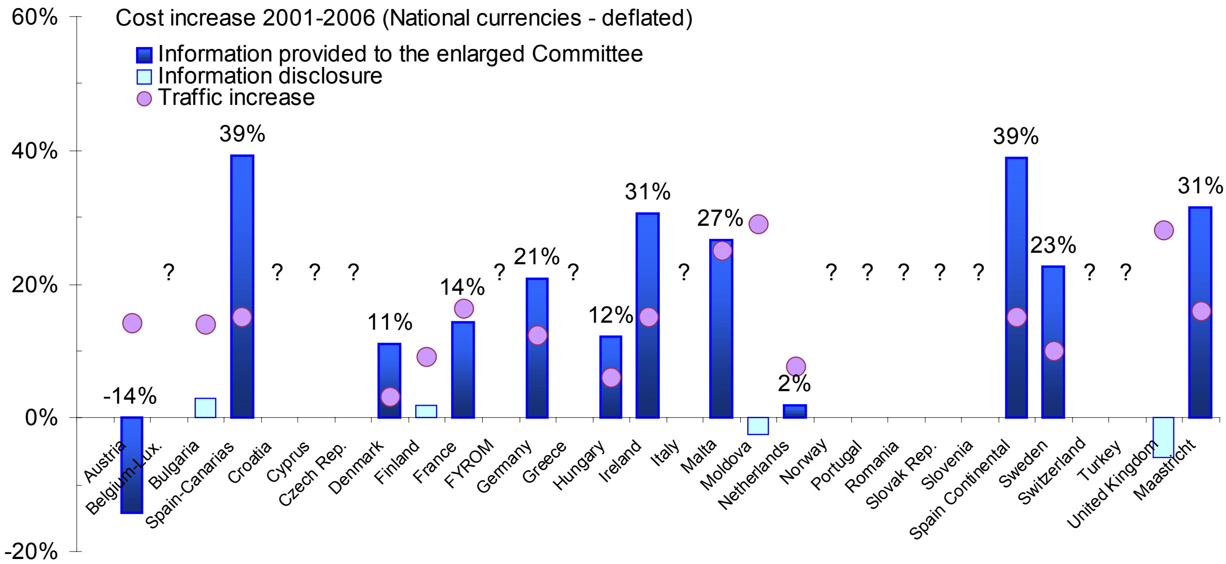


Figure 52: Projected cost increases (2001-2006, in national currencies)

5.6.2 Figure 52 shows that real costs (blue bar) are projected to increase faster than traffic (dot) between 2001 and 2006 in 9 ANSPs out of 16 that provided data. This is particularly the case in Spain (+39%), Ireland and Maastricht (+31%), Sweden (+23%), and Germany (+21%).

57 Net Book Value.

58 Ten States out of 28 have provided information to the enlarged Committee for Route Charges. Information for 4 additional States has been received in the context of information disclosure.

5.6.3 According to these projections, the present trend of growing unit costs will continue in the next five years, whereas one would expect a progressive decrease. This indicates a need for better discipline in controlling costs.

5.7 The EUROCONTROL Route Charges System

5.7.1 The EUROCONTROL Route Charges System was introduced in 1971 in order to recover the costs of air navigation services and facilities from airspace users, in conformity with ICAO texts. It has provided the European ATM system with a secure source of financing and efficient cost recovery.

5.7.2 However, the aviation world has evolved since then. This system now presents a number of shortcomings, particularly as regards alignment with strategic objectives, accountability and effective oversight of more and more independent ANSPs, effective consultation and involvement of users, transparency, and decision-making.

5.7.3 This section reviews these shortcomings and indicates general principles to be considered in resolving them.

Alignment with strategic objectives

5.7.4 One objective of the ATM 2000+ Strategy agreed at MATSE 6 is *"To reduce the direct and indirect ATM-related costs per unit of aircraft operations"*. While this objective was met from 1999 to 2002 (see § 8.2.10), there is no process to ensure this is the case.

5.7.5 Figure 53 shows the historic evolution of unit delays and costs, which together form the total cost. Typically, when delays go up, policies are implemented whereby capacity is increased, which increases costs, and progressively reduces delays, and vice-versa. Unit delays and costs tend to move in opposite directions. Such reactive approaches, addressing the most pressing issue of the time, resulted in the cycles visible in Figure 53 and less than optimum ATM performance. Forward-looking capacity and cost management are both needed.

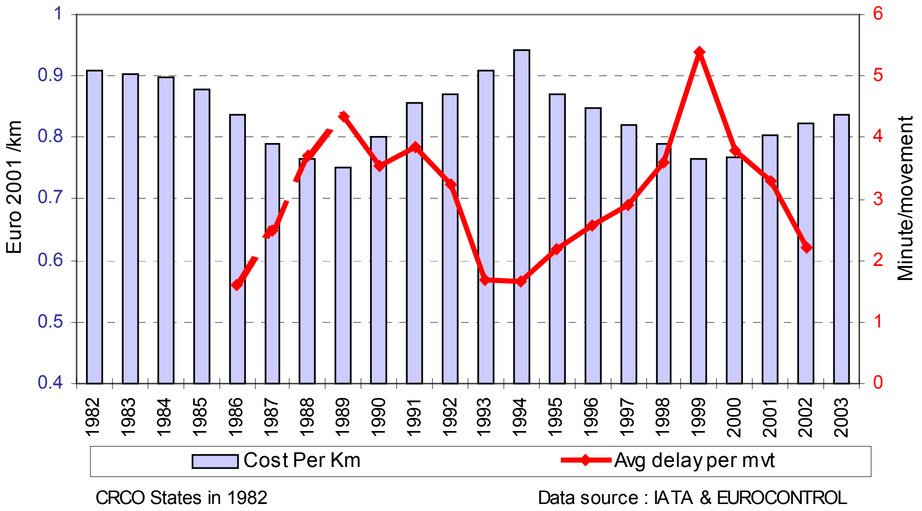


Figure 53: Unit delays and unit costs

Capacity and cost management

5.7.6 Medium-term capacity management is developing (see section 4.6). However, capacity management has so far relied on purely indicative, non-binding processes[59]. Although this may be adequate if all concerned parties play their part, there may be a case for more binding and/or contractual relationships between airspace users and ANSPs, under the supervision of regulators.

5.7.7 By comparison, forward-looking cost management is still in its infancy.

5.7.8 Route Charge principles require States to submit projections of the cost base for the next five years. In addition, the Economic Information Disclosure rules adopted in 2001 (ref. 15) require ANSPs to publish operational and financial forward-looking information. However, many States do not comply with this basic requirement, as shown in Figure 52. Furthermore, when projections exist, they are not demonstrably consistent with ANSP capacity plans. Moreover, States are not required to present justifications of the proposed cost increase and there is no link with explicit performance objectives. Finally, forward-looking information is virtually not discussed in the enlarged Committee and there is no consolidated European ATM cost plan at the moment.

5.7.9 Capacity and cost management processes remain disconnected:

- capacity management has so far been conducted without any reference to corresponding costs;
- States have set unit rates without any explicit commitment by ANSPs for capacity enhancements.

Forward-looking plans

5.7.10 Reliable forward-looking plans are essential to ensure improved ATM performance, keeping a balance between sometimes-contradictory objectives (see trade-offs in chapter 8). Building forward-looking plans requires ANSPs to put together consistent operational, staffing, investment and financial plans. Such plans:

- provide key information for ANSPs in managing their future performance;
- enable EUROCONTROL to build a consolidated European performance plan, to assess global requirements (e.g. training needs), to detect any divergence from agreed Europe-wide performance targets and any network co-ordination gaps, and to translate them into desired individual ANSP performance levels;
- provide the basis for more contractual and/or binding approaches to ATM performance, involving both users and providers of ANS services;
- can benefit from best practices identified through benchmarking, using historic EID information from all ANSPs;
- improve predictability of future ATM performance for all ATM stakeholders.

5.7.11 While ANSP costs are to a large extent fixed in the short term, scope certainly exists to make adjustments in the medium term (5 years horizon). The process should therefore focus on longer-term performance objectives and business plans, in addition to the short-term focus on next year's unit rate.

5.7.12 ANSPs should commit to meeting their medium term plans. Such plans could be revised annually following thorough consultation. Consideration of medium-term plans should form part of short-term decision-making processes, such as setting unit rates.

[59] With the exception of the UK, where the regulator sets a price cap, which includes penalties to the ANSP in case of excessive delays.

5.7.13 The disclosure of clear performance objectives and consistent business plans to meet those objectives should be seen as an essential element in that process. As with any business, careful assessment of customer preferences and trade-offs is essential to this process.

Transparency

5.7.14 The route charges system is based on the EUROCONTROL Principles (ref. 17). However, the application of those Principles is the responsibility of each individual State.

5.7.15 There is limited visibility on the assumptions used to establish the cost-base. Staff costs (on average 57% of the cost-base) are provided with few details on associated staff numbers. The capital related costs (interest charged and depreciation) are not supported by figures on the capital employed. There is no obligation for external audited accounts. Some ANSPs do not even have a proper accounting system.

5.7.16 The move towards corporate organisations has improved the situation in this respect, since those organisations are required by national law to produce a set of audited accounts, generally accompanied by an annual report. However, there remain significant differences across national accounting standards. Moreover, audited accounts usually do not distinguish en-route services from the other lines of business, making reconciliation with the route charges figures difficult.

5.7.17 The document "Guidance on the Rules and Procedures of the Route Charges System" gives the CRCO a role in ensuring that States' cost-base data are in accordance with the Principles. However the CRCO has no right of initiative, nor any authority to enforce compliance with the Principles.

5.7.18 The Provisional Council's decision in 2001 to make Economic Information Disclosure mandatory constitutes a significant step forward towards greater transparency. Implementation of Article 9 of the draft SES ANS regulation (ref. 3), which requires ANSPs to comply with International Accounting Standards, to publish annual reports and undergo independent audit, should build on EID and provide for enforcement.

Terminal charges

5.7.19 While visibility on route charges is good through CRCO reports, visibility on terminal charges is more problematic. As terminal charges are collected by individual States, sometimes through the CRCO, there is no readily available information on terminal charges across Europe.

5.7.20 One way to ensure transparency of terminal charges and avoid accounting pitfalls would be to collect terminal charges in a similar way to en-route charges. This would probably also improve efficiency in the recovery.

Effective consultation

5.7.21 Both ICAO and EUROCONTROL emphasise the importance of effective consultation with airspace users. Bilateral consultation meetings, when they take place, provide the only opportunity for the users to seek explanations for the level of charges that will be imposed. They seldom take the form of proper consultations on the required level of performance and the opportunity for new investments. There is little transparency on the outcome of these bilateral meetings.

5.7.22 In principle, proper consultations should result in agreements between ANSPs and users, whereby the former commit themselves to deliver service (e.g. capacity) and the latter accept to pay the corresponding costs.

Full cost recovery

5.7.23 The present full cost recovery regime does not provide incentives to deliver performance and to be responsive to user needs beyond levers normally available in the public sector. With the current system, airspace users are bearing most, if not all, of the business risks. On the one hand, if demand is higher than expected or if the planned capacity is not delivered, airspace users will incur higher delays. On the other hand, if demand is lower than expected or actual costs are higher than planned, the airspace users will incur higher charges.

5.7.24 The adjustment of unit rates in 2002, in response to the economic downturn, illustrates one drawback of the full cost recovery regime. While airlines had no choice but to cut costs, most ANSPs continued to increase their costs significantly, resulting in even higher unit costs.

5.7.25 The EUROCONTROL Principles permit pricing as an alternative option to full-cost recovery, provided that it is operated under a regulated environment. This option is considered to generate greater incentives to deliver performance and was adopted by the UK in 2001. Whether it could apply elsewhere remains to be assessed.

Enlarged Committee

5.7.26 The Revised Convention foresees the creation of a Route Charges Committee to replace the enlarged Committee[60]. In this context, it is important to highlight some of the weaknesses that characterise the current arrangements:

- *Club/cartel syndrome:* States are reluctant to challenge the cost base of other Contracting States, so that their own cost base is not discussed;
- *Conflict of interest:* Contracting States are often represented by ANSP representatives. ANSPs have therefore a strong voice in the enlarged Committee while user representatives have only observer status;
- *Decision-making:* decisions taken by consensus tend to hamper the decision-making of the enlarged Committee.

Possible improvements

5.7.27 An urgent review of the processes used for discussing and adopting unit rates is required. While the diagnosis is clear, it will take some time to develop and agree remedies. A staged approach (packages) would be preferable.

5.7.28 As a first step, existing rules should be applied and enforced if necessary. States/ANSPs should effectively publish historic and forward-looking information, as required by Route Charges and EID rules. Making such publication a prerequisite for any increases in unit rates would be an incentive to do so.

