

# EUROCONTROL Experimental Centre

Activity Report 2003



European Organisation for the Safety of Air Navigation



# TABLE OF CONTENTS

<b>EUROCONTROL, the European Organisation for the safety of air navigation</b>	<b>4</b>
<b>Introduction - Placing the EEC at the hub of ATM Research</b>	<b>6</b>
<b>Key Results</b>	<b>10</b>
<b>EUROCONTROL and the Experimental Centre</b>	<b>18</b>
<b>Partnership</b>	<b>20</b>
European Commission and Industry	21
Stakeholder Relations	22
The Experimental Centre Consultation Group (ECCG)	23
Assistance to Central European Air Traffic Services (CEATS)	23
<b>Communication and Public Relations</b>	<b>24</b>
<b>Overview - Resources</b>	<b>28</b>
Budget	29
Core Business versus Support	30
Work Programme Trends	30
Core Business - Distribution of Resources	30
People	31
<b>Research Areas - Results</b>	<b>32</b>
Network Capacity and Demand Management (NCD)	33
Sector Safety and Productivity (SSP)	36
Airport Throughput (APT)	42
Innovative Research (INO)	45
Society, Environment and Economy (SEE)	49
<b>Key Methodologies</b>	<b>54</b>
Safety	55
Validation	56
<b>Technical Infrastructure</b>	<b>58</b>
Human Factors Laboratory (HFL)	59
EATMP Reference Industry-based ATM Simulation and Trials Platform (ERIS)	59
Simulation Facility Management (SFM)	61
Software Engineering Unit (SEU)	61
<b>Business Enablers and Support Activities</b>	<b>64</b>
Development Platform and Information Technology services (ITM)	65
Administrative & Management Information software (AMI)	66
Transport, Infrastructure and General Services (TIG)	66
Human Resources Management (HRM)	67
Social and Medical Unit (SMU)	67
Welfare Officer	68
Service for the Prevention and Protection at Work (SPP)	68
Continuous Improvement (CI)	69
<b>Publications</b>	<b>73</b>
<b>Glossary</b>	<b>83</b>



# EUROCONTROL

the european organisation for the safety of air navigation

EUROCONTROL is an international organisation with 33 Member States. It is responsible for Air Traffic Management in Europe. Its goals are to:

- heighten air traffic safety;
- increase airspace capacity;
- reduce air traffic delay;
- enhance the air traffic management system's cost-effectiveness;
- minimise aviation's effect on the environment.

Originally founded in 1960 as a civil/military international organisation to deal with air traffic control on a European level, EUROCONTROL is now a world-leader, pioneering advancement in air traffic management technology, operational procedures and system interoperability.

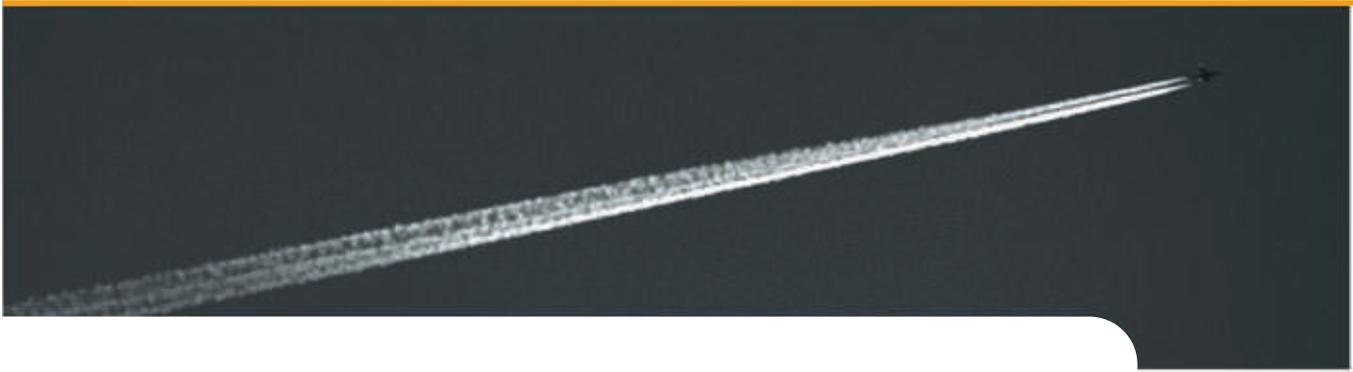
EUROCONTROL aims at developing a seamless air traffic management system for the entire European continent; a system which processes almost 60% of the world's international flights.

With more than 2,000 experts based in seven European countries, EUROCONTROL's core business activities are:

- to define and manage pan-European programmes for Air Traffic Management;
- to do Research and Development work aimed at increasing Air Traffic Control safety and capacity in Europe;
- to operate a Central Flow Management Unit;

- to collect Route Charges on behalf of Member States and through bilateral agreements with non-Member States – 5.6 billion were billed in 2003;
- to carry out training, education and the transfer of knowledge in Air Navigation Services, across the European continent and beyond;
- to provide Air Traffic Services through the management of an international Air Traffic Control Centre at Maastricht in the Netherlands for four states and the development of another centre for eight states in Central Europe.

Working closely with Member States, air navigation service providers, civil and military airspace users, airports, the aerospace industry, professional organisations and European institutions, EUROCONTROL is committed to ensuring that airspace users and passengers can continue to benefit from a safe, reliable and efficient air transport system.



## Placing the EEC at the hub of ATM Research

# INTRODUCTION

In its 2002 report the Performance Review Commission stressed that research is still scattered across Europe, with overlaps between national and international programmes and lacking synergy amongst the ATM R&D community. As a consequence and in response to numerous requests from its stakeholders, EUROCONTROL and naturally the EEC have been asked to play a leading role in the organisation and management of European ATM Research.

Thus in 2003, coherent with the ATM 2000+ strategy, and confirmed by the Advisory Council for Aeronautics Research in Europe (ACARE) in its "Strategic Research Agenda" (SRA), the EEC actively participated in the development of the research part of the European ATM Master Plan. This initiative, in close co-operation with the European Aerospace supply industry represented by AECMA, will create a coherent and manageable Research and Implementation path to mobilise and consolidate scarce resources, avoiding unproductive duplication and overlap.

This was strengthened at the end of 2003 by the signature of an agreement for co-operation between EUROCONTROL and the European Commission which, inter alia, establishes a Joint Programme Board to reinforce the co-ordination role assigned to the Agency by the revised Convention. This board will aim at combining

European Commission and EUROCONTROL ATM Research programmes in a single programme that will support the European ATM Master Plan.

In that context in order to fulfil its new role, the EEC's Core Business was reorganised, at the beginning of 2003, in five Research Areas.

Three contribute directly to the research deliverables of the European ATM Master Plan, and correspond to the three main pillars that structure the European ATM Master Plan:

- Network Capacity and Demand Management (NCD), consistent with the ATFM action plan and the European Single Sky initiative, covers research on airspace management, demand and capacity management and traffic management issues.
- Sector Safety and Productivity (SSP) is concerned with all aspects of air traffic control related to controller-centred sector-level planning and separation management functions.
- Airport Throughput (APT) concentrates on the capacity issues facing airports and their immediate environments.

In 2003, the objectives of these three Research Areas were to consolidate the existing project portfolio in a coherent work programme fully aligned with the emerging European ATM Master Plan. A significant step in this consolidation and

realignment was achieved in 2003, which allowed to strengthen top priority research axes as identified by the European ATM Master Plan, and to successfully deliver key results along these axes, which are highlighted in our report.

Beside these three Research Areas and to complement the European ATM Master Plan, two others Research Areas were maintained to pursue activities considered of strategic importance:

- Innovative Research (INO) investigates and coordinates studies on embryonic topics suggested by the ACARE Strategic Research Agenda.
- Society Environment Economics (SEE) addresses the public perceptions and expectations concerning the Air transport industry. In addition to insight and understanding of the drivers for Transport demand evolution it provides expertise, methods and tools to address the ATM contribution to Air Transport impact on the environment.

To achieve our strategy we are continuing the development of our key methodologies to improve safety and ensure appropriate validation. This activity has been maintained in 2003 as a top priority and key milestones have been achieved in the development and in the recognition of these methodologies.

As a direct consequence of the reorientation of our Work programme and of our key research methodologies, we reviewed the strategy for the technical infrastructure for ATC simulation, experimentation and for the human factors exploration.

Our report this year explains what has been achieved by the combination of reoriented research activities and applied methods within this changing context.





# KEY RESULTS

## RESEARCH AREAS

### Network Capacity and Demand Management (NCD)

Supporting the Air Traffic Flow Capacity Management (ATFCM) strategic action plan, the objective of this Research Area is to conduct the research in key elements such as airspace management, strategic and tactical capacity management, ATFM operations and tactical traffic management.

#### Strategic and Tactical Capacity Management

The first of a series of Interactive Capacity Workshops was held in October to give ANSPs a clearer view of the underlying data and assumptions used by the FAP model. In addition, a new method, proposed by the Capacity Task Force, was developed for assessing ACC capacity (ACCESS), which would be applicable to all ACCs, whether or not producing delays, and based on a comprehensive simulation of the European ATM network.

Complementing the short to medium term planning activity, COCA (Complexity and Capacity) is a study to identify and evaluate factors related to air traffic control complexity and their links to controller workload. During

2003 aspects of the COCA method were applied by the PRU to investigate performance differences between selected US and European centres and for benchmarking purposes in the ACE (ATM Cost Effectiveness) reports.

#### Support to European Enhanced Flow Management ATFM Operations

Several ATFM assessments were completed including an improved model for ACC optimal configuration. A slot allocation algorithm alternative to the first planned first served rule was completed and initial tests showed promising results.

The study of a "Collaborative Airline Interface with ATFM" (CAIA) was concluded through a series of prototyping exercises at airline sites.

#### Tactical Traffic Management

Following the 2002 delivery of a draft Operational Concept, prototypes were produced in 2003. To further strengthen the development of this concept a TEN-T project was signed, in November 2003, with the European Commission resulting in the project called "Cooperative ATM Measures for a European Single Sky" (CAMES).

## Sector Safety and Productivity (SSP)

The main objective of the creation of the new SSP Research Area was to consolidate all aspects of controller-centred sector-level operations. In 2003 emphasis has been placed on development of an overall integrated sector view rather than a collection of individual independent functions. A substantial number of experiments and studies were executed by SSP during the course of 2003.

Some key results were obtained in the following areas:

### ASAS Package 1

Amongst the various ADS-B projects, SSP has taken a particular interest in sequencing and merging. Simulations (both ground and air-side) continued to show positive results for this application, which involves the use of new ATC "spacing" instructions. Feasibility of the techniques has now been demonstrated down in the TMA and final approach showing benefits that are recognised by both controllers and pilots involved in the experiments.

### Datalink

Experiments to support initial Link2000+ implementation have confirmed the feasibility of the initial Link2000+ set of services. Simulations involving more advanced datalink services have clearly shown benefits for some services but not for others.

Work also continued on new controller tools and the associated changes in controller working methods. Particularly successful in 2003 were a series of live shadow-mode trials involving automated conflict detection. Further studies looked at new techniques and HMI for arrival management support tools.

## Airport Throughput (APT)

APT was established in 2003 as part of the EEC realignment. To address airport related issues it has focused initially on Collaborative Decision Making (CDM) and Wake Vortex.

## Wake Vortex

The Time Based Separation Project reported on runway capacity calculation under various wind conditions, indicating that 2 to 3 landings per hour can be recovered in 15 knots headwind. Controller tools and initial hazard analysis together with a PC demonstrator have been delivered.

### WakeNet 2 Europe Thematic Network

WakeNet 2 Europe Thematic Network promotes research on wake turbulence. Results from previous studies showed a major improvement in the knowledge of Wake Vortex phenomenon. WakeNet 2 Europe will provide guidance for complementary research and operational applications.

### ATC-Wake

As Leader of the development of Operational and System Requirements, the EEC has delivered Operational Requirements, Operational Concept and Procedures together with User and System Requirements in August 2003. A 15% average increase of runway throughput is expected.

## CDM

CDM pursued the development of more advanced Airport CDM Applications and support to initial implementation at a number of European airports. Messages to exchange CDM information between the CFMU and the airport and the Variable Taxi Time Applications were defined in 2003. Athens, Lisbon and London Heathrow airports took part in implementation trials.

A Cost Benefit Analysis (CBA) study has been commissioned and will, together with the CDM promotional film and Implementation Manual play an important part in the introduction of CDM at all major airports in the ECAC area.

A co-operation with the University of Aachen has started to map airport landside processes and establish the state-of-the-art of research within the domain.

### Innovative Research (INO)

2003 has seen great progress in our objective to strengthen innovative research providing many encouraging and fruitful results:

Exploration of a new control paradigm based on large volume of airspace, linked to ACARE proposals, has focused on the shift of controller working practices, in an adapted airspace. Simulation has shown subsequent gains in capacity while reducing the conflict solving work load, confirming the initial hypothesis that larger volumes of airspace offer the possibility for more organised responses to unpredictable events in traffic planning. Five papers have been published at international conferences on this topic.

On the advanced technology investigation front, the study into the adaptation of digital watermarking techniques for pilot-controller VHF (Very High Frequency) voice communication has provided remarkable results that could open the door to significant short-term applications. Baptised Aircraft Identification Tag (AIT) the study demonstrated that aircraft identification, e.g. call-sign, can be automatically added as a digital signature to a voice air/ground communication without any modification to the existing equipments. In consequence the aircraft call-sign can be automatically detected through VHF communications thus enhancing security protection with a very promising low level of Message Error Rates.

Also showing great potential is the study on the applicability of Stereoscopic 3D visualisation and multi-media interaction techniques for future controller working positions. The human-in-the-loop experiment assessing comparative accuracy and time performance in 2D and 3D stereoscopic environments has shown that controllers perform quicker with 3D stereoscopic displays, without any detriment to accuracy. This positive result reinforces initial expectations and has orientated the study towards pilot-testing of an application for airport tower control.

Analytical modelling has recorded a remarkable advance at the theoretical level incorporating the inclusion of uncertainty in planning estimates: a Markov Decision Programming model which had been developed from collaboration between the EEC and University of California at Berkeley was applied to small-scale dynamic rerouting problems. Referred to as the "uncertainty region model" it can summarise all uncertainty factors in just one parameter for use in the dynamic re-planning process. While awaiting confirmation with larger scale problems to validate its applicability in ATM, the results have been extremely encouraging.

In 2003, four new PhD theses, one university study and two new partnerships with national research establishments were initiated. Thirty-six papers were published in international conferences and journals.

### Society, Environment and Economy (SEE)

SEE was formed at the start of 2003, its work is organised around four main threads:

- Noise nuisance around airports;
- Fuel burn and emissions;
- Air quality issues around airports;
- Sustainable aviation.

#### Noise nuisance around airports

Though being rapidly caught-up by local air-quality, aircraft noise is still the largest source of aviation-related complaint among people living close to airports.

SEE has played a major role in the ECAC Airmod working group responsible for rewriting ECAC Doc. 29 – the guidelines for aircraft noise modelling in Europe, now the "Interim Aircraft Noise Model" for the EC Common Noise Policy. Our role has been especially prominent in the design of the noise and performance database that will accompany the new version of this document. To this end, a web site has been produced that will enable registered users access to this data.

### **Fuel burn and emission**

Recent research indicates that the effect of cirrus cloud forming from aircraft contrails could be having a significant effect on global warming and climate change. In this context we started late in 2003 a project called CONTRAILS in cooperation with the European Space Agency (ESA) to identify the relationship between changes in cirrus and air traffic density.

### **Air Quality Issues**

The issue of Airport local air quality is becoming more and more important. In partnership with Lyon St-Exupéry and Zurich airports we have focused on establishing a thorough airport emissions inventory database with validation studies and developments of a Geographical Information System (GIS) tool to visualize the three dimensional distribution of the emissions around an airport.

### **Sustainable Aviation**

In a two phase study into the concept of sustainable development in Air Transport, we considered in 2003 the notion of "sustainability". In the second and more challenging phase in 2004, we will attempt to identify pricing options and/or regulatory mechanisms consistent with the notion of sustainability and which could foster sustainable development.

### **Attitudes to Aircraft Annoyance Around Airports (5A)**

5A looks at how socio-economic, cultural, age, status, education and situational factors modify the way in which noise translates into annoyance among residents around the three study airports: Manchester, Lyon, Bucharest. The attitudinal responses indicated a reasonably high degree of consensus across the three countries.

### **Flight efficiency and its impact on environment**

Direct flight between departure and destination airports offers significant savings in fuel and thus environmental benefits. In conjunction with the Performance Review Unit (PRU) and the EUROCONTROL Environment Domain, the ENV-KPI project pursued the establishment of

indicators of flight efficiency and environmental performance indicators.