5.7.29 Further steps will take some time to be developed. However, the following considerations and general principles seem to be relevant in any case:

- ANSPs should publish robust business plans, including consistent capacity and cost plans;
- a regional focus[61] for consultation on those capacity and cost plans, under EUROCONTROL auspices and with concerned States as arbiters, could help

60 See "Justification" of Article 7.6 of the Revised Convention.

61 Possibly linked with functional airspace blocks.

strike the right balance between overall consistency and consideration of local circumstances. It would also enhance visibility, mutual awareness of providers and active involvement of users, while avoiding a multiplicity of bilateral meetings;

- if agreed between users and providers, such plans could form the basis of more binding and/or contractual relationships, under supervision of regulators;
- these plans should be consolidated and checked for consistency with strategic European objectives by the EUROCONTROL Agency;
- the ratification of the Revised Convention and the accession of the European Communities offer an opportunity to rationalise and reinforce capacity and cost management processes (enlarged Committee, ATM/CNS Consultation Group (ACG), Chief Executive Standing Conference);
- both users and providers of ATM services should be directly involved in these processes;
- historic and forward-looking information submitted under Route Charges/EID, together with its analysis by the PRC, should become an important element in these processes.

PRC contribution

5.7.30 The PRC plans to develop ANSP benchmarking and to propose evolutions of Economic Information Disclosure.

5.7.31 In accordance with its Terms of Reference (ref. 18), the PRC can contribute guidelines for economic regulation, but is not in a position to develop and test detailed rules. It will examine the performance of economic regulation, in parallel with the performance of ANS provision.

5.8 Conclusions

5.8.1 Not only are real unit costs high by reference to other ATM systems (e.g. US), but they are growing fast in many States. The real unit cost is set to increase by 9.5% net of inflation over three years (2000 to 2003). According to ANSP plans, this trend will continue in the medium-term.

5.8.2 The situation is compounded by slow traffic growth and under-recoveries from past years. As a consequence, the average weighted unit rate for 2003 is 22.3% higher than in 2000.

5.8.3 One would expect to see regular efficiency gains leading to a reduction in real unit costs, typically 2-3% every year. Thus, ATM real unit costs are growing some 5-6% per year faster than one would expect. This indicates the need for better discipline in controlling costs.

5.8.4 Notwithstanding its merits, the Route Charges System lacks cost-effectiveness focus and discipline, transparency, incentives to deliver performance, clear performance objectives and effective consultation. Furthermore, unit rates are generally adopted without reference to capacity commitments.

5.8.5 The enlarged Committee, working as it does by consensus, has shown that it lacks effective decision-making and oversight of the system.

5.8.6 An urgent review of the processes used for discussing and adopting unit rates is required. The new processes should:

- require that complete and transparent data are available;
- have a longer-term focus, with clear performance objectives and business plans to meet them, in addition to a short-term focus on next year’s unit rates;

- ensure that airspace users and ANSPs are more directly involved in, and accountable for, decisions on capacity and cost plans, and that risks are shared more equitably between them;
- stimulate ANSPs to meet their performance objectives, and do away with the full cost recovery principle if necessary;
- induce ANSPs to objectively review whether the various facilities and services are in line with requirements.

5.8.7 Implementation rules of the draft SES regulation on ANS Provision (Article 14e, charging scheme) should be developed rapidly, building upon the EUROCONTROL Economic Information Disclosure scheme, and provide for enforcement.

5.8.8 As a minimum, availability of forward-looking information should be made a prerequisite for the adoption of any increases in unit rates.

6 FLIGHT EFFICIENCY

6.1 Introduction

6.1.1 Flight efficiency is the fourth Key Performance Area. It is closely linked with environment. This chapter is a further elaboration of information given in previous PRRs, and includes a first economic valuation of flight inefficiencies. Accurate measurement is still restricted by lack of data in some areas.

6.1.2 Flight efficiency has both horizontal and vertical components. In the absence of specific indicators for the en-route and terminal flight portions, flight extension, i.e. excess distance between actual route flown (black line in Figure 54) and optimum route[62] (red line) is used as an interim indicator for horizontal efficiency. As departure and arrival phases are to a large extent "uncompressible", flight extension cannot be reduced to zero.

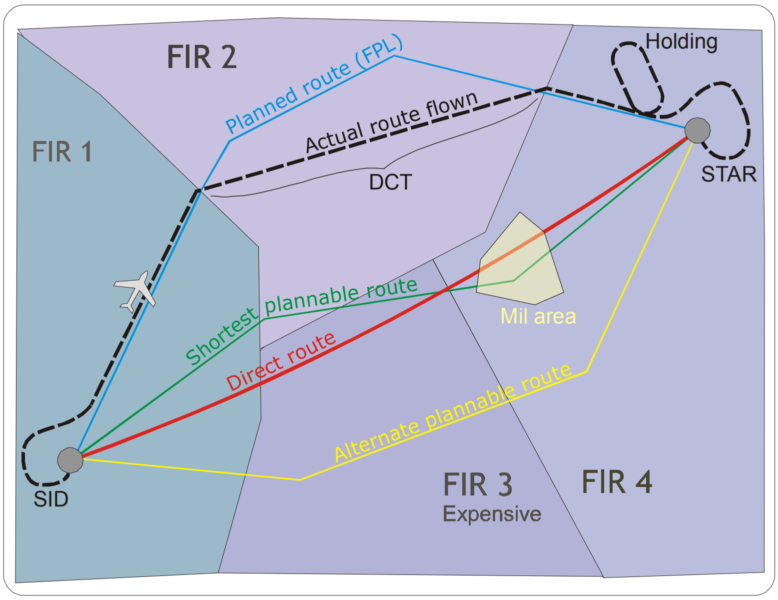


Figure 54: Possible 2D routes vs. actual flight

6.1.3 Horizontal flight extension arises from a combination of the following elements:

- route network: for various reasons (historical, operational, political, military etc.), existing routes are generally not direct;
- flight planning: airspace users may be unable or unwilling to fly the shortest plannable route (green line in Figure 54) for various reasons, such as congestion, temporary segregated areas, weather, route charges;
- tactical changes of the flight path (black line in Figure 54): diversions and holding can extend the flight path, while tactical direct routing (DCT) can shorten it;
- departure (SID) and arrival procedures (STAR): these are constrained by operational and environmental considerations.

6.1.4 Vertical efficiency is not quantified here. However, additional fuel burn is computed with reference to the optimal vertical profile.

62 The great circle line is a good approximation of the optimum 2D flight path for short/medium haul flights (average flight length under 800-1000km), but not true for long haul flights due to wind (i.e. optimum path longer, but faster).

6.2 Flight efficiency in the departure and arrival phases

6.2.1 Results in sections 6.2 and 6.3 are based on studies performed by the EUROCONTROL Experimental Centre (EEC) for the PRC (ref. 19).

6.2.2 As a significant amount of fuel (some 43%[63]) is burnt outside the cruise phases, it is worth analysing potential improvements in standard departure and arrival procedures (SID/STAR).

6.2.3 Analysis of an airport of medium complexity shows a fuel burn difference of 2%-18% between the SID and the direct route, depending on the engine type. However, the potential gain in flight efficiency would be at the expense of enlarging noise contours on the ground (up to 40% in this example).

6.2.4 These results are specific for the particular airport analysed, so a generalisation is not possible. Detailed analyses are needed to identify potential improvements in flight efficiency in every European TMA, including RNAV procedures and continuous descent, while respecting environmental limitations. Nevertheless, there would appear to be scope for improvement.

6.3 Flight extension and additional fuel burn

6.3.1 The EEC report gives initial evaluations of flight extension, additional fuel burn, and corresponding economic value. The study was performed on a sample of flights (see Figure 55) which is considered representative for traffic within the ECAC area.

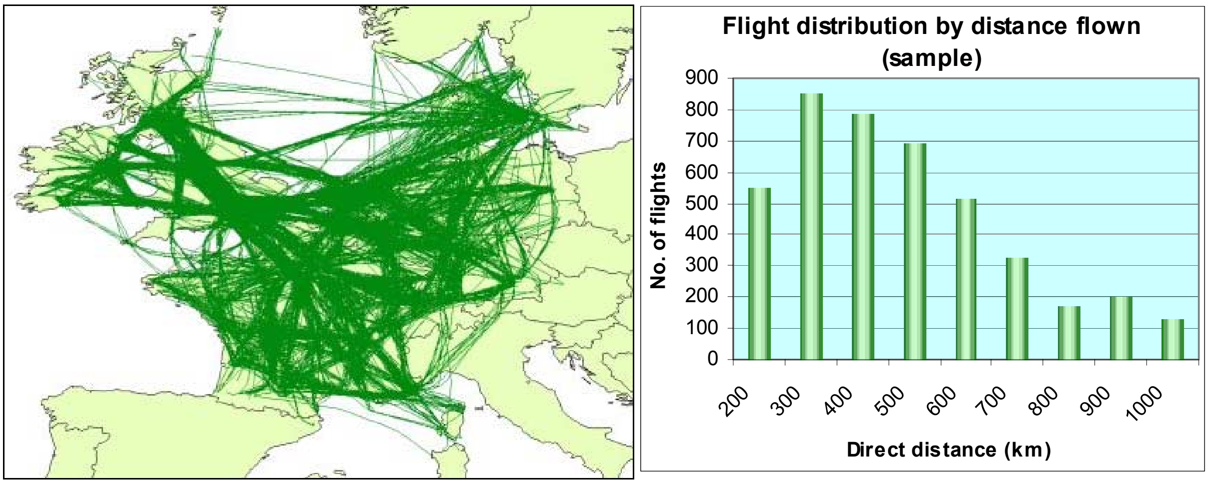


Figure 55: Traffic sample for flight-efficiency analysis

6.3.2 Total flight extension was evaluated as described in § 6.1.2 above (maximum theoretical value). Figure 56 shows the corresponding average flight extension of 8.9%, which confirms earlier EEC estimates[64].

63 See PRR 4, p. 35.

64 An earlier EEC study quoted in PRR 5 (§ 6.2.4) indicated flight extensions of 8-12%.

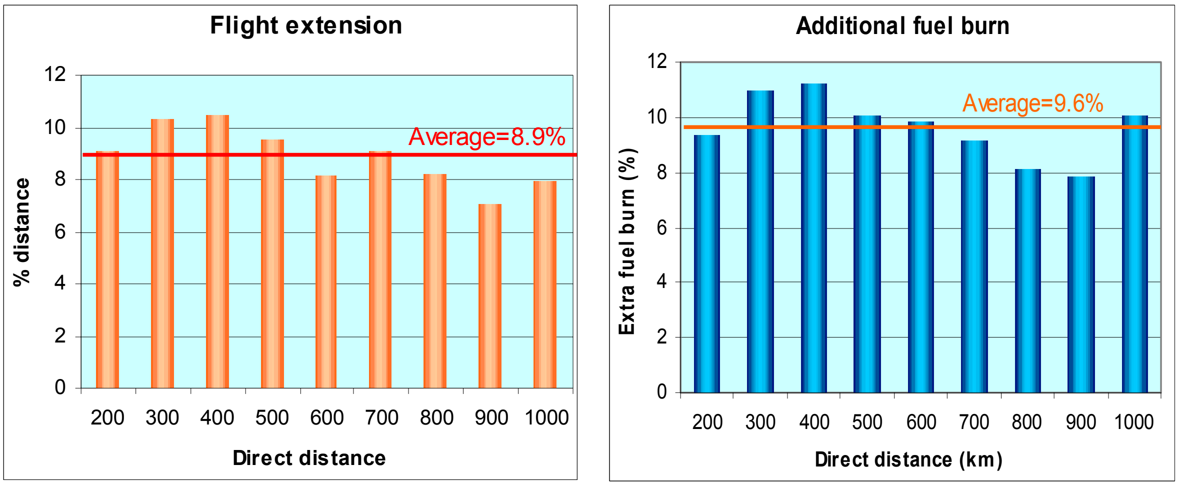


Figure 56: Flight extension and additional fuel burn (actual vs. theoretical optimum)

6.3.3 As parts of the flight are "uncompressible", a rough estimate of potential flight efficiency gains is 2-5%. This is consistent with a 6% potential improvement from ATM quoted by the IPCC report (ref. 20).

6.3.4 An estimate of 9.6% extra fuel burn (see Figure 56) was computed using the same sample (difference between estimated fuel burn on actual and ideal route and profile). The difference with flight extension may come from non-optimal vertical flight profiles used by actual flights.

Economic value

6.3.5 The EEC report gives an initial evaluation of the economic value of flight inefficiencies. The environmental cost to society is a complex and difficult matter, which is not addressed here.

6.3.6 Various elements of flight inefficiency increase the airlines' operating costs. The direct cost component is determined by the additional fuel burned and indirect costs are added due to the additional flight time.

6.3.7 The EEC report uses a marginal cost of flight time of € 12-28 per minute and a marginal fuel cost per minute of € 11[65]-€ 15 (ref. 21) for economic valuation of flight inefficiencies.

6.3.8 Preliminary results are summarised in Figure 57.

	Low bound	High bound
Theoretical maximum benefit (based on measured flight extension of 8.9% and fuel burn of 9.6%)	€ 1 000M	€ 2 500M
Estimated achievable benefit (based on 2-5% flight efficiency gain)	**€ 200M**	**€ 1 400M**

Figure 57: Potential benefits in flight efficiency

6.3.9 The magnitude of potential savings in flight efficiency, i.e. € 200M-€ 1 400M, is significant compared with other KPAs (see section 8.1). Trade-offs with delays are discussed in section 8.3.