## **SUPPORT TO RESEARCH**

To support the Research the EEC has developed key methodologies (Safety, Validation) and technical infrastructure (ATC simulation and experimentation platform, Human Factor Laboratory).

### **Key Methodologies**

#### **Safety**

In the wake of the tragic mid-air collision over Lake Bodensee, the High-Level European Action Group on ATM Safety (AGAS) identified a need for targeted R&D to improve safety in European ATM.

Some of the key results we have achieved in 2003 are:

- The ACAS Monitoring Cell detected a series of incidents relating to the new terminology in TCAS Version 7 which had led to pilot confusion and unsafe action in a number of cases. An explanation of the problem and a warning advisory note was sent out.
- The EEC-developed Automatic Safety Monitoring Tool (ASMT) was requested by the DFS and ENAV and is being delivered. ASMT has now reached the end of its R&D phase and in 2004 an ASMT implementation in Europe will be led by EUROCONTROL HQ. ASMT is already used by NATS, Bratislava, and Maastricht.
- The Safety Research Team developed a means of using the Target Level of Safety (TLS) in safety cases, a key requirement for ATM industry risk assessment.
- A safety focus has been integrated in six projects in NCD, SSP and APT. In 2004 this will be increased to twelve projects and

include an overall risk picture for SSP's proposed future operational concept. For NCD, it will be targeted to collaboration on investigating complexity and safety for the Maastricht centre and for APT, to safety activities related to continuous approach and ground monitoring systems (ASMGCS).

- RA Downlink;
- The Conflict Resolution Assistant (CORA) project;
- CARE Uncertainty.

As a complement to the lab and in cooperation with the HUM domain, human factors training was given to EUROCONTROL personnel.

- In an endeavour to improve the safety culture of the EEC, a safety culture survey revealed a reasonable level of safety understanding but plenty of scope for improvement. Subsequently a Strategic Safety Research Plan has described how safety should better fit in EEC's activities. A second safety culture survey will be carried out in 2004, and a Safety Management System (SMS) for the EEC will be developed.

#### **Validation**

A "Validation Methodology" was reviewed by G2G partners and accepted by European Commission in May 2003.

Further G2G developments resulted in a draft EUROCONTROL Concept Validation Methodology.

The plan for 2004 is to make available a European Concept Validation Methodology that all projects sponsored by EUROCONTROL or the European Commission will be expected to apply.

### **Technical Infrastructure**

#### **Human Factors Laboratory**

The Human Factors Laboratory was completed in 2003. It facilitates human factors experimentation at an early stage in the development of new systems and tools. It also offers a prototyping platform and a variety of human factors equipment, such as eye movement tracking and psycho-physiological measurement devices.

Projects that used the HF Lab in 2003 include:

- The SuperSector project;

#### **EATMP Reference Industry-based ATM Simulation and Trials Platform (ERIS)**

The ERIS Programme provides simulation and trials platforms to support the validation activities of the European Air Traffic Management Programme (EATMP) and the European Commission. ERIS is an important enabler for the EATMP Validation Programmes and a link between these and the EC's Applied Research Programmes. ERIS also addresses the need for open systems architecture with which to validate future ATM concepts and to progress from the definition and design phases to implementation.

#### **ESCAPE**

ESCAPE is the reference platform for the EUROCONTROL Air Traffic Management Programme. A major target for ERIS in 2003 was to replace the ESCAPE real-time ATM simulator platform with ACE (Avenue-Compliant ESCAPE).

ESCAPE has been adapted to support new features including an industry supplied Arrival Manager and enhancements to Airborne Separation Assurance features (ASAS), Datalink and Medium-term Conflict Detection (MTCD).

In October the Airbus Iron Bird test bed in Toulouse was linked using "pre-operational" equipment with the ESCAPE in Brétigny for validation of Datalink. In November a live trial of MTCD was run at MUAC Maastricht, considered by its participants as the most successful trial to date.

#### **Multi-Cockpit Simulator**

The Multi aircraft Cockpit Simulator (MCS) is a sophisticated Pilot Position developed for the EEC. It allows professional pilots to participate realistically in a simulated ATC scenario.

During 2003 MCS was used in two important experiments:

- The Mediterranean Free-Flight (MFF) project's "Air weeks" in February was a distributed simulation with 3 cockpit simulators (MCS in Brétigny, RFS in Amsterdam, ACS in Rome) connected to an ESCAPE platform running at ENAV in Rome.
- The AVT (ADS-B Validation and Trials platform) project was set up with ESCAPE and MCS to conduct live trials in Arlanda, Sweden. MCS connects directly to ARTAS and its data merges with the live data presented to the controllers.

**eDEP (EUROCONTROL Early Demonstration and Evaluation Platform)**

eDEP is a low-cost, lightweight, web-enabled ATM simulator platform, offering an ideal environment for research and advanced concept projects to rapidly prototype applications.

*Detailed description of these key results and more information on EEC activity are provided in the following chapters of the present report.*



# EUROCONTROL AND THE EXPERIMENTAL CENTRE

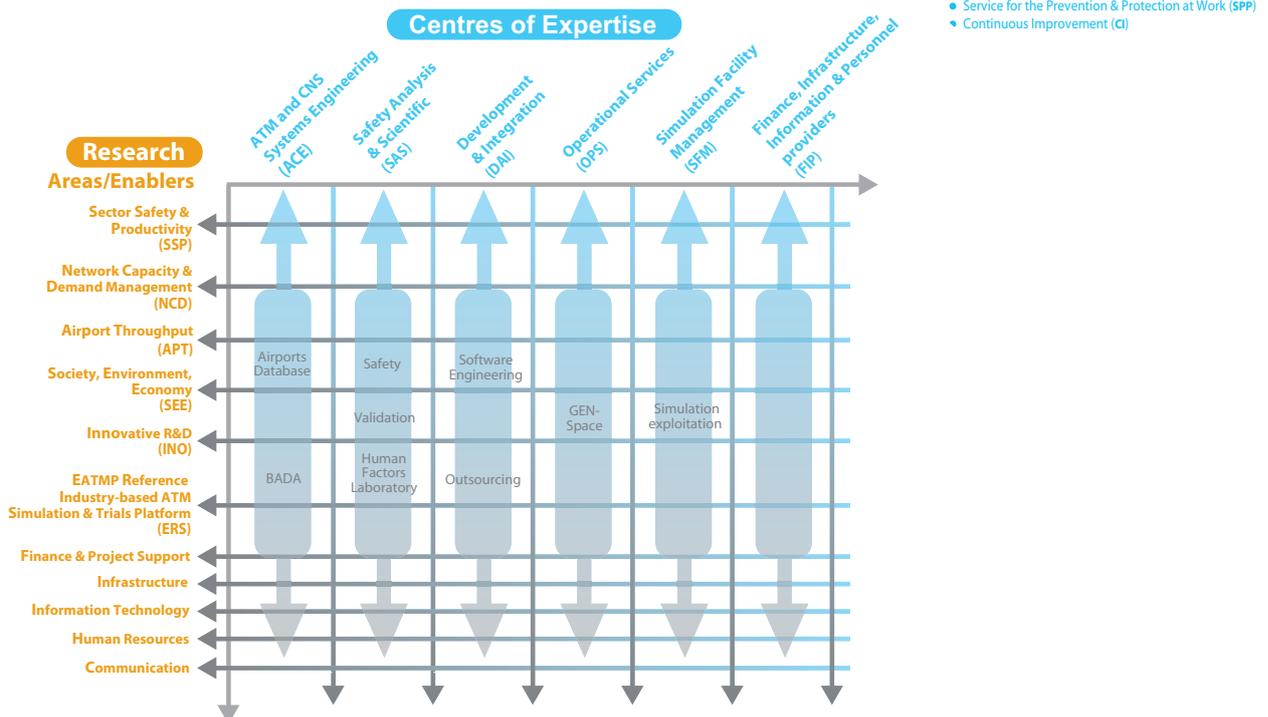
The Mission and Strategy of the EEC have been developed and continuously refined in recent years.

They are described in the following diagram\*.