65 Source: IATA.

6.3.10 While significant improvements have been achieved during the past decade (airspace design, new procedures, etc.), gains are still possible. Further work is needed to identify clearly where and how these gains are achievable. This should also help to prioritise present activities aimed at optimising ATM.

6.4 RVSM

6.4.1 Preliminary results from an EEC study (ref. 22) indicate significant environmental benefits from the implementation of RVSM (January 2002) in terms of reduced fuel burn and aviation emissions, due to six additional flight levels being available in upper airspace for optimisation of flight profiles.

6.4.2 Fuel savings after six months of RVSM operations were estimated on average at 1.6-2.3%, with the same reduction in CO_2, SOx and water emissions (greenhouse gases). NOx emissions have also been reduced by about 0.7-1%. In absolute terms, fuel savings are approximately 17 - 37 kg per flight. Considering that 46% of all flights in the ECAC airspace fly at RVSM flight levels, the reduction is equivalent to some 100 000 intra-European flights.

6.4.3 The result is even more positive for flight levels FL300-FL330, which are most sensitive to NOx and H_2O emissions. Emissions are more homogeneously spread and reductions of up to 4.4% for NOx and 5.0% for H_2O have been estimated.

6.5 Conclusions

6.5.1 A rough estimate of potential flight efficiency gains is in the range of 2-5%. This leads to potential flight efficiency savings estimated at € 200M-€ 1 400M annually, which is certainly worth pursuing. Trade-offs with other KPAs, except safety, must be considered.

6.5.2 There is a trade-off between noise and flight efficiency, specific to each airport. Detailed analyses are needed to identify potential improvements in flight efficiency in every European TMA, while respecting environmental limitations. Nevertheless, there would appear to be scope for improvement.

6.5.3 The implementation of RVSM has led to flight efficiency and environmental benefits. Reductions in fuel burn and emissions of greenhouse gases (CO_2, SOx and water vapours) are estimated at 1.6-2.3%, and reduction of NOx at 0.7-1%. This is equivalent to some 100 000 less flights per year in ECAC airspace.

7 TERMINAL AREAS AND AIRPORTS

7.1 Introduction

7.1.1 Airports are an essential component of the air transport system, and their interaction with ATM plays a key role in its performance. This chapter gives facts concerning European airports, and discusses aspects of ATM performance at and around airports.

7.1.2 Airports and associated terminal areas (TMAs) have an influence on all key ATM performance areas. Conversely, ATM influences airport performance:

- ATM has a role in safety at and around airports, which is not discussed here.
- As en-route capacity problems tend to reduce, major airports and associated TMAs will become more critical to ATM delay performance.
- While increasing airport capacity is primarily a political responsibility, it is the responsibility of ATM to make best use of the existing airport capacity.
- Terminal charges[66] are ~23% of ATM charges (see § 5.5.10). Terminal costs are ~25% of ATM costs (see Figure 48 page 48). Terminal costs are partly recovered through route charges (ref. 23).

7.2 Airport traffic and delays

7.2.1 Figure 58 presents a map of main airports in Europe.

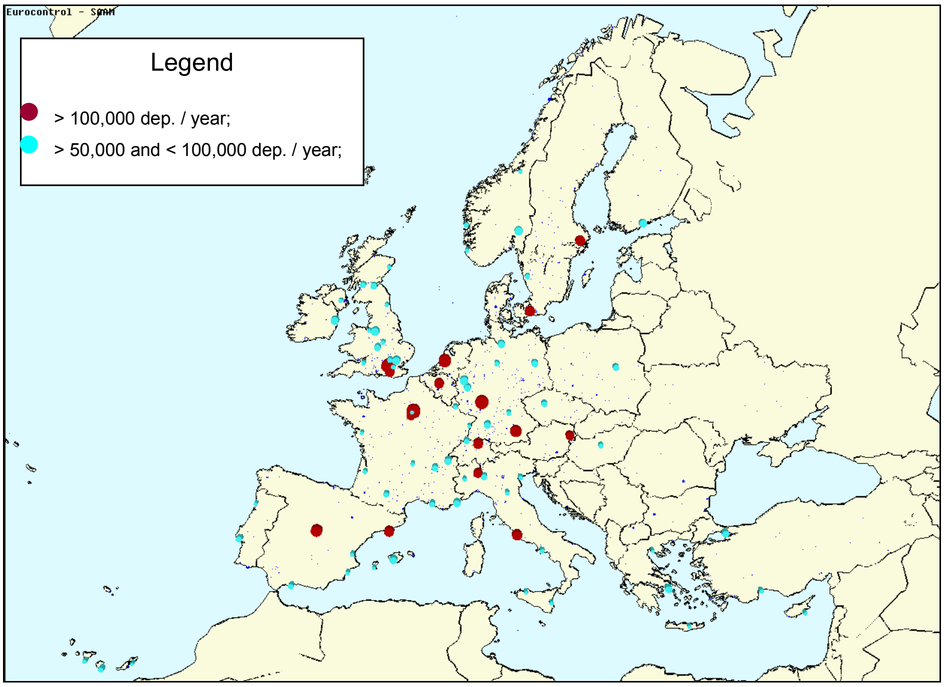
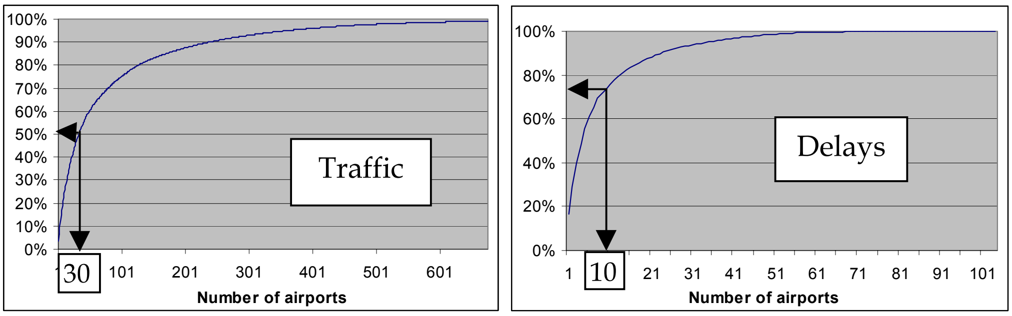


Figure 58: Main European airports and corresponding traffic in 2002

7.2.2 More than 1000 airports handle IFR traffic in the ECAC States. However, traffic tends to be concentrated in a limited number of airports. The top 30 airports generated 50% of departures (see Figure 59, left).

66 Terminal charges are based on cost allocation using the “20 km rule”. TMAs tend to be larger.



(Data source: EUROCONTROL/CFMU)

Figure 59: Cumulative distribution of traffic and ATFM delays at European airports

7.2.3 34% of ATFM delays were due to airport capacity restrictions in 2002 (see section 4.5), 77% of which originated in 10 airports (see Figure 59, right). Figure 60 gives delays and major causes at those airports.

Rank	Airport	ATFM delay (min)	Cumulated ATFM delay	Delay/arrival flight (min)	% weather delays	% ATC delays
1	Frankfurt	933 573	16%	4.0	48%	2%
2	Paris (CDG +Le Bourget)	729 908	28%	2.6	30%	65%
3	Amsterdam	685 612	40%	3.3	81%	5%
4	London/Heathrow	603 368	50%	2.6	82%	10%
5	Milan-Malpensa	486 162	58%	4.5	44%	7%
6	Barcelona	363 668	65%	2.7	46%	36%
7	Zurich	235 575	69%	1.7	48%	40%
8	Rome-Fiumicino	229 106	73%	1.6	46%	14%
9	Munich	129 127	75%	0.8	73%	23%
10	Firenze-Peretola	116 778	77%	7.6	-	36%

Figure 60: Top 10 airport ATFM delays

7.2.4 Since demand is limited at "co-ordinated" airports, airport ATFM delays should occur only in exceptional cases, except for bad weather. The interaction between airport co-ordination and ATFM delays warrants further study.

7.2.5 A few airports, particularly in the Greek islands, generate disproportionate delays compared to their traffic (see Figure 61). Most delays in the Greek islands are caused by a mismatch between airport and ATFM slots.

Name	ATFM delay	Delay/arrival flight (min)	ATFM delay Rank
Iraklion/Nikos/Kazantzakis	96 198	4.8	12
Diagoras	69 303	4.7	15
Cannes-Mandelieu	21 186	3.8	29
Santorini	14 970	3.6	38
Catania-Fontanarossa	87 215	3.5	13
Kos	17 466	3.0	34

Figure 61: Airports generating high ATFM delay/flight

7.2.6 Most of the 30 most critical airports in 2000[67] still generate high ATFM delays today. Relevant bodies, such as the EUROCONTROL Agency, should review progress made in resolving critical airport issues on a regular basis.

67 See PRR 4 Annex 7

7.3 Optimising airport throughput

7.3.1 Runway capacity is a limited resource at key airports, and is likely to remain so even if new runways are built. It is therefore incumbent on ATM to maximise the use of this resource, particularly at major hubs.

7.3.2 At the moment, airports and ATM performance requirements do not always match:

- hub operations maximise airline and airport efficiency, but create peaks and troughs for ATC;
- adherence to ATFM slots may penalise airport operations, but non-adherence (see Figure 36, page 38) jeopardises ATFM performance;
- airborne holding helps maximising landing throughput, at the expense of flight efficiency and also has environmental implications.

7.3.3 As en-route capacity issues become resolved, it will become more imperative to focus on terminal areas and airports. Initial indications are that considerable value could be created by optimising airport throughput: one additional slot at a major airport in a peak hour is worth several million Euro.

7.3.4 Extensive use of metering and spacing, as in the US, would help maximise runway throughput and adherence to schedules, while minimising holding requirements and consequential environmental impact. Implementation of metering and spacing, however, may require some spare en-route capacity (see § 4.6.6), a more tactical approach to ATFM (see § 4.8.13), and greater co-operation among ANSPs in Europe (e.g. pre-sequencing of inbound traffic by upstream ACCs).

7.3.5 Fostering co-operation and interoperability among ANSPs are important topics for the Single European Sky.

7.4 Conclusions

7.4.1 Runway capacity is a limitation at key airports, and is likely to remain so. ATM should seek to maximise the use of this finite resource.

7.4.2 Airport ATFM delays tend to originate from a few airports and little progress has been observed in this respect. Relevant bodies, such as the EUROCONTROL Agency, should review progress made in resolving critical airport issues on a regular basis.

7.4.3 Metering and spacing would help maximise runway throughput and hence adherence to schedules, while minimising holding requirements and consequential environmental impact. Its implementation however may require some spare en-route capacity, a more tactical approach to ATFM, and greater co-operation among ANSPs.

7.4.4 Fostering co-operation and interoperability among ANSPs are important topics for the Single European Sky.

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8 TRADE-OFFS

8.1 Introduction

8.1.1 Safety performance must stand alone, and be regulated separately, without trade-offs. There are however trade-offs between other Key Performance Areas (KPA) i.e. Delay, Cost-effectiveness and Flight Efficiency. For example, delays can be reduced through additional capacity, which has a cost, or through avoidance of congested areas, which entails lower flight efficiency.

8.1.2 Penalties incurred by airspace users due to performance shortfalls in those three KPAs are as estimated as follows:

- Delays: € 700M-€ 1 000M (see section 4.3);
- Cost-effectiveness: € 600M-€ 1 800M (supposing 10%-30% gain[68]);
- Flight efficiency: € 200M-€ 1 400M (see § 6.3.8).

8.1.3 As no KPA has negligible economic value compared to the other KPAs, ATM policy must address all three KPAs in a balanced way.

8.2 Delays versus cost

Short term trade-off

8.2.1 In the short term, resources available to ANSPs are essentially fixed[69].

8.2.2 Section 2.2 has identified diurnal, weekly and seasonal traffic variability, with different magnitudes in every ACC. This external factor can have a negative influence on delays and/or cost-effectiveness if not properly managed.

8.2.3 In part A of Figure 62, resources are provided at a constant, high level. This is adequate to meet demand at a high quality of service, but leads to under-utilisation at off-peak times. In part B, resources are provided at a lower, but still constant level. This reduces the under-utilisation and consequent loss of productivity, but also causes delays. Part C shows the optimum position, in which the same resources are adapted to variations in demand. High quality of service can be maintained without loss of productivity caused by under-utilisation of resources.

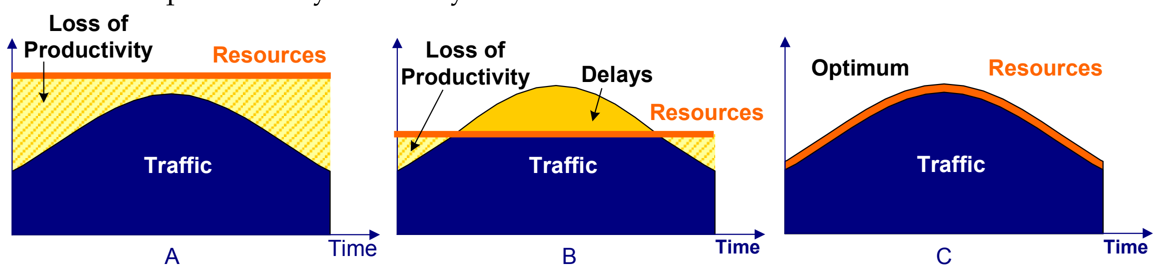

Figure 62: Short-term delay-productivity trade-off

8.2.4 Flexibility of resource allocation clearly appears as an important factor for both delays and cost-effectiveness. It was identified as a main factor in the productivity difference between US and European ACCs (see § 9.3.17).

68 The US-Europe comparison (see Chapter 9) confirms that unit costs are some 70% higher in Europe than in the US.

69 In less than one year, it is not possible to recruit and train additional staff, procure major equipment, etc.

8.2.5 Achieving an optimal level of flexibility will be an item for ANSP management and staff to address.

Medium term trade-off

8.2.6 In the medium term, resources are essentially variable. Within five years, it is possible to hire and train new staff, to procure and install new equipment, etc, in order to meet forecast traffic demand.

8.2.7 Adding capacity generally increases fixed (capacity) costs[70], and reduces delay costs where demand is high, as shown in Figure 63. Both capacity and delay costs are ultimately borne by airspace users in Europe, where route charges apply. The sum is a U-shaped curve, with a minimum where capacity matches demand.

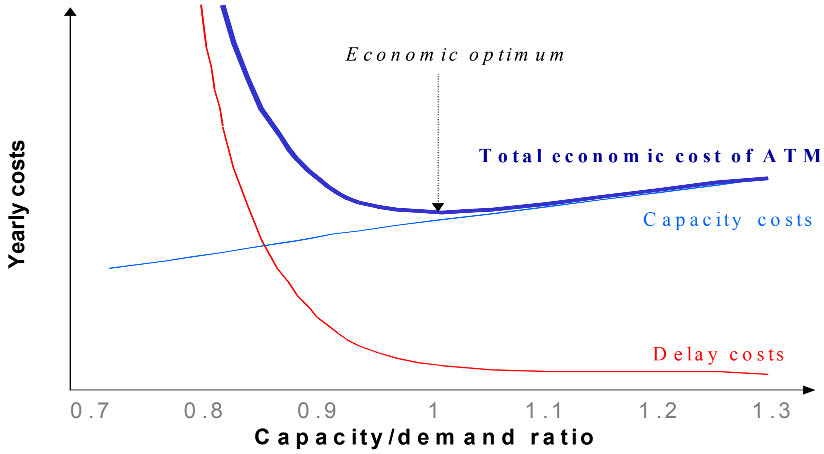

Figure 63: Trade-off – Delay/cost

8.2.8 Acting on a PRC recommendation, the Provisional Council has set a medium term delay target that corresponds to this optimum (1 min/flight). This target would have been reached in 2002 (see § 4.7.7) if London ACC had not been affected by temporary problems. This demonstrates that the target is reachable. The PRC considers that the agreed delay target of one minute per flight remains valid as a high level target.

8.2.9 The target should be reached as soon as possible and maintained thereafter. Capacity management will therefore need continuous attention.

Total unit cost

8.2.10 An objective of the ATM 2000+ Strategy is *"To reduce the direct and indirect ATM-related costs per unit of aircraft operations"*. Figure 64 shows that, since 2000, this objective has approximately been met, with decreasing unit delays compensating for increasing unit costs. Delays will need to be lower or equal to 2002 levels if the objective is to be met in 2003[71]. Furthermore, both delays and costs will need to be managed carefully if the objective is to be met in the future.

70 The cost of effective capacity has been found to be quasi-linear in the long run (see PRR 4, Figure 32).

71 Figure 64 is drawn using standard value of ground delay used by EUROCONTROL for Cost-benefit analyses (€ 62 per minute), and supposing ATFM delays are equal in 2002 and 2003.

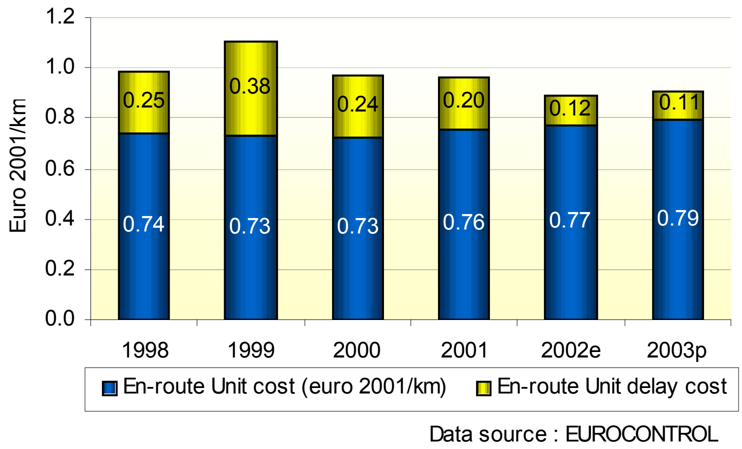

Figure 64: Total unit cost

8.3 Delays versus flight efficiency

8.3.1 Trade-offs between delays and flight efficiency must also be considered. Several decisions influence performance in both areas:

- several months before operations, route networks are designed so as to improve capacity, which reduces delays. However, any departure from the direct route entails flight efficiency penalties;
- on the day before operations, the CFMU may decide to move certain flows so as to off-load those sectors likely to be most congested, which improves delays, but increases route length;
- on the day of operations, airspace users may also decide to file for longer routes so as to avoid delays for certain flights.

8.3.2 As both delays and extra route length have a cost, there is a delay/flight efficiency trade-off, with an optimum corresponding to the minimum total cost, which is represented in Figure 65.

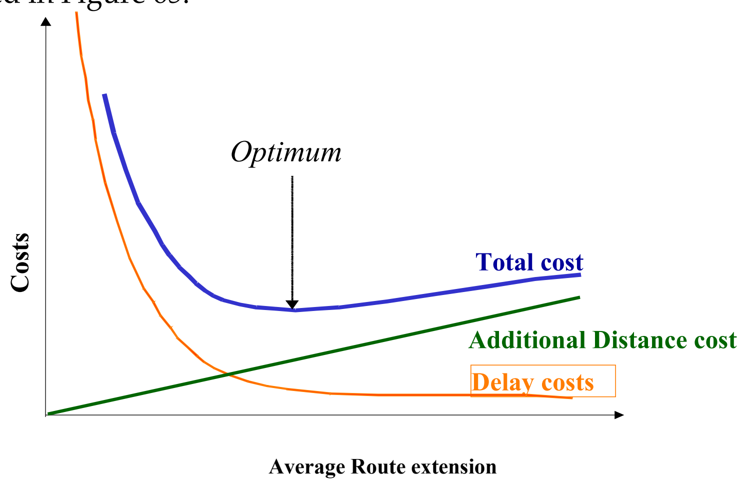

Figure 65: Trade-off - Ground delay/Flight-efficiency

8.3.3 Given the orders of magnitude indicated in § 8.1.2, both delays and flight-efficiency need to be carefully considered. If delay benefits clearly outweigh the marginal cost of additional route length for specific flows or flights, then there is a case for re-routing flows or single flights, on a voluntary or mandatory basis[72].

8.3.4 Conversely, if flight efficiency could be improved in certain regions without increasing the total cost (charges + delays), then there is a case for more direct routings, provided that safety standards are met.

8.3.5 The PRC is currently assessing the situation in more detail. The trade-off between delay and flight efficiency needs to be better understood before any rules or incentives are agreed (e.g. compensation to users for mandatory re-routing around congested areas).

8.4 Conclusions

8.4.1 Since 2000, the ATM 2000+Strategy objective relating to cost-effectiveness has approximately been met, with decreasing unit delays compensating for increasing unit costs. However, both delays and costs will need to be managed carefully if the objective is to be met in the future.

8.4.2 Flexibility of resource allocation clearly appears as an important factor in ATM performance, with an influence on both delays and cost-effectiveness. However, flexibility also has social implications. Achieving an optimum level of flexibility will be an item for ANSP management and staff to address.

8.4.3 The trade-off between delay and flight efficiency needs to be better understood before any rules or incentives are agreed.

[72] There may be a case for compensation for mandatory re-routing and/or higher charges in congested areas. In the latter case, care must be taken that ANSPs are not encouraged to deliver insufficient capacity.

9 UPDATE ON US/EUROPE COMPARISONS

9.1 Introduction

9.1.1 The US ATM system is the closest in terms of traffic characteristics and geographical dimensions, which makes it a natural yardstick for the European ATM system.

9.1.2 In PRR 4 (ref. 10), a first "continental" comparison of the US and European[73] ATM systems for the year 1999 was presented. This initial comparison concluded that the unit cost of the European ATM system was on average 70% higher than its US counterpart. In July 2001, the Provisional Council encouraged the PRC to investigate this finding further in co-operation with ANSPs[74].

9.1.3 This chapter explores in greater depth the significant cost-effectiveness difference first identified in PRR 4. Cost-effectiveness has been broken down into three main components (ATCO productivity, employment costs, support costs), using the same methodological framework developed initially for European purposes (ref. 14).

9.1.4 Cost-effectiveness of the US and European ATM systems was analysed both at system-level for all Air Navigation Services (ANS) and in a sample of en-route centres

9.1.5 Section 9.2 presents an update of the first "continental" comparison for the year 2001 and confirms earlier results. Section 9.3 presents the main findings of a detailed comparison of selected US and European centres commissioned by the PRC to analyse whether the differences identified at system level also exist at en-route centre level. The detailed comparison is documented in a separate report commissioned by the PRC (ref. 24). Comparable data for year 2001 were collected, validated and analysed in close co-operation with ANSPs concerned. Section 9.4 summarises results from the continental and ACC comparisons.

9.1.6 One should refrain from drawing rapid conclusions from comparative analyses, which are necessarily not exhaustive. Indeed, even though many similarities exist between the US and European ATM systems, different legal, economic, social, cultural and operational environments may explain part or all of observed performance differences. In this report, a distinction is made between factual findings, which have been checked extensively and are as accurate as possible to the PRC's knowledge, and performance drivers which may explain the differences.

9.2 US-Europe continental comparison (system level)

9.2.1 Key data for all ANS except MET in the US and Europe are presented in Figure 66 - Figure 69. European data correspond to the 29 ANSPs which reported information in ACE 2001 (see Figure 45, page 47). The US Federal Aviation Administration (FAA) kindly provided official US data for fiscal year 2001 (FY 2001).

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73 European area corresponding to EUROCONTROL Member States in 1999.

74 The Provisional Council *"encouraged the ATSPs to participate actively in the benchmarking exercise being undertaken by the Performance Review Commission in co-operation with the interested parties."* (PC 11, July 2001).

	FAA (FY2001)	European Area (2001)
Size of en-route controlled airspace[75]	13 753 000 km²	10 785 000 km²
Number of civil en-route ANSPs	1	29
Number of en-route centres	21	58
Number of sectors in en-route centres	780	594

Figure 66: Structural & organisational comparison

	FAA (FY2001)	European Area (2001)
IFR flights (thousands)	17 678	8 120
IFR km flown (millions)	15 044	6 709
Flight hours controlled (thousands)	24 858	10 204
Average km per flight	851	826
Average flight hours per flight	1.41	1.26
Air traffic controlled towers	496	341

Figure 67: Traffic activity/output comparison

	FAA (FY2001)	European Area (2001)
Total en-route + terminal ANS staff[76]	34 532	46 100
ATCOs in en-route centres	7 724	7 732
ATCOs in APP + TWRs	9 617	5 025
Total number of ATCOs in OPS	17 341	12 757

Figure 68: Staff resources/input comparison

	FAA (FY2001)	European Area (2001)
En-route costs	€ 3 531M	€ 4 452M
Terminal costs	€ 3 874M	€ 1 301M
En-route, terminal & AFIS costs[77]	€ 8 028M	€ 5 752M
Staff costs	50%	55%
Operating costs	39%	25%
Depreciation & amortisation	11%	14%
Interest (including return on capital) and tax[78]	0%	6%
Total ATCO employment costs	€ 2 600M	€ 1 184M

Figure 69: Costs comparison & costs structure

9.2.2 Because the cost allocation between en-route and terminal ANS is not comparable among the two ATM systems, it is more relevant to focus the cost-effectiveness analysis on the sum of en-route and terminal ANS (system level).

9.2.3 Cost data from Figure 69 combined with output data from Figure 67 allow the derivation of the main cost-effectiveness KPIs as represented in Figure 70 below.

75 Including Alaska.

76 Including EUROCONTROL staff.

77 Excluding MET charges (~ € 300M) for the European Area and including AFIS costs for FAA(~ $566M).

78 No return on capital for FAA.

Costs per flight are equally relevant in this "continental" comparison since the average distance flown and the average flight time per flight are relatively similar.