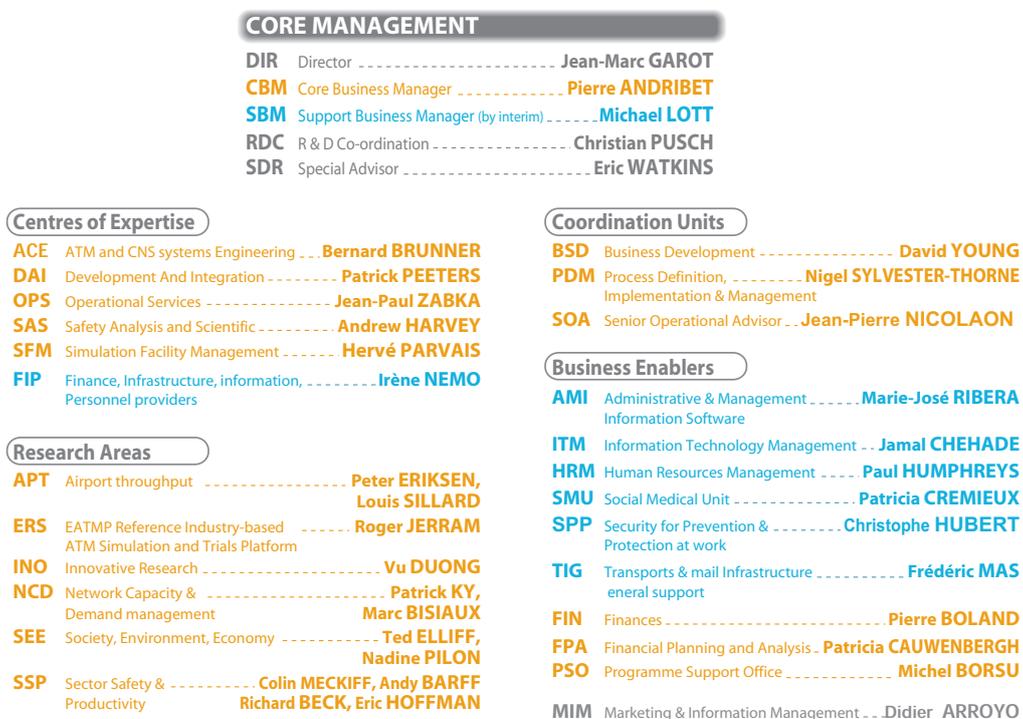


\*Please note that this diagram takes into account changes decided during 2003 after the adoption of the Business Plan V.4.0.

The implementation of the strategy is achieved via a matrix organisation as follows:



The overall organisation of the Experimental Centre is described in the following diagram.



Details of the projects, activities and results are provided in the rest of this activity report.



# PARTNERSHIP

## European Commission and Industry

The accession of the European Commission to EUROCONTROL in 2002 followed in 2003 by the signature of an Agreement for Co-operation between the two institutions provides a new political and institutional environment where the Experimental Centre is central for the articulation of European ATM Research and Technological Development.

In recent years there has been a growing awareness that there needs to be structure introduced into the organisation and management of ATM Research at a pan-European level to ensure a consistent and efficient approach to the challenges which are now identified. Throughout 2003, in full consultation with the stakeholder community, the EEC has endeavoured to structure and arm itself for the challenges that a leading role in the organisation and management of European ATM Research entails.

Consistent with the strategic objectives identified in the EEC's 2003 Business Plan, addressing the goals identified by the Group of Personalities in their report "European Aeronautics - A Vision for 2020", and through the avenues identified to achieve these by the Advisory Council for Aeronautics Research in Europe (ACARE) "Strategic Research Agenda", the EEC, working together

with the European Aerospace supply industry represented by AECMA, actively participated in the development of the European ATM Master Plan, which has as objective to create a coherent and manageable Research and Implementation path to mobilise and consolidate scarce resources, avoiding unproductive duplication and overlap.

In the realm of ATM related research, both EUROCONTROL and the European Commission have been seeking to minimise duplication and achieve a high degree of complementarity and reciprocity in the execution of their respective research programmes. With the accession of the European Union to EUROCONTROL and the fact that today some 80% of annual ATM R&D expenditure is piloted by EUROCONTROL and the European Commission (source ARDEP), initiatives are in progress to establish a Joint Programme Board to assure the articulation of European ATM research in accordance with the European ATM Master Plan, thereby further developing the co-ordination and management objectives identified in the 2003 Business Plan.

The EEC also contributes to the EC's activities by providing expertise, resources and facilities to the European RTD programmes. Throughout the year, the EEC's teams continued to contribute actively to the ongoing 5th Framework, Trans-European Network-Transport (TEN-T) and Thematic

Networks programmes, whilst preparing for the 6th framework programme.

The 17th December 2002, the European Commission officially launched the first call to its 6th Framework programme for Research and Technological Development, more commonly referred to as FP6. Based on the Treaty establishing the European Union, the Framework Programme has to serve two main strategic objectives: strengthen the scientific and technological bases of industry and encourage its international competitiveness while promoting research activities in support of other EU policies.

Some 17.5 billion EUR have been earmarked for co-financing successful candidates involved in European Research and Technological Development. Alas, only a finite portion of this is dedicated to ATM related activities (150 Million EUR).

FP6 has introduced new instruments for its implementation aimed at ensuring coherent project funding over a longer time frame greatly facilitating the assembly of the “critical mass” of expertise, resources and activities needed to achieve its ambitious objectives. In a number of ATM related areas, the EEC is part of this critical mass.

FP6 is structured around three main headings:

- Focusing and integrating EU research;
- Structuring the European Research Area;
- Strengthening the foundations of the European Research Area;

The EEC has focussed its participation inside the first segment, where the Aeronautics and Space Thematic priority is located, but has not restricted its activities to this area alone. Between 17th December and 20th March, the EEC actively participated in the preparation of some seven proposals aimed specifically at reinforcing the strategic orientations adopted by the EEC, five of which were successful and are currently under final contract negotiations.

Finally, the EEC once again provided support to the International Co-operation Programmes initiated by the European Commission, through the organisation of and participation in seminars and workshops, aimed at providing greater insight into the European Research and Technological Development activities.

### Stakeholder Relations

In conformance with the Business Plan, the EEC is engaged in a Continuous Improvement Process, applying the EFQM model and recommended practices. In this context, Stakeholder satisfaction surveys are performed on a periodic basis to enable the EEC to identify the evolution of its strengths and weaknesses and ensure its Business Development is fully in harmony with stakeholder expectations.

The previous editions of the stakeholder surveys were performed by the EEC and obtained mixed results. It was decided to seek professional assistance and advice when conducting the 2002 edition of the survey and consequently IPSOS were contracted to perform this on behalf of the EEC.

Although participation in the quantitative component of the survey was a little disappointing, which in itself equally provides useful feedback, initial results were of great interest and highlight areas of concern for improvement.

The results were finally published early in 2003. This last edition shows that our activity portfolio in general is well tuned to stakeholder expectations and the services provided are of very good quality.

In many ways the EEC benefits from a slightly different image to EUROCONTROL: a natural position as an “independent and neutral expert” in the ATM world, an organisation with its eye to the horizon seeking mid and long term solutions for the industry. The EEC appears as the natural choice to enable a better management and integration of research and development in the ATM field

throughout Europe and as such, a natural ally for the Commission which is in real need of an expert body behind it to enable it to make and enforce future solutions in ATM.

However, the EEC is also criticised, firstly, for its apparent difficulty to communicate and ensure the operational application of research results and secondly for its use of funds on non operational projects. There is clear desire to see a move away from the bureaucratic and administrative procedures which characterise the whole organisation, and see a real improvement in its reactivity. There is a need to see the EEC developing towards a more central role in the coordination of R&D in Europe and becoming the facilitator in finding operational solutions for the Commission in its drive towards the single sky for Europe.

Through our continuous improvement processes, we are addressing both positive and negative elements to improve the level of services provided and ensuring we remain attuned to the rapidly evolving air transport landscape.

Once again, the EEC would like to thank all contributors for their assistance in providing the essential feedback that will enable it to evolve and provide the appropriate quality of service to its sponsors and beneficiaries.

### **The Experimental Centre Consultation Group (ECCG)**

Since its inception in 1998, the ECCG has been chaired with vigour and dedication by Phil Hogge, independent ATM Consultant, and since 2002 by Marc Baumgartner, President and CEO of IFATCA. After one yearly meeting over the years 1999 to 2001, the Group came back to a semestrial meeting cycle with meeting number 7 in April and number 8 in October 2003. The standard agenda items were the annual EEC Activity Report (spring meeting) and the EEC Business Plan (autumn meeting), thus aligning fully with the Agency approval cycle of those two important EEC business documents.

Special attention was given this year to EEC's Strategic Reorientation in the context of EEC's alignment with ACARE's Strategic Research Agenda (spring meeting) and the European ATM Masterplan (autumn meeting).

As in previous years, the members of ECCG are composed of key stakeholders from Research Centres, Air Traffic Service Providers and ATM Industry and the attendance is in the order of 50 persons.