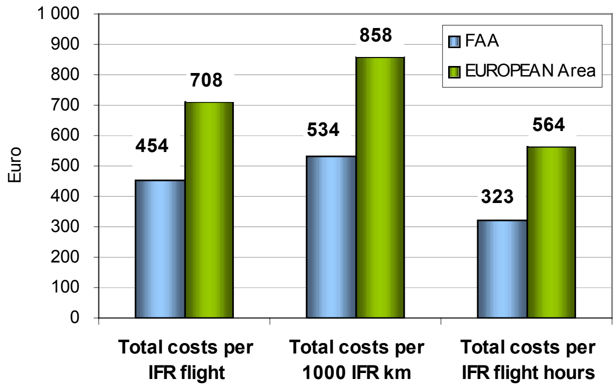


Figure 70: System-level cost-effectiveness KPIs (2001 data)

9.2.4 Figure 70 indicates that the unit cost of the European ATM system is significantly higher than in the US in 2001. The performance gap is between 60% and 70% depending on the output metrics considered. This confirms and updates the results first presented in PRR 4 (see ref. 10) for year 1999. It should be noted that the 1999 results are confirmed despite an appreciation of about 18% of the US dollar between 1999 and 2001[79].

9.2.5 It is possible to breakdown the cost-effectiveness KPI in order to understand the main drivers for this performance gap between the European and US ATM systems. This is done in the next section.

Breakdown of the cost-effectiveness KPI (System-level)

9.2.6 The cost-effectiveness KPI is broken down into three key driving factors: ATCO productivity[80], employment costs per ATCO[81], and support costs[82], as shown in Figure 71.

9.2.7 As indicated in Figure 71, the average cost per flight-hour was 75% higher in Europe than in the US in 2001. For ease of reference, the notion of performance ratio is introduced. By convention, ratios higher than 1 indicate higher performance in the US.

9.2.8 In the US, the higher ATCO productivity (ratio 1.79) associated with lower support costs (ratio 1.58) more than outweighs the higher employment costs (ratio 0.62). Performance ratios are multiplicative ($1.75 = 1.79 \times 0.62 \times 1.58$).

9.2.9 It should be emphasised that the significantly higher ATCO productivity in the US (ratio 1.79) is partly driven by higher annual working hours. Higher employment costs in the US, however, are nearly compensated by higher working hours (see §9.3.10).

79 Average exchange rate used for 1999 was 1.07$ per Euro, and for 2001 it was 0.91$ per Euro.

80 Defined as output per ATCO. Flight-hours controlled is generally a better measure of output as they more closely reflect the service provided than e.g. the number of flights. Subsequent analysis for cost-effectiveness breakdown focuses on flight-hours controlled.

81 ATCO employment costs, including social benefits and employer's share of pension.

82 Defined as total costs divided by total ATCO employment costs.

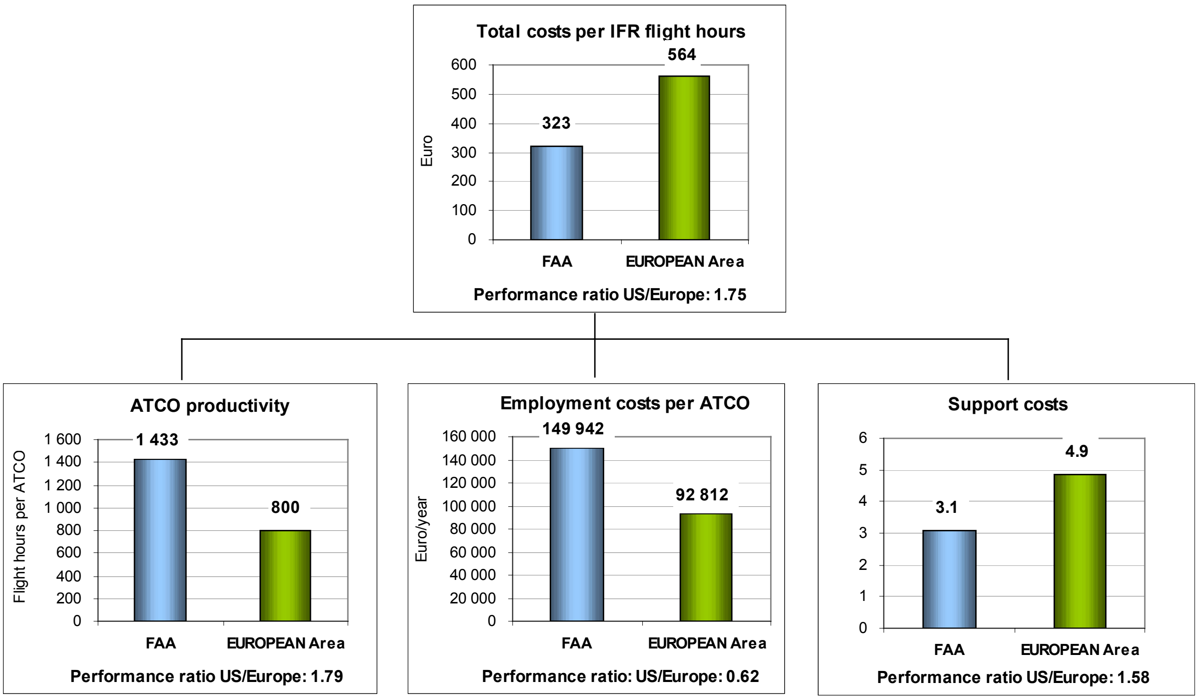


Figure 71: Cost-effectiveness and its breakdown (system-level)

9.2.10 There is a striking difference in terms of support costs (performance ratio of 1.58). Figure 71 shows that for every Euro spent to employ ATCOs, the front line staff, nearly 5 Euro are spent overall in Europe, and approximately 3 Euro in the US. Support costs are a main contributor in the performance difference observed at system level.

9.2.11 The difference in support staff ratios is even higher. In Europe, there are on average 3.6 staff (operational and non-operational) for every ATCO, compared to 2.0 in the US. This is illustrated in Figure 72 below.

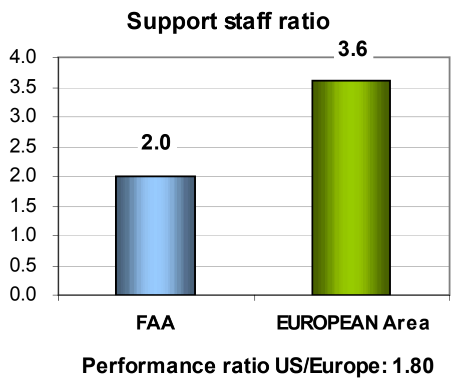


Figure 72: Support staff ratio

9.2.12 It is likely that the significantly higher support staff ratio is a consequence of the duplication of numerous support functions throughout the ANSPs comprising the European ATM system, plus necessary co-ordination through EUROCONTROL. This fragmentation increases overhead and fixed costs, as well as transaction costs, thereby reducing overall cost-effectiveness.

9.2.13 Implementation measures of the Single European Sky should help reduce fragmentation, for example by encouraging joint research and development, and foster co-operation among ANSPs.

9.2.14 These system level differences have been explored in greater depth at centre level, as presented in the next section.

9.3 US/Europe centres comparison

Background

9.3.1 In response to the Provisional Council's request (see footnote 74, page 69), the PRC commissioned a detailed comparative study of a sample of US and European en-route centres (see Figure 73). This section summarises the key findings of this study (ref. 24).

9.3.2 This study was conducted by the PRU in close collaboration with six European ANSPs[83] and the US Federal Aviation Administration (FAA). The PRC wishes to express its appreciation to all of them for their active contributions.

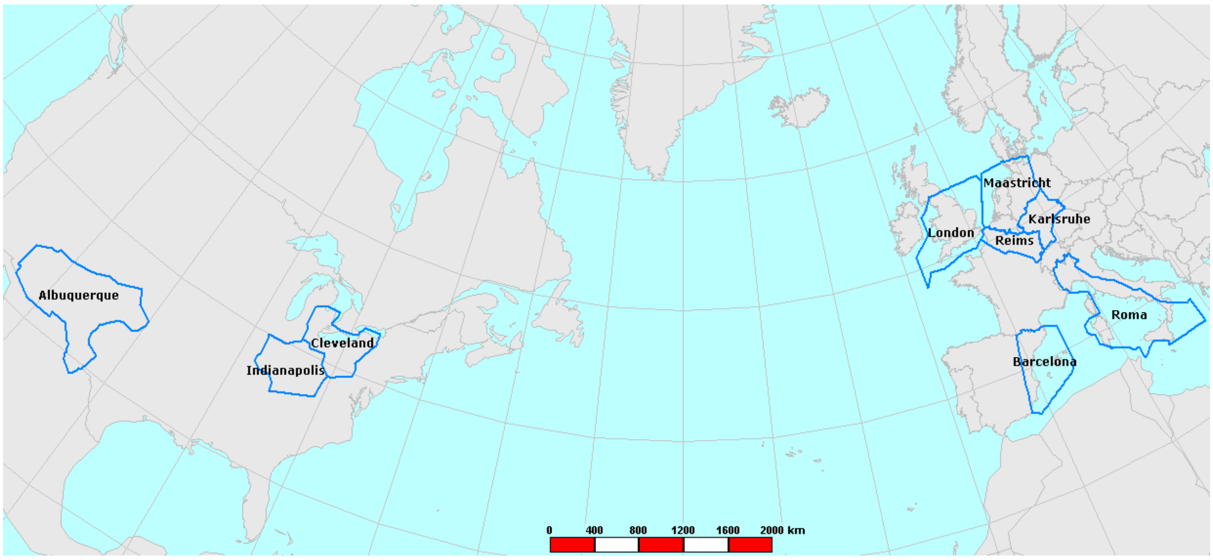


Figure 73: Selected US and European centres

Objectives and methodology

9.3.3 The objective of the study was to analyse performance at en-route control centres in the US and Europe and see to what extent the cost-effectiveness differences identified at system level in PRR 4 (see ref. 10) arose from differences at the level of the basic operating units. The focus of the study was on identification of systemic differences between European centres as a whole and US centres as a whole, rather than on comparing individual centres.

9.3.4 Safety issues were excluded from the scope of the study: there is no evidence of any difference in ATM safety performance between the US and European ATM systems. Similarly, the study did not address or compare quality of services provided to users. The methods of measuring delay, the chief element of quality of service, were not readily comparable between Europe and the US.

9.3.5 A sample of six control centres in Europe and three in the US was selected, seeking good homogeneity (large and dense en-route centres) and manageable sample size. This represents 12% and 19% of the flight hours controlled in the US and European systems respectively.

83 AENA, DFS, DNA, ENAV, EUROCONTROL Maastricht, and NATS.

9.3.6 The cost-effectiveness analysis methodology (ref. 14), which was further developed for applicability at ACC level, was found to be well suited also for the US system.

9.3.7 Great care was taken to compare like with like. Data were collected, validated and analysed in close co-operation with the ANSPs concerned. Only direct operating costs for ATM provision were considered. Capital-related costs (finance costs and depreciation), maintenance costs for the CNS infrastructure, and HQ support costs were excluded.

9.3.8 All results were extensively discussed and validated with the active involvement of all participating ANSPs.

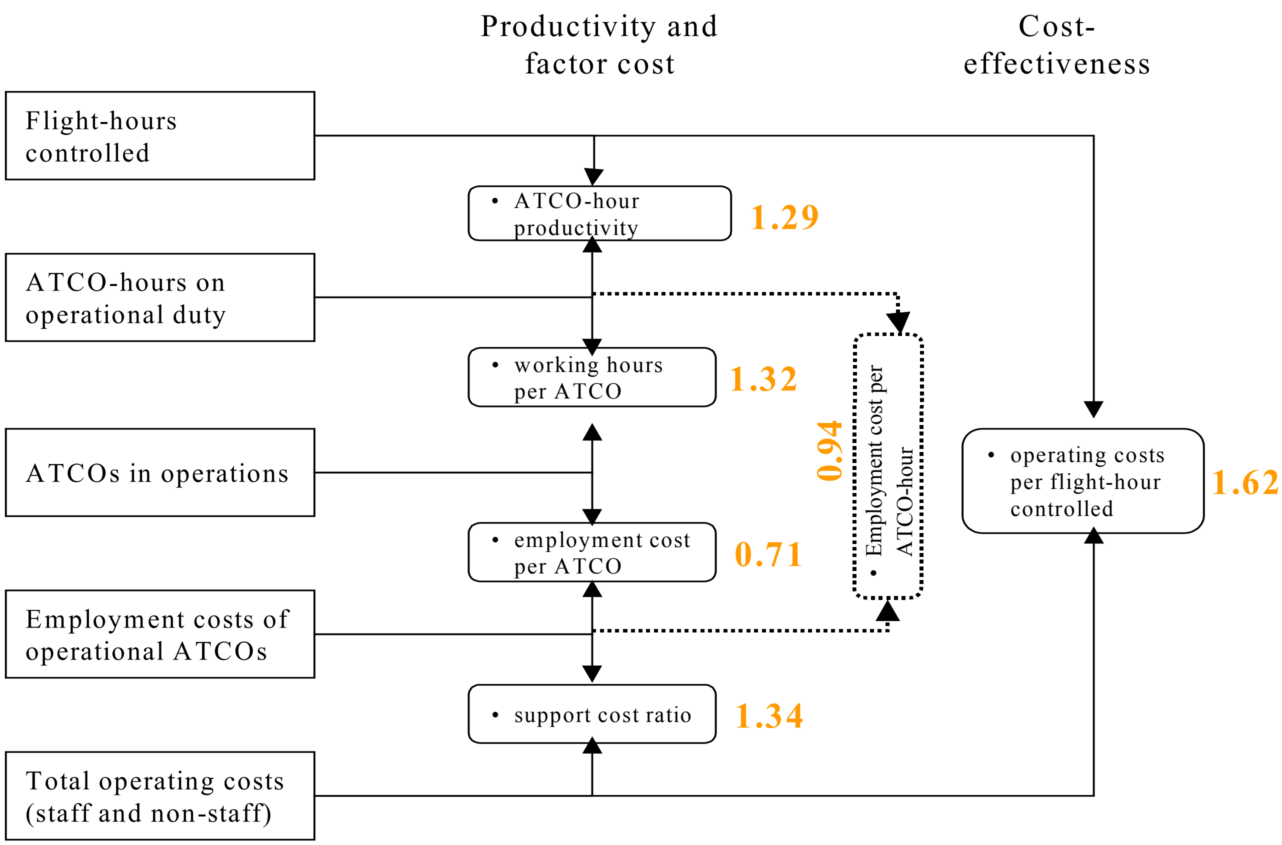
Factual findings

9.3.9 The cost-effectiveness KPI (operating costs per flight-hour) was measured and broken down, as shown in Figure 74. Using the same convention as above, performance ratios higher than 1 indicate a better US performance.

9.3.10 Average centre costs per flight-hour (as defined in § 9.3.7) are 62% higher in the European than in the US sample. This difference results from three major factors:

- the ATCO hourly productivity is, on average, 29% higher in the US (ratio 1.29). This difference arises principally from flexibility in the use of resources (see § 9.3.16 below);
- employment costs of US ATCOs are some 41% higher than in the European sample (ratio 0.71), which is compensated by higher working hours (ratio 1.32), resulting in similar employment costs per hour (ratio 0.94);
- the support cost ratio is 34% higher in the European sample (ratio 1.34). This is a major cause of the overall difference. Both labour and non-labour support costs are consistently higher or equal in the European centres.

9.3.11 The combination of higher ATCO hourly productivity and higher working hours in the US explains the considerable difference in observed ATCO productivity (ratio 1.70=1.29x1.32). On average, each ATCO on operational duty controls approximately 1700 flight-hours per year in selected European centres, and 2900 flight-hours in the US centres.



Performance ratios higher than 1 indicate a better US performance

Figure 74: The analytical framework and associated performance ratios

9.3.12 The study factually identified the origins of the cost-effectiveness difference observed at en-route centre level (62% higher unit cost per flight-hour) as summarised in Figure 75 below.

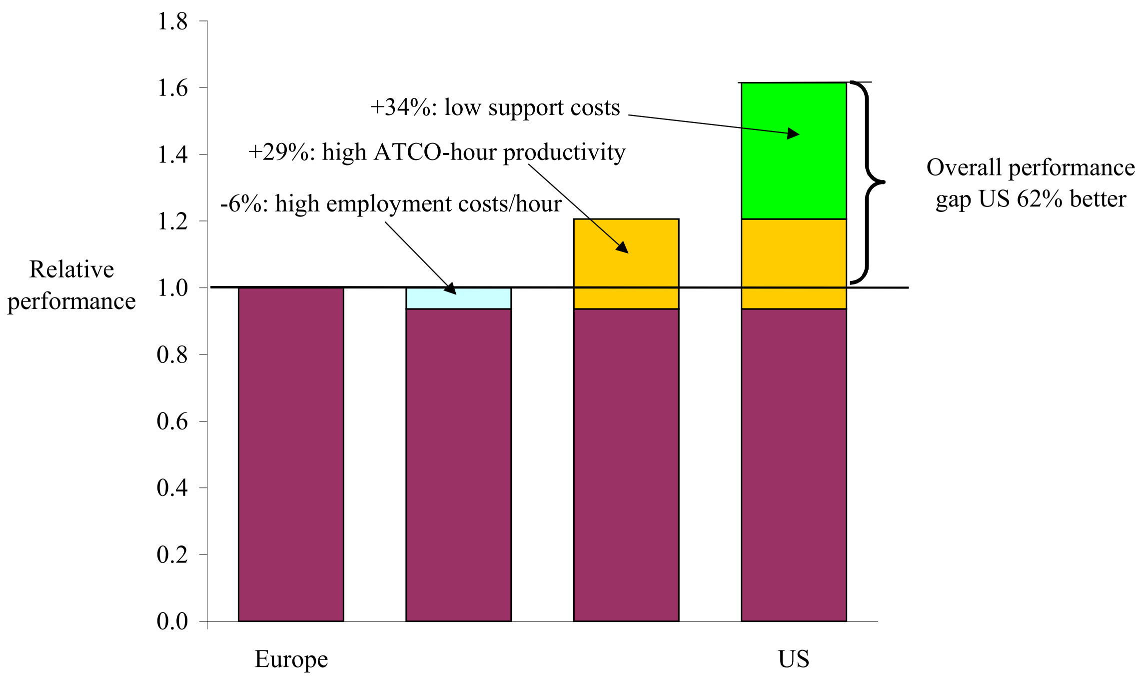


Figure 75: Breakdown of cost-effectiveness differences

Performance drivers

9.3.13 Beyond the factual findings exposed above, the study also attempted to identify underlying performance drivers and if possible to quantify their influence.

9.3.14 Social and cultural differences
Social and cultural differences are apparent. For example, preference is given in Europe to lower working hours, and corresponding lower employment costs on average. These differences reflect, to a large extent, conditions in society and the labour market as a whole, not specific to ATM.

9.3.15 Traffic complexity
Several traffic complexity indicators were measured for all selected centres, using the same tools and actual traffic recordings (ref. 25). Although traffic complexity is expected to influence performance, there was no systemic difference in measured complexity indicators between the selected US and European centres. Traffic complexity cannot therefore be an explanatory factor in the observed performance difference among selected centres.

9.3.16 Traffic variability
Seasonal, within-week and hourly traffic variations were measured in all centres and correlated with deployed human resources. Adaptation to known traffic variability was found to be an important performance driver of ATCO productivity. Some 20% of the 29% difference in ATCO hourly productivity arise from a better adaptation of staffing to traffic variability in US centres.

9.3.17 Flexibility in the use of resources
Adapting the deployment of ATCOs to variations in traffic, and hence achieve the highest possible resource utilisation, requires working practices that allow for flexibility. In many centres, practices appear to be imperfectly adapted to current patterns of traffic variation. In some cases, there were clear indications that adopting best practices might bring improvements.

9.3.18 ATFM procedures
While they share the same objectives of safety and efficiency, the US and Europe have radically different approaches to ATFM:

- ground delay is the principal ATFM measure in Europe. It is considered as a last resort measure in the US, among a variety of more tactical ATFM measures;
- collaborative decision-making is much more developed in the US and involves all ATFM stakeholders;
- ATFM is much more decentralised in the US. Typically, six to eight highly qualified ATCOs are permanently responsible for flow management in every US centre, there are less or none in Europe.

ATFM procedures and modes of operation appear to be a significant performance driver.

9.3.19 Other drivers
Other performance drivers were identified, including civil-military co-operation (more integrated and more effective civil-military arrangements in the US), inter-operability between systems (hand-over between US centres requires no more workload than hand-over between sectors), airspace design.

9.4 Summary of findings

9.4.1 Drawing upon the findings in sections 9.2 and 9.3, Figure 76 presents a summary of key performance ratios at system level and in the ACC samples.

	Cost-effectiveness		ATCO productivity		Employment costs		Support costs
System level	1.75	=	1.79	x	0.62	x	1.58
ACC sample	1.62	=	1.70 [84]	x	0.71	x	1.34

Figure 76: Summary of performance ratios

9.4.2 As performance ratios are similar at system and centre levels, one can infer they are similar in the rest of the system (terminal services, CNS infrastructure, capital related costs and overheads). This will need to be explored in more detail.

9.4.3 The support cost ratio is even higher at system level. The multiplication of support costs in a fragmented European ATM system is likely to play a significant role in the performance difference inferred in the rest of the system. Reduction of the fragmentation of the European ATM system appears to be a necessary undertaking for the Single European Sky, in order to improve ATM performance.

9.5 Conclusions

9.5.1 The system-level comparison (all ANS) confirmed earlier findings. The average cost per flight-hour was 75% higher in Europe than in the US in 2001, resulting from higher ATCO productivity (ratio 1.79), higher employment costs (ratio 0.62), and lower support costs (ratio 1.58) in the US.

9.5.2 A detailed comparison of nine en-route centres (Barcelona, Karlsruhe, London, Maastricht, Reims, Rome, Albuquerque, Cleveland, Indianapolis) found similar ratios at centre level. The average cost per flight-hour was 62% higher in the European ACC sample than in the US sample (ratio 1.62). This can be broken down as follows:

- the ATCO hourly productivity is, on average, 29% higher in the US than in Europe (ratio 1.29). This difference arises principally from flexibility in the use of resources;
- employment costs of US ATCOs are some 41% higher than in the European sample (ratio 0.71), which is compensated by higher working hours (ratio 1.32), resulting in similar employment costs per hour (ratio 0.94);
- the support cost ratio[85] is 34% higher in the European sample (ratio 1.34). This is a major cause of the overall difference. Both labour and non-labour support costs are consistently higher or equal in the European centres.

9.5.3 As performance ratios are similar at system and centre levels, one can infer they are similar in the rest of the system (terminal services, CNS infrastructure, capital costs and overheads). This will need to be explored in more detail.

9.5.4 Several underlying performance drivers could be identified and their influence quantified to some extent, namely social and cultural differences, traffic variability and adaptation through flexibility in the use of resources, and ATFM procedures.

84 See § 9.3.11.

85 Total operating costs of the centre divided by employment costs of ATCOs.

9.5.5 As there was no systemic difference in measured complexity indicators, traffic complexity could not be an explanatory factor for the performance difference among the centres studied.

9.5.6 Reduction of the fragmentation of the European ATM system appears to be a necessary undertaking for the Single European Sky, in order to improve ATM performance.

10 SINGLE EUROPEAN SKY

10.1 Introduction

10.1.1 The ratification of the Revised Convention (ref. 2), the accession of the European Community[86] to EUROCONTROL, and the adoption of the Single European Sky (SES) legislative package (ref. 3) will create a new institutional environment for ATM in Europe, whose main purpose is to improve ATM performance.

10.1.2 Four draft EU regulations for the creation of the SES are being adopted[87]:

- Framework regulation for the creation of the SES, including provisions for ATM performance review;
- Organisation and use of airspace;
- Provision of Air Navigation Services;
- Interoperability of the European ATM network.

10.1.3 Article 9 of the draft framework regulation for the creation of the Single European Sky, which should become applicable in EU and EEA States shortly, lays down the provisions relating to performance review:

"Article 9 - Performance review

1. *The Commission shall ensure the examination and evaluation of air navigation performance, drawing upon the existing expertise of EUROCONTROL.*
2. *The analysis of the information collected under paragraph 1 aims at:*
   - *a) allowing the comparison and improvement of air navigation service provision;*
   - *b) assisting air navigation service providers to deliver the required services;*
   - *c) improving the consultation process between airspace users, air navigation service providers and airports;*
   - *d) allowing the identification and the promotion of best practice.*
3. *Without prejudice to the public's right of access to the Commission's documents as laid down in Regulation (EC) No 1049/2001 of the European Parliament and of the Council of 30 May 2001 regarding public access to European Parliament, Council and Commission documents [88], the Commission shall adopt, in accordance with the procedure referred to in Article 5(3), measures for the dissemination to interested parties of the information referred to in paragraph 2".*

10.1.4 The PRC is ready to play its role in this new context, and will make recommendations to the Council/Assembly as required. It also intends to evaluate the success of these initiatives from a performance viewpoint.

10.1.5 The conclusions of this performance review report should be taken into account when developing implementation measures of the Single European Sky regulations.

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86 The protocol of accession of the European Community to EUROCONTROL was signed on 8 October 2002.

87 In March 2003, the EU Council defined its common position. The European Parliament is expected to complete its second reading in summer 2003, opening the way for adoption of the legislation later in the year.

88 OJ L 145, 31.5.2002, p.43.

10.2 Conclusions relating to the Single European Sky

10.2.1 Figure 77 collates the conclusions in this report that are relevant to implementation of the draft SES regulations.