### **Assistance to Central European Air Traffic Services (CEATS)**

The CEATS programme, an Agency/EATMP initiative, aims to establish a regional ATC centre in central Europe on behalf of eight EUROCONTROL Member States. The EUROCONTROL Agency has been entrusted with the establishment and operation of the air traffic services and support units.

The EEC, heavily involved in the implementation of the CEATS Research, Development and Simulation Centre (CRDS) in Budapest, continues to support the CRDS in many areas. This affects mainly the operation of the CRDS real-time simulation platform, which is based on EEC's ESCAPE and which serves to fulfil CRDS main task, to validate main technical and operational choices during the implementation period of the CEATS Upper Airspace Control unit, CUAC, in Vienna.



# COMMUNICATION AND PUBLIC RELATIONS

## Conferences, Exhibitions and Workshops

The EEC was responsible, together with the FAA, for the organisation of the 5th US/Europe ATM Research Seminar. This fifth of a meanwhile well established series of ATM research conferences took place in Budapest in June 2003 and attracted 200 researchers from both sides of the Atlantic.

The EEC participated to several exhibitions, ATC Maastricht, ATCA Prague and Washington, ATC-CEE conference and exhibition in Warsaw. As in 2002, Jean-Marc Garot, Director of the EEC has been invited to address several conferences and, in particular, represented the DG at the colloquium: "Le défi du ciel unique: la France dans l'Europe de la navigation aérienne", organised by the French Assemblée Nationale in the Palais Bourbon.

The EEC has again hosted several seminars and workshops in 2003 with a very wide variety of participants and a wide scope of subjects. Two of them should be particularly mentioned: the first interactive capacity workshop in October 2003, organized by the Network Capacity and Demand management (NCD) Research Area with the objective of improving the capacity planning process. Ten ANSPs and IATA participated to this workshop. The second was the annual December workshop of the Innovative Research Area

presenting their projects and receiving feedback from the independent audience.

## Visits

Public Relations have been as each year very active. 31 official visits of the EEC were organised in 2003, during which more than 300 guests were welcome in our premises. As in previous years, brochures on the Centre and its activities have been updated, completed and distributed. The set of slide presentations has been kept up-to-date and was widely used during these visits. Demonstrations have been organised in the operational rooms and in the show-room providing a lively view of a wide scope of EEC projects.

The database developed in 2002 recording all the details of the visits has been completed. It contains now, not only details on the visits of 2003, but also all historical data back to 1995.

## Publications

A total of 123 publications were produced by the EEC in 2003, comprising EEC reports and notes, and numerous contributions to peer-reviewed scientific journals, professional magazines and

conferences. They are listed in a special chapter at the end of the present report.

Were also produced a large number of leaflets and brochures or new issues of them as well as posters, videos and CD-ROMs.

### **Internal Communication**

During the year 2003 the important programme of improvement of the internal communication, started in 2002, has been further developed. The Internal Information Monitoring Group, IIMG, has supervised numerous actions performed in order to keep the level of information and transparency in the EEC as high as possible. 34 Weekly Information Corners have been organised with an average audience of about 50 persons each week. The internal magazine, EEC News, continues to be issued quarterly and is widely read and appreciated by staff. An important enhancement of the information available through the Intranet has been achieved in close coordination with the EEC Web Steering Committee. The use of the newsgroups, internal forums of discussion, has been reviewed and their organisation has been simplified.

A short video report has been produced for the CoSpace project. The objective is to develop internal knowledge on EEC projects as we intend to broadcast this report through the different available facilities: large screen in the cafeteria, auditorium sessions, internal network, etc... If successful, it could be repeated for other projects, eventually leading to the development of an "EEC TV News" providing regular information on the Centre's activities and events.

Special software has been installed in order to make accessible to all staff the very large amount of photographs produced during the now rather long history of the Centre. Some 1500 pictures are available through this new tool.





# OVERVIEW

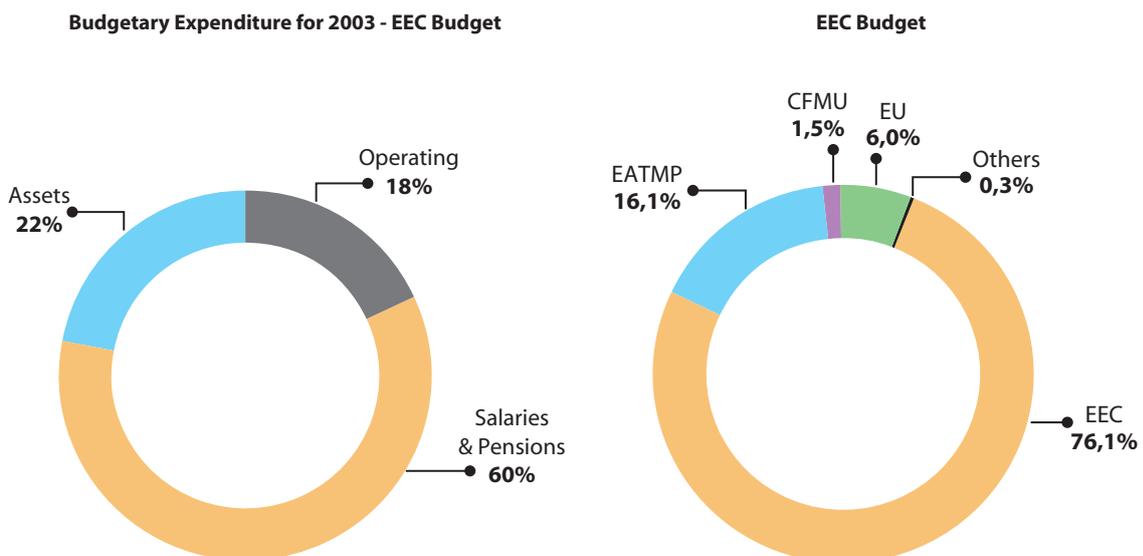
## RESOURCES

### Budget

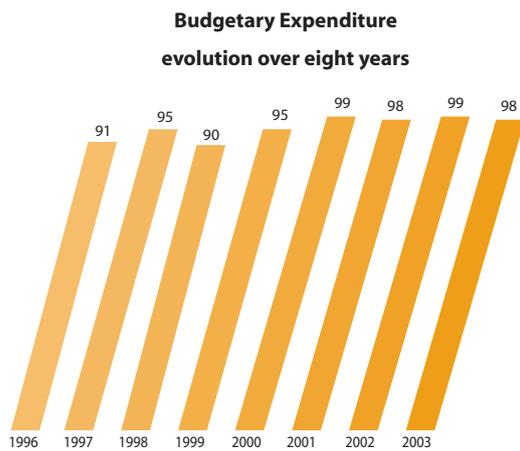
The total approved budget for the EEC in 2003 was 55.9 MEUR of which 55.1 MEUR were spent.

The graph "Budgetary Expenditure for 2003 - EEC Budget" shows the distribution between the different nature of expenditure (salaries/pensions, assets and operating).

Taking into account the credits that have been delegated by our various sponsors (EATMP, CFMU, European Commission, Maastricht and ENAV) the total expenditure amounts to 72.4 MEUR as shown in the following graph.



The trend chart with the evolution over eight years is a clear indication that the performance of the EEC expenditure, including the external funding, has improved substantially during the last years and has reached a very efficient level. This is the result of the measures implemented since 2000 to improve the financial processes (organisation of regular checkpoints and implementation of user-friendly tools for the project managers).

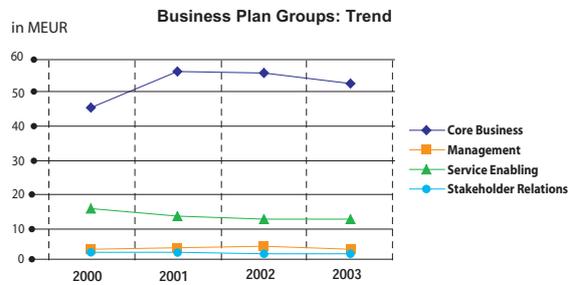


**Work Programme trends**

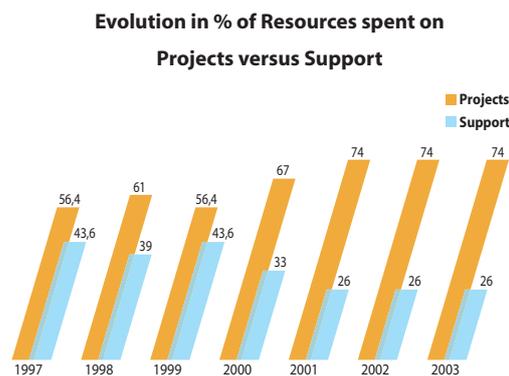
The EEC Work Programme is defined in the Business Plan document produced annually since 1999. This document defines 4 categories of activities:

- Core Business
- Executive Management
- Service Enabling
- Stakeholder Relations

Remembering that GNS and CNS activities have been removed from EEC activities, the “Business Plan Groups: Trend” diagram shows an almost stable situation.