Subject	PRR 6 ref.
A homogeneous legal framework specifying duties and liabilities in the case of delegation of the responsibility to provide ATS should be applicable in all Member States.	3.8.7
As foreseen in the Single European Sky draft regulation (ANS, art 4), the European Commission will identify and adopt the ESARRs that shall be made mandatory under Community law. This should be done without delay as soon as the regulations enter into force.	3.9.3
There is a need for strong safety regulation and oversight, based on harmonised standards. The combination of a European safety regulatory framework and regional safety regulation could strike the right balance between the needs for harmonisation, efficiency, qualified personnel and understanding of local issues.	3.9.6
Implementation measures of the SES should foster enhanced co-operation and interoperability among ANSPs.	4.9.8 7.4.4
The European Community should adopt implementing rules for the provision of information by ANSPs, building on the Economic Information Disclosure rules adopted by EUROCONTROL, and provide for enforcement.	5.7.18 5.8.7
Implementation measures of the Single European Sky should seek to reduce fragmentation.	9.2.13 9.4.3

Figure 77: Conclusions relating to the Single European Sky

11 PRC RECOMMENDATIONS AND CORRESPONDING DECISIONS

[This Chapter will completed after 3 July 2003]

11.1.1 The Performance Review Commission developed recommendations using the conclusions contained in PRR 6, as well as feedback from the open consultation meeting held on 19 May 2003*. The summary report of the consultation meeting is available on the PRC website* http://www.eurocontrol.int.prc.

11.1.2 The PRC recommendations were submitted to the EUROCONTROL Commission, through the Provisional Council, and considered by those bodies at their meetings (PC 17, Ad hoc Session of the Commission) held on 3 July 2003.

11.1.3 Figure 78 below shows the PRC recommendations as well as the corresponding decisions.

	PRC Recommendation	Commission - decision(s)
1	The Provisional Council is invited to….	

Figure 78: PRC Recommendations

ANNEX 1: SAFETY TABLES

Extract from SRC Document 26 – Annual Safety Report 2002

AGGREGATED SAFETY DATA REPORTED BY ECAC STATES FOR THE YEAR 2000

2.1 Accidents

The EUROCONTROL ASTs for 2001 captured 768 accidents, of which 121 were fatal, including VFR non-commercial flights. Of the total accidents reported:

- three of the accidents were identified as having ATM DIRECT contribution. Two of these were fatal, and only one of these involved commercial IFR flights,
- twenty accidents involving commercial IFR flights (of which two were fatal), were identified as having an ATM INDIRECT contribution.

Of the 768 accidents reported in 2001, only 142 have been further sub-classified in terms of accident type using ESARR 2 accident sub-categories.

The types of accident used for sub-classification of data for 1999, 2000 and 2001 are shown below *(figures in brackets show the numbers within the accident totals which were fatal):*

TYPE OF REPORTED ACCIDENT	1999	2000	2001
Total Number of MIDAIR Collisions	14 (7)	9 (3)	10 (5)
Total number of CFIT	71 (21)	23 (9)	39 (20)
Total Number of Collisions on the ground between a/c	3 (0)	9 (0)	7 (1)
Total Number of Collisions on the ground between Aircraft and Vehicle /persons/ Obstruction(s)	27 (1)	107 (0)	82 (3)

Table 3: *Accident Categorisation (includes IFR and VFR traffic)*

Of the reported MIDAIR Collisions in 2001, there is no IFR involvement indicated. In two cases, both of which were non-fatal, ATM was identified as having an INDRECT contribution.

Of the reported CFIT in 2001, two fatal accidents were indicated as having an IFR implication, one of these having an ATM INDIRECT contribution and one having ATM DIRECT contribution.

There are still a significant number of reported collisions on the ground between aircraft and vehicle(s)/person(s)/obstruction(s). Of those reported, one fatal collision had a direct ATM contribution, and there were three (out of which one was fatal) with ATM INDIRECT contribution.

2.2 ATM - Related Incidents

Number Reports	Total			FLIGHT RULES									TYPE OF OPERATIONS					
				IFR/IFR			IFR/VFR			VFR/VFR			GAT/OAT			GAT/GAT		
	1999	2000	2001	99	00	01	99	00	01	99	00	01	99	00	01	99	00	01
AIRPROX Report	652	599	725	339	255	257	147	184	163	36	122	141	78	69	73	443	308	295
ACAS Report	625	1329	746	129	377	420	11	35	95				11	26	122	127	389	443
ATIR/AP DSG form report	142	1319 9*	1245 8*	40	25	77	44	11	12	14	22	61	35	17	78	93	47	73

*) includes a number of other reports on different issues

Table 4: ATM related incident reports within ECAC

Number Reports	Total			FLIGHT RULES									TYPE OF OPERATIONS					
				IFR/IFR			IFR/VFR			VFR/VFR			GAT/OAT			GAT/GAT		
	1999	2000	2001	99	00	01	99	00	01	99	00	01	99	00	01	99	00	01
AIRPROX Report	562	527	499	310	235	175	142	159	80	33	120	26	75	62	48	409	253	231
ACAS Report	413	861	673	97	272	119	3	21	19		1	1	6	22	47	94	275	98
ACAS False RAs	4	115	181	2	87	88		1	23		1			11	28	2	97	86
ATIR/AP DSG form report	71	105	188	32	61	56	43	5	4	11	7	52	34	18	75	48	61	39

Table 5: ATM related incident reports INVESTIGATED within ECAC

The following features may be derived from the above table:

- The number of TCAS reports, although reduced from the 2000 figure, is still high. Moreover, the proportion of TCAS reports declared (after investigation) to be false reports has significantly increased (26% versus 13%). SRC will be investigating this further with the ACAS Programme,
- The number of incident reports involving mixed OAT/GAT traffic is proportionally higher than the normal traffic ratio between the two categories of operations,
- The proportion of reports which are not investigated remains high, and may indicate resourcing problems in the investigation process.

3.8 Categorisation of Incidents Reported

The table below presents the absolute figures, not only for the categories normalised in the charts above, but also for the other categories of occurrences most frequently reported.

TYPE OF INCIDENTS	NO OF INCIDENTS REPORTED		
	1999 (24)	2000 (25)	2001 (24)
Separation minima infringement	975 (17)	987 (20)	814 (19)
Inadequate separation	78 (9)	95 (12)	85 (16)
Near Controlled Flight Into Terrain (CFIT)	6 (2)	1 (1)	6 (2)
Runway excursion by aircraft	2 (2)	8 (4)	8 (5)
Aircraft deviations from applicable ATM regulations	7 (2)	758 (12)	1000 (15)
Aircraft deviations from applicable published ATM procedures	30 (6)	29 (9)	73 (12)
Aircraft deviation from ATM clearance	164 (6)	623 (16)	762 (18)
Unauthorised penetration of airspace	511 (9)	428 (13)	619 (17)
Runway Incursion	56 (13)	99 (14)	219 (15)

Table 7: Categories of Incidents in ATM

NOTE: The values in parenthesis represent the number of reports providing data, e.g.

- In table heading : 2001 (24) indicates that in 2001 aggregated statistics have been built up from 24 reports,
- Runway Incursions 219 (15) indicates that 15 reports out of 24 have mentioned this type of indicator and the total sum from the 15 reports is 219 incidents classified as Runway Incursions.

ATTACHMENT 3 (TO SRC DOCUMENT 26)

PUBLICLY AVAILABLE DATA

1. GENERAL

In past years, a number of sources in the public domain, such as published industry reports, have provided valuable complementary material to the SRC assessment of ATM safety performance across ECAC[89]. For each category of data, the most suitable source had been presented in each case.

However, in the case of the 2001 report, an analysis of the various sources showed that ICAO ADREP provided the most comprehensive and consistent data for each category, and this source has therefore been used as the basis for this section of the report.

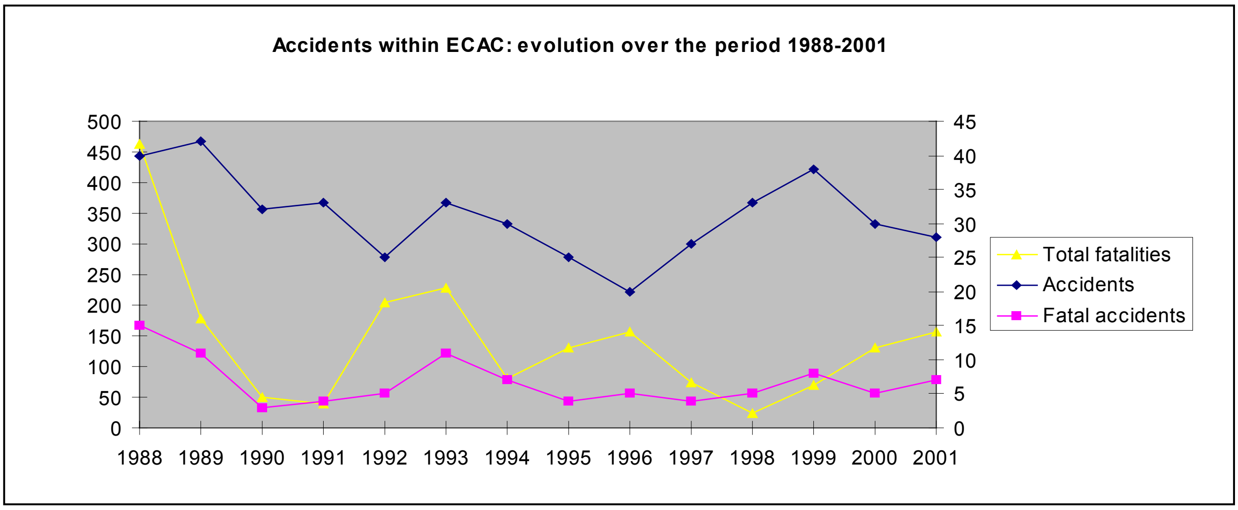
2. *ACCIDENTS*

Table 1 below presents the ICAO statistics for the ECAC region for the period 1988-2001 (figures relate to all accidents of aircraft with MTOW > 2,25t.).

Table 1: Accidents on an ECAC-wide basis over the period 1988-2001
(Source ICAO ADREP)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total	Average
Accidents	40	42	32	33	25	33	30	25	20	27	33	38	30	28	436	31
Hull losses	15	14	5	7	7	12	11	7	6	5	10	11	8	9	127	9
Fatal accidents	15	11	3	4	5	11	7	4	5	4	5	8	5	7	94	7
Total fatalities	464	178	51	40	205	228	80	131	157	73	24	69	130	157	1987	142
On board fatalities	453	178	51	40	162	226	80	131	154	72	20	69	126	153	1915	137
Third parties	11	0	0	0	43	2	0	0	3	1	4	0	4	4	72	5

Note: Third parties represent ground fatalities.



89 More information on safety data collected from public sources is collated in SRC DOC 2 "Aircraft accidents/Incidents and ATM contribution: Review and Analysis of historical data". SRC DOC 2 will continue to be updated and will constitute a source a cross-reference for national safety data collection.

Table 2: CFIT accidents within ECAC

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total	Average
Accidents	8	5	2	5	5	5	6	1	2	3	2	1	3	1	49	4
Hull losses	6	5	1	3	3	4	4	1	2	2	1	1	1	1	35	3
Fatal accidents	6	4	1	3	3	4	2	0	2	1	1	1	1	1	30	2
Total fatalities	112	75	46	39	102	137	62	0	145	70	2	35	1	24	850	61
On board fatalities	112	75	46	39	102	137	62	0	143	70	2	35	1	24	848	631
Third parties	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0

Table 3: Mid-air collisions within ECAC

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total	Average
Accidents	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Hull losses	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Fatal accidents	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Total fatalities	0	0	0	0	0	0	0	0	0	0	14	0	0	0	14	1
On board fatalities	0	0	0	0	0	0	0	0	0	0	14	0	0	0	14	1
Third parties	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Over the period 1988-2001, according to ICAO, 32% of ECAC accidents were due to CFIT. As far as fatalities are concerned, the corresponding percentage is 43%.

Mid-air collisions represent only 1% of ECAC fatal accidents, whereas fatalities due to these collisions represent also 1% of total fatalities in the ECAC area.

Within the above figures, there is no correlation in the figures for fatal accidents, number of fatalities or hull losses that would enable any trend to be established, or permit an accurate regression on which to base forecasts.

ANNEX 2: MOST PENALISING ACCs AND LOCATIONS

The table below (Figure 79) shows the traffic, delay and their variation from 2001 for all ACCs with an average en-route delay per movement above 0.3 minutes.