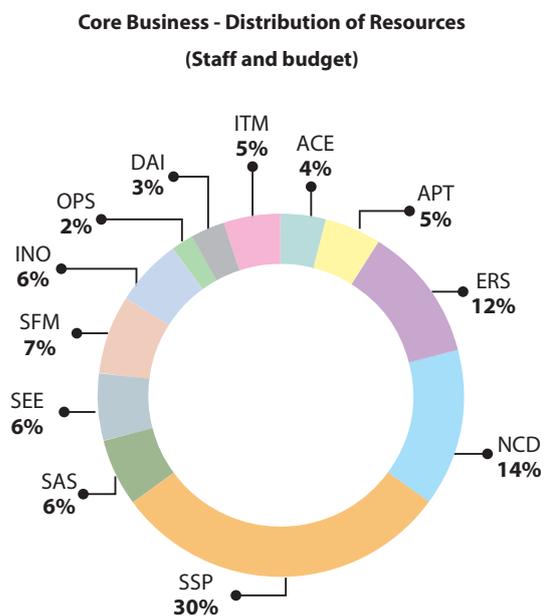
**Core Business versus Support**



The EEC still maintains its objective to privilege its resources for the benefit of its Core activities. The stability of the repartition observed in the last three years seems to indicate that the EEC has reached a good balance between resources dedicated to Core Business and those dedicated to Management and Support.

**Core Business - Distribution of Resources**

The 2003 EEC Business Plan reflects the new EEC strategy and the resulting re-organisation of the Centre.



«Core Business - Distribution of Resources» shows the predominance, in terms of resources (staff and budget), of two strategic Research Areas and one Research Enabler, namely Sector Safety and Productivity (SSP), Network Capacity and Demand Management (NCD) and EATMP Reference Industry-based Simulation and Trials Platform (ERIS).

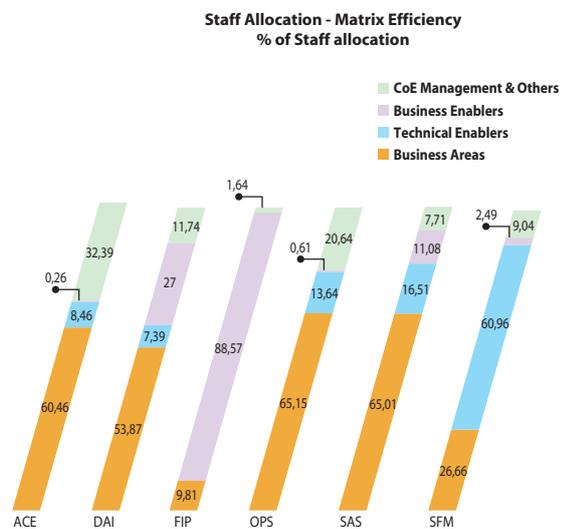
### People

In 2003, the matrix organisation was extended to staff in the Support services. This facilitates easier lateral mobility of people across projects and services, and between Core Business and Support activities. The figure shows the distribution of staff across Business Areas, Technical Enablers, Business Enablers, and CoE management. It should be noted that, significantly, staff from four Centres of Expertise are assigned to both the Core Business and to the Support function, indicating on the one hand the availability of a wide range of skills, and on the other, an efficient distribution of those skills.

The flexibility afforded by the matrix has had tangible results in terms of internal mobility and career development of staff.

At the beginning of the year, the EEC had an approved allocation of 257 staff. By year end this had been reduced to 248 due to Agency budgetary restrictions.

The EEC has been able to compensate for this reduction in overall staffing levels by assigning responsibilities of a higher level to current staff. Consequently, 20 people were successful in internal competitions for posts at a higher grade.





# RESEARCH AREAS

## RESULTS

### NETWORK CAPACITY AND DEMAND MANAGEMENT (NCD)

Supporting the ATFCM strategic action plan, the objective of this area is to conduct the research in key elements such as airspace management, strategic and tactical capacity management, ATFM operations and tactical traffic management.

While inactive during 2003 in airspace management, significant results were achieved in the three other domains.

#### Strategic and Tactical Capacity Management

In the context of the Capacity Enhancement Function and with ACG agreement the first of a series of Interactive Capacity Workshops was held in October to give ANSPs a clearer view of the underlying data and assumptions used by the FAP model. Representatives from CEATS, MUAC, ANS CZ, SCTA, DFS, PATA, NAV Portugal, LPS SR, AENA, Skyguide and IATA attended and expressed their satisfaction along with the desire that this interactive, transparent approach to collaborative capacity planning become an established feature. In addition, a new method, proposed by the Capacity Task Force, was developed for assessing ACC capacity (ACCESS), which would be applicable to all ACCs, whether or not producing delays, and

based on a comprehensive simulation of the European ATM network.

Complementing the short to medium term planning activity, COCA (Complexity and Capacity) is a study to identify and evaluate factors related to air traffic control complexity and their links to controller workload. During 2003 aspects of the COCA method were applied by the PRU to investigate performance differences between selected US and European centres and for benchmarking purposes in the ACE (ATM Cost Effectiveness) reports. COCA will be extended during 2004 to include a functional model of ATC cognitive complexity.

### Support to European Enhanced Flow Management

#### ATFM operations

Several ATFM assessments were completed including an improved model for ACC optimal configuration. A slot allocation algorithm alternative to the first planned first served rule was completed and initial tests showed promising results.

The pre-tactical ATFM simulator COSAAC (deployed in the CFMU in 2002) is now fully used by the Network Management Cell (NMC) as an

operational tool. During the pre-tactical ATFM phase, CFMU use it to foster co-operation and collaborative decision making between Aircraft Operators, Flow Management Positions, and the Flow Management Division. The tool is used to analyse traffic demand and to assess re-routing efficiency in order to maximise the available capacity as expressed in the "Air Traffic Flow & Capacity Management evolution plan for the ECAC states" (CFMU/ URB/ ATFCM-EVOL-01-00, July 2003). As a result, the "COSAAC working practices" have been published by FMD/SDS+OPS and will be referred to by the CFMU to define the requirements of the future CFMU pre-tactical and post-operation analysis tool.

All the CFMU pre-tactical studies are performed directly by NMC specialists. The EEC continued to carry out specific studies such as the transitional phase to the NEON new ATM environment (over the Belgian airspace and the Maastricht control area) or the definition of the CFMU contingency plan (which has been largely automated).

The study of optimisation models in order to maximise ACC capacity according to traffic demand that started in 2000 resulted in a presentation of results during a seminar on optimisation techniques. The main objective of this study initially requested by CFMU was to define an improved model and a user-friendly graphical interface for the CFMU OPTICON tool. Validation with NMC will be carried out in 2004.

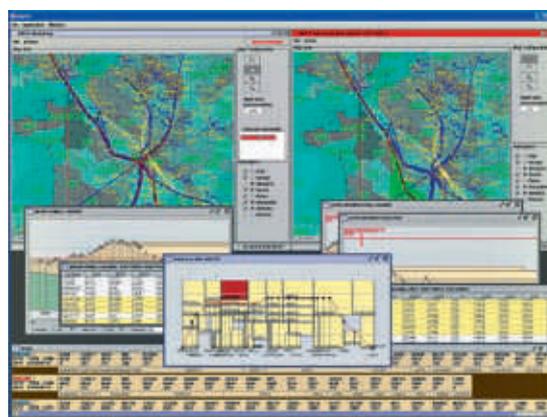
Other studies dealing with ETFMS efficiency assessment have also been conducted. A first evaluation of the benefit from updating slot lists with ACC system activation messages indicates a reduction of 10% in total delay.

An assessment was made to determine the minimal set of data to be considered as part of an Initial Single European Flight Plan. The study focussed on an IFPS perspective, identified the elements which should have a contractual status and the associated requirements in terms of interoperability and recommended a first set of rules to ensure consistency.

The study of a "Collaborative Airline Interface with ATFM" (CAIA) was concluded through a series of prototyping exercises at airline sites (BA, KLM, SAS, Easyjet, Brussels Airlines) resulting in feedback for the design of advanced CFMU interfaces for airlines.

### **Tactical Traffic Management**

As recently underlined by the PRC, one of the most promising elements of the ATFCM strategy, will be the development and implementation of the Tactical Traffic Management (TTM) concept. It will improve traffic smoothing performance by complementing the current ATFM system with real-time air traffic synchronisation and dynamic negotiation. Following the 2002 delivery of a draft Operational concept, prototypes were produced in 2003, to consolidate this concept by facilitating the identification of appropriate measures and the negotiation and communication of those measures between different centres.



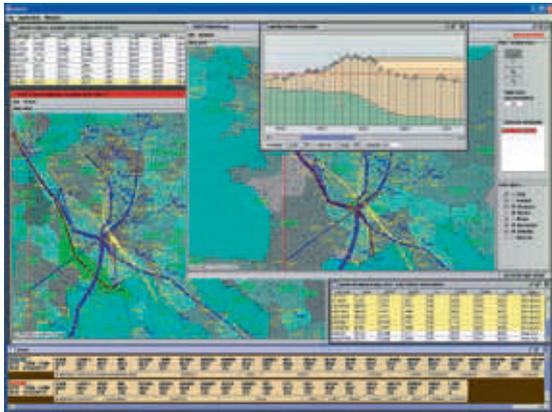
*HMI showing FL change*

In this context the Future ATFM Measures (FAM) project will improve traffic smoothing performance by complementing the current ATFM system with real-time air traffic synchronisation and dynamic negotiation facilities. FAM will provide techniques and procedures to facilitate rapid reaction between area control centres (ACC) and airports to address late-arising risks of traffic overload and to allow corrective actions until the point where the traffic is handed off to

the controllers to control instead of the current practice, two hours in advance.

All the phases of the process have been addressed:

- Traffic load monitoring (including what-if functions): DARTS (Decision Aid for Real-Time Synchronisation) HMI + Engine;
- Negotiation support: DARTS Messenger (shared between Traffic Managers);
- Synchronisation Strategy implementation: communication to ATC through ICS (Internal Communication Support).



HMI showing forecast overload

To further strengthen the development of the TTM concept a TEN-T project was signed, in November 2003, with the European Commission resulting in the project called "Cooperative ATM Measures for a European Single Sky" (CAMES). In cooperation with Skyguide, AENA, DNA and ENAV, as well as CFMU, it will validate the first elements of tactical traffic management concepts based on specific traffic flows. A series of workshops with these key ANSPs reviewed ATFM operations in the targeted areas and assessed the appropriateness of the proposed measures.

The FAM OCD was updated for use by both FAM and CAMES projects (EEC Note 02/04, to be published in January 2004).

## Performance Analysis and Strategic Target setting

The new planning cycle started with the 2002 capacity baseline measurement for individual ACC's and the calculation of capacity profiles as the basis for capacity planning out to 2008.

A reference capacity profile has been established for each ATC unit (ACCs and selected TMAs) for 2004-2008, based on FAP simulations, with the following assumptions:

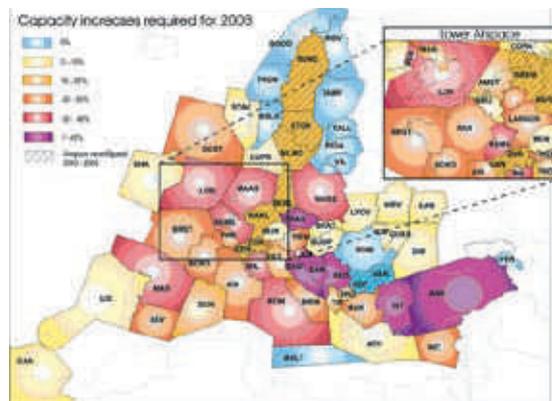
- medium traffic forecast (STATFOR) produced in February 2003;
- shortest routes and unconstrained profiles;
- 1 minute average en-route ATFM delay target at ECAC level;
- re-organisation of German ACCs, Swiss and Swedish airspace from 2005;
- CEATS operational from 2008.

Several alternative scenarios were also simulated.

Each profile is linked to the 2002 capacity baseline, determined by FAP, using the economic optimisation to meet, in 2006 and 2008, the overall delay target of 1 min.

Capacity profiles were calculated and submitted to ACG/20 (May 2003) for endorsement and publication in the ECIP 2004-2008.

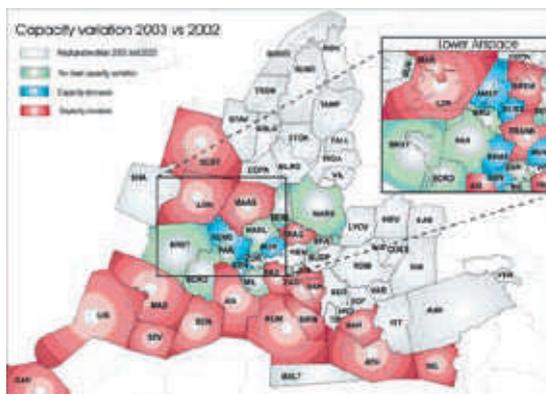
The following map shows the capacity increases required for 2008 in the reference scenario:



### 2003 Baselines

The capacity baselines for 2003 for ACCs and selected TMAs were calculated by FAP during the summer reference period (10 June to 6 August 2003), to be published in the 2004-2008 LCIPs. These baselines were distributed in September and have been coordinated bilaterally with ANSPs.

The following map shows the evolution of the ACC capacity performance between 2002 and 2003 over the May-October period.



### Capacity Planning Methodology and Tools

Following discussions during 2002, a Capacity Planning Task Force was set up to address pending issues, and in particular the methodology to assess ACC capacity. This TF recommended a number of measures which are being applied to improve the transparency and quality of the process.

The task force recommended, in particular, that a new method be developed for assessing ACC capacity (ACCESS), which would be applicable to all ACCs, whether or not producing delays, and would be based on a comprehensive simulation of the ATFM network (at sector level). The ACCESS method was developed by the FAP team but due to lack of data provision by ANSPs, the new methodology could not be tested and/or applied.

Existing methodologies with their limitations therefore had to be retained for assessing the 2003 capacity baselines.

A new version of the Portable ACC Capacity Tool (PACT 2) has been developed and distributed to all ANSPs. This new tool not only provides an assessment of ACC capacity, but also presents clearly sector traffic loading and permits simple what-if simulations.

### Economic studies

These were organised around four main themes:

- The differentiation between upper and lower airspace, which aimed at defining a set of operationally coherent airspace categories, and then comparing their cost and revenue structure.
- the analysis of the ATM supply chain, in terms of fragmentation of development and procurement policies;
- the economic analysis of Functional Blocks of Airspace;
- an in-depth analysis of ATM accounting rules and principles.

Results from the two first themes will be published in the first quarter of 2004.

The two last themes were delayed in order to be complementary to the EC initiatives on the Single Sky economic regulation and results will be published in the summer of 2004.

### SECTOR SAFETY AND PRODUCTIVITY (SSP)

The main objective of the creation of the new SSP Research Area was to consolidate all aspects of controller-centred sector-level operations. This scope includes air-ground integration applications such as new ATC spacing instructions and others which may transfer some workload from the ground to the cockpit.

SSP's objective is to carry out concept clarification, execution of experiments and studies and the study of transition and implementation issues to generate data in support of: proof of usability

and operational coherence, business case development, standardisation and regulation processes, safety assessments and, ultimately, overall implementation decisions.

In 2003 emphasis has been placed on development of an overall integrated sector view rather than a collection of individual independent functions. Involvement in the Gate-to-Gate and OATA projects has supported this.

A substantial number of experiments and studies were executed by SSP during the course of 2003.

Key results were obtained in the following areas.

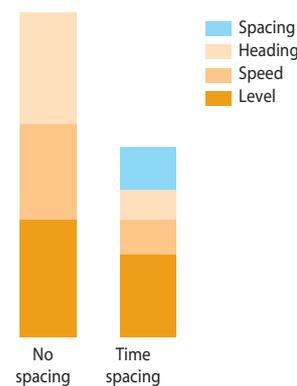
### ASAS Package 1

Amongst the various ADS-B projects, SSP has taken a particular interest in sequencing and merging. Simulations (both ground and air-side), in the context of the CoSpace project supported by the AGC and ADS EATM Programmes as well by the EC TEN-T NUP2 and EVP Programmes, continued to show positive results for this application, which involves the use of new ATC “spacing” instructions. Feasibility of the techniques has now been demonstrated down in the TMA and final approach showing benefits that are recognised by both controllers and pilots involved in the experiments.