ACC	Traffic ('000 flights)	En-route delay ('000 min.)	Avg en-route delay per flight (min/flight)	Traffic variation 2002/2001	Avg en-route delay per flight variation 2002/2001
London	1 699	5 377	3.2	-1%	77%
Zurich	697	1 086	1.6	-5%	-23%
Reims	714	515	0.7	2%	-62%
Maastricht	1 236	878	0.7	1%	-65%
Nicosia	199	129	0.6	-7%	-13%
Madrid	793	458	0.6	0%	-71%
Bordeaux	703	272	0.4	2%	-77%
Paris	1 136	406	0.4	-1%	-56%
Sevilla	289	95	0.3	2%	50%
Praha	369	118	0.3	9%	-69%
Athinai	361	114	0.3	-3%	520%
Bremen	345	106	0.3	-6%	-72%

Figure 79: ACCs with highest en-route ATFM delay (2002)

Evolution of en-route most penalising locations

Reference Location	Flow Management Position	Enroute Delay ('000 minutes)	Collapsed or Elementary Sector	Upper or Lower Sector	Proportion of Enroute Delay	Cumulated Proportion of Enroute Delay
EGTTN2S	LONDON	418	Collapsed	Both	4%	4%
LSAZU14L	ZURICH	380	Collapsed	Upper	3%	7%
EGTTBLE	LONDON	366	Collapsed	Both	3%	10%
EBMAWSL	MAASTRICHT	355	Elementary	Upper	3%	13%
EGTTHRN	LONDON	342	Collapsed	Both	3%	16%
EGHEW	LONDON	337	Collapsed	Both	3%	18%
EBMALUX	MAASTRICHT	262	Collapsed	Upper	2%	21%
EGTTDVR	LONDON	243	Collapsed	Both	2%	23%
EGDTN	LONDON	228	Collapsed	Both	2%	25%
EGN2S	LONDON	212	Collapsed	Both	2%	26%
EGTTSTB	LONDON	208	Collapsed	Both	2%	28%
LFEUHL	REIMS	201	Elementary	Upper	2%	30%
LFFUJ	PARIS	187	Collapsed	Upper	2%	31%
EGTTLUS	LONDON	183	Collapsed	Upper	2%	33%
EG14CLW	LONDON	161	Collapsed	Both	1%	34%
EGTTS14	LONDON	160	Elementary	Lower	1%	36%
LSAZU24H	ZURICH	146	Collapsed	Upper	1%	37%
EGLKS	LONDON	145	Collapsed	Upper	1%	38%
EGTTDLD	LONDON	145	Collapsed	Both	1%	39%
EGTT3C4	LONDON	134	Collapsed	Upper	1%	40%
EGTTCLW	LONDON	127	Collapsed	Both	1%	41%
EGCC29G	MANCHESTER	126	Collapsed	Both	1%	42%
LECMZMR	MADRID	125	Elementary	Upper	1%	43%
EG18SFD	LONDON	114	Collapsed	Both	1%	44%
LSAZNE	ZURICH	111	Collapsed	Upper	1%	45%

(Data source: ATFM Summary 2002 Report, CFMU)

Figure 80: Most penalising en-route locations (2002)

- The ATC sector has been a bottleneck for 3 years
- The ATC sector has been a bottleneck for 2 years
- The ATC sector has been a bottleneck for 1 year

ANNEX 3: GLOSSARY

ACC	Area Control Centre
Accident **Source: ICAO Annex 13**	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: a) a person is fatally or seriously injured as a result of: • being in the aircraft, or • direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or • direct exposure to jet blast, except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or b) the aircraft sustains damage or structural failure which: • adversely affects the structural strength, performance or flight characteristics of the aircraft, and • 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; c) the aircraft is missing or completely inaccessible.
ACARE	Advisory Council for Aeronautical Research in Europe
ACE	ATM Cost-Effectiveness programme
ACE 2001 ANSPs	ANSPs of Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, FYROM, Malta, Moldova, the Netherlands, Norway, Portugal, Romania, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom, Estonia, Latvia, Lithuania + Maastricht UAC
ACG	ATM/CNS Consultation Group (EUROCONTROL)
ADREP	Accident/Incident Reporting System
AENA	Aeropuertos Españoles y Navegatión Aérea (Spain)
AFIS	Aeronautical Flight Information Service
AGAS	EUROCONTROL High-level European Action Group for ATM Safety
Agency	The EUROCONTROL Agency
AIRPROX **Source: ICAO** Doc. 4444	The code word used in air traffic incident reports to designate aircraft proximity. AIRPROX A – Risk of collision "The risk classification of an aircraft proximity in which serious risk of collision has existed". AIRPROX B – Safety not assured "The risk classification of an aircraft proximity in which the safety of the aircraft may have been compromised".
ANS	Air Navigation Service
ANSP	Air Navigation Services Provider
APP	Airport Approach Unit
Area North	Munich, Karlsruhe, Maastricht, Reims ACCs
Area South	Marseille, Milan, Geneva, Zurich ACCs
ARTCC	Air Route Traffic Control Center (US)
ASM	Airspace Management
ASMT	Automated Safety Monitoring Tool
AST	Annual Summary Template
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management composed of ATC, ATFM and ASM
ATMCP	ATM Operational Concept Panel (ICAO)
ATM 2000+ Strategy	EUROCONTROL ATM Strategy for the Years 2000+
ATS	Air Traffic Services

CEATS	Central European Air Traffic System. The CEATS Programme is created to meet the needs of eight States – Austria, Bosnia-Herzegovina, Croatia, the Czech Republic, Hungry, Italy, the Slovak Republic and Slovenia – to co-operate in the provision of air traffic services within their airspace.
CESC	Chief Executive Standing Conference
CFIT	Controlled Flight Into Terrain
CFMU	EUROCONTROL Central Flow Management Unit
CFMU Area (36 States)	EUROCONTROL Member States in 2002 + Estonia, Latvia, Lithuania, Poland, Ukraine
CHIEF	CH (Switzerland), I (Italy), E (Spain), F (France)
CIP	EUROCONTROL Convergence and Implementation Programme
CNS	Communications, Navigation and Surveillance
CO_2	Carbon Dioxide
Commission	The governing body of EUROCONTROL, formerly the Permanent Commission. It is responsible for formulating the Organisation's general policy.
CRCO	EUROCONTROL Central Route Charges Office

DCAC	Department of Civil Aviation Cyprus
Departure delay	Difference between actual and scheduled departure time
DFS	DFS Deutsche Flugsicherung GmbH (Germany)
DNA	Direction de la Navigation Aérienne (DGAC, France)

EATMP	EUROCONTROL European Air Traffic Management Programme
EC	European Commission
ECAC	European Civil Aviation Conference.
EEA	European Economic Area (all EU Member States plus the States of Norway, Iceland and Liechtenstein)
EEC	EUROCONTROL Experimental Centre, Brétigny
Effective capacity	"Effective Capacity" is defined as the traffic volume (km) which the ATM system can handle with a given level of ATFM en-route delay, see PRR 5, annex 6
EID	Economic Information Disclosure
ENAV	Ente Nazionale di Assistenza al Volo (Italy)
Enlarged Committee	Enlarged Committee for Route Charges
Enlarged Commission	Enlarged Commission for Route Charges
ESARR	EUROCONTROL Safety Regulatory Requirement
ETFMS	Enhanced Tactical Flow Management System. ETFMS gathers radar data in Europe in order to present an actual traffic picture to flow managers.
EU	European Union
EUROCONTROL (31 States)	The European Organisation for the Safety of Air Navigation comprised 31 Member States at 31 December 2002: Albania, Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, the former Yugoslav Republic of Macedonia, Malta, Moldova, Monaco, the Netherlands, Norway, Portugal, Romania, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.
EUROCONTROL Route Charges System - 1988	11 States: Belgium, Luxembourg, Germany, France, United Kingdom, Netherlands, Ireland, Switzerland, Portugal, Austria, Spain.
EUROCONTROL Route Charges System - 2000	28 States. The 11 States listed above + Greece, Turkey, Malta, Cyprus, Hungary, Norway, Denmark, Slovenia, Czech Republic, Sweden, Italy, Slovak Republic, Romania, Croatia, Bulgaria, Monaco, FYROM.
EUROCONTROL Route Charges System - 2001	29 States. The 28 States listed above + Moldova.
EUROCONTROL Route Charges System – 2002	30 States. The 29 States listed above + Finland. (Albania's integration into the Route Charges System, scheduled for 1.1.2003, was postponed at Albania's request).
EUROSTAT MUIC	Monetary Union Index of Consumer Price

FAA	Federal Aviation Administration of the United States of America
FDP	Flight Data Processing / Flight-plan Data Processor
FL	Flight Level
FMU	Flow Management Unit

FYROM	The Former Yugoslav Republic of Macedonia
GAT	General Air Traffic
H_2O	Water
HCAA	Hellenic Civil Aviation Authority (Greece)
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
Incident	An occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation.
Institutional bodies	PRC, SRC, Regulatory Commission, Civil-Military Interface Standing Committee, Audit Board
Interested parties	Government regulatory bodies, Air Navigation Service Providers, airport authorities, airspace users, international civil aviation organisations, EUROCONTROL Agency, representatives of airspace users, airports and staff organisations and other agencies or international organisations which may contribute to the work of the PRC.
IPCC	Intergovernmental Panel on Climate Change (http://www.ipcc.ch/)
KPA	Key Performance Area
KPI	Key Performance Indicator
Level bust	Any unauthorised vertical deviation of more than 300 feet from an ATC flight clearance
Lower airspace	For the purposes of PRR 6, it is below Flight Level 245.
M	Million
Maastricht	The EUROCONTROL Upper Area Centre (UAC) Maastricht. It provides ATS in the upper airspace of four States: Belgium, Luxembourg, the Netherlands and Northern Germany.
MATSE	ECAC Transport Ministers' meeting on the Air Traffic System in Europe
MET	Meteorology
MSAW	Minimum Safe Altitude Warning
MUIC	Monetary Union Index of Consumer Price
NATS	National Air Traffic Services (United Kingdom)
NBV	Net Book Value
Nox	Oxides of Nitrogen
OPS	Operational
Over-delivery	This occurs when the actual number of aircraft that entered the sector during a particular period exceeds the regulated capacity. An over-delivery does not necessarily result in an overload.
Overload	An overload occurs when an ATCO reports that s/he has had to handle more traffic than s/he considers it was safe to do so.
Organisation	The EUROCONTROL Organisation, i.e. Member States and the Agency
PRC	Performance Review Commission
PRR	Performance Review Report
PRR 6	Sixth Performance Review Report, covering the calendar year 2002
PRU	Performance Review Unit
Primary Delay	A delay other than reactionary
Permanent Commission	See "Commission" above
PC	Provisional Council of EUROCONTROL

RASP	Required ATM System Performance
Reactionary delay	Delay caused by late arrival of aircraft or crew from previous journeys
Real Costs	Costs that have been deflated to account for inflation
Revised Convention	Revised EUROCONTROL International Convention relating to co-operation for the Safety of Air Navigation of 13 December 1960, as amended, which was opened for signature on 27 June 1997.
RPI	Retail Price Index
Runway incursion	European definition: Any unauthorised presence on a runway of aircraft, vehicle, person or object where an avoiding action was required to prevent a collision with an aircraft. Source: ESARR 2. US definition: Any occurrence at an airport involving an aircraft, vehicle, person, or object on the ground, that creates a collision hazard or results in a loss of separation with an aircraft taking-off, intending to take off, landing or intending to land. Source: US (FAA order 8020.11A).
RVSM	Reduced Vertical Separation Minima

SARPs	ICAO Standards And Recommended Practices
SES	Single European Sky
SID	Standard Instrument Departure (Route)
Sox	Oxides of Sulphur
SRC	Safety Regulation Commission
SRU	Safety Regulation Unit
Stakeholders	See "Interested parties"
STAR	Standard Arrival Route(s)
Summer period	May to October inclusive

TCAS	Traffic Alert and Collision Avoidance System
Terminal ANS	Terminal Air Navigation Services
TMA	Terminal Manoeuvring Area
TWR	Tower control unit

UAC	Upper Airspace Area Control Centre
UK	United Kingdom
UoW	University of Westminster
US	The United States of America
USOAP	Universal Safety Oversight Audit programme

VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

ANNEX 4: REFERENCES

Note:	Most references are available on line from the PRC Website (http://www.EUROCONTROL.int/prc).

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About the Performance Review Commission

The Performance Review Commission (PRC) was established in 1998 to advise the Governing Bodies of EUROCONTROL[90] on the development of a strong, transparent and independent performance review and target-setting system. This system addresses all aspects of air traffic management including policy and planning, safety management at and around airports and in the airspace, as well as financial and economic aspects of services rendered.

The PRC is composed of 12 independent Commissioners with considerable senior managerial and technical experience of aviation. They are:

Mr Jozsef Bakos	Mr Jovica Lazarevski	Mr Adrian Serban
Mr Francisco Cal Pardo	Mr Gregory Nanidis	Mr Per Wallden
Mr Cees Gresnigt	Mr Vittorio Pimpinelli	Mr Keith Williams
Mr Philippe Jaquard	Dr Johannes Reichmuth	12th member to be selected

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NOTICE

The PRC has made every effort to ensure that the information and analysis contained in this document are as accurate and complete as possible. Only information from quoted sources has been used and information relating to named parties has been checked with the parties concerned. Despite these precautions, should you find any errors or inconsistencies we would be grateful if you could please bring them to the PRU's attention.

90 EUROCONTROL, the European Organisation for the Safety of Air Navigation, has 31 Member States. They are: Albania, Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, The former Yugoslav Republic of Macedonia, Malta, Moldova, Monaco, Netherlands, Norway, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom (situation at 31 December 2002).