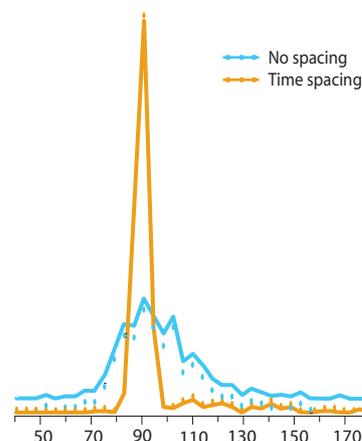
A principal interest has been an application known as “Sequencing and Merging”. This is a technique which involves reallocation of spacing tasks between controller and flight crew using a new set of “spacing” ATC instructions: aircraft are themselves instructed to maintain an in-trail spacing distance (or time) relative to a target aircraft. The expectation is that this will allow more effective air/ground task distribution without changing responsibility for separation provision. There has been particular interest in applying this to arrival flows from Extended TMA right down to final approach. Experiments were carried out in 2003 to investigate both ground and airborne issues.

Previous ground experiments had investigated sequencing and merging principally in Extended TMA, and 2003 saw these experiments carried down through TMA i.e. closer to the runway. Early analysis has shown a reduction in controller workload, better sequence building and substantial improvement in regularity of spacing into final approach. Despite the fact that significant changes in working method were required, controllers had a positive perception of the techniques and understood the benefits. As an early example of results, the following graphics show the change in number of manoeuvring instructions issued without and with the new sequencing and merging instructions, and the improvement in quality of inter-aircraft spacing at the final approach fix using the technique.

**Manoeuvring instructions**



**Inter aircraft spacing at final approach fix**



The use of sequencing and merging techniques clearly requires that appropriate functionality and operations are also incorporated in the cockpit. In this respect experiments were run to see how well pilots were able to apply and maintain spacing instructions issued by ground ATC. The EEC multi-cockpit simulator was upgraded with avionics which included appropriate functions and cues to help pilots manually fly at the required spacing distances (or times). A series of experiments was undertaken mid-2003 involving 12 European airline pilots and one Airbus test pilot. The experimental design allowed each crew to execute 8 measured runs looking at both distance and time-based spacing. In all cases crews were able to successfully achieve their spacing tasks within the required levels of tolerance: 0.5NM was easily achievable. Subjective feedback on the design of HMI and procedures was positive. The pilots did, however, express the need to work with more complex scenarios (changes to target, changes to merging point, more realistic weather, more difficult approach procedures) and these will be addressed in the future, probably using more realistic full flight simulators.

Further ASAS sequencing and merging studies took place as part of the European Commission Mediterranean Free Flight (MFF) project, which simulated arriving traffic in the region of the Balearics. This work showed that the techniques needed careful application and will not work in some conditions – for example it is not possible to apply sequencing and merging directly to highly heterogeneous traffic.

Globally we can say that the ASAS sequencing and merging technique, if correctly applied, could be an ADS-B application which provides real improvements in ATC efficiency and quality of service.

### **Datalink**

Experiments to support initial Link2000+ implementation (from both operational and technical perspectives) have confirmed the feasibility of the initial Link2000+ set of services.

Simulations involving more advanced datalink services have clearly shown benefits for some services but not for others.

Link2000+ is the Agency's principal programme oriented to near-term implementation of an initial set of datalink services. At the beginning of 2002 a first simulation studying several implementation issues was executed. 2003 saw a second simulation, specifically designed for the French ATC Administration and focusing on local concerns. The simulation exposed participants to new "stripless" HMI principles, working methods and task sharing adapted for data link operations. A particular objective of the simulation was to look at operational and technical timing issues related to the use of data link messages. Phraseology proposed by the Link 2000+ Operational Focus Group was also tested.

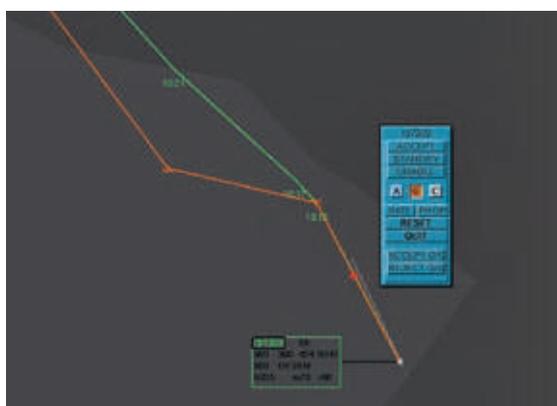
The simulation identified the controller interface as key to the success of datalink – it is vital that any potential gain in controller workload is not offset by inadequacies in the construction, transmission and reception of data link messages. The simulation also investigated communication response times that would be acceptable to controllers. In practice the random response times used during the simulation were acceptable for non time-critical tasks, allowing the controllers to work asynchronously with several aircraft.

More advanced datalink concepts were studied in the DOVE2 simulation which ran in May 2003. This studied the operational impact of services such as COTRAC 2D (Common Trajectory Co-ordination), FLIPCY 2D (Flight Plan Consistency) and DYNAV 2D (Dynamic Route Availability).

The ability to uplink trajectories (a COTRAC service) was shown to save time compared to R/T, but the added value of this clearly depends on the target airspace structure and the traffic levels. The trajectory edition process was not too time consuming, averaging about 14 seconds, but the full attention of the controller was required during this time. COTRAC without any automated conflict detection support was difficult to use, as controllers could move the aircraft from the

standard airways and create new conflict points or change traffic sequencing – this confirms results already seen in free-route experiments. Moreover, the ability to receive unsolicited trajectory requests from the pilots was not always appreciated by controllers.

DYNAV seems to be a good application, reducing workload and resulting in better service for the airline operators (shorter routes). Controllers suggested full automation of uplink of the FDPS (Flight plan Data Processing System) trajectory in case of discrepancy detected by the FLIPCY service.



DOVE COTRAC HMI

More generally these datalink services required new controller working methods due to the asynchronous nature of air-ground communication, and also required increased time for radar monitoring. The planning controller could now perform some of the actions previously only available to the tactical controller, for instance issuing of route instructions, and this allowed him to use his spare capacity. However no consensus was reached during the simulation as to exactly how tactical and planning controllers should share their tasks.

### Controller tools and roles

Work continued on three controller tools. "Shadow-mode" trials of a medium-term conflict detection tool (MTCD) were executed, there was continued

study of a tool to support conflict resolution (CORA), and an "off the shelf" arrival manager (AMAN) with a new HMI was integrated into the EEC simulation facilities. Some preliminary studies also took place on a departure management tool. This work was funded by EUROCONTROL EATM ASA programme together with the European Commission (EVP project).

MTCD "shadow-mode" trials were carried out in April at Rome ACC, and in November at Maastricht UAC. The Rome trials took a significant step forward in EUROCONTROL's live-trialing capability: previously the ESCAPE/ PROVE platform had been used for shadowing live operations – control of traffic remaining strictly in the hands of the centre's operational system. The Rome trials, however, used the EUROCONTROL installation including a fully operational MTCD to actually control traffic, with the operational system being used as a safety backup.

The report issued after the Rome trials indicates the following uses of MTCD information: First, the information given in the aircraft-oriented flight leg was used as a means for mentally integrating an aircraft into the general traffic situation. Second, the information conveyed in the Potential Problem Display was used as a trigger for conflict detection. Third, the information conveyed in the manual MTCD was used as a means for analysing potential problem situations that were initially detected by the controller. Finally, the information conveyed in the Vertical Aid Window was used as a means for finding a (vertical) conflict resolution. A full report is available detailing all the findings.

The Maastricht MTCD trial was performed in the Delta High sector exclusively in shadow mode. Detailed results are still being analysed, but early comments from controllers indicate that they expect to be able to handle more traffic as a direct result of MTCD usage (+10% has been publicly stated). A second trial will take place early 2004 in the Luxembourg sector and this will present a more interesting challenge, with a high proportion of climbing and descending traffic.

Shadow-mode trials are much appreciated by controllers. In response to the question “the trials enabled me to form a thorough opinion of the MTCD” 100% of controllers participating in the Rome trials responded with either “agree” or “strongly agree”.

With regard to AMAN, an industry-supplied component was installed into the ESCAPE platform and an EATMP-standard HMI was implemented. This HMI takes a radical new approach to presenting AMAN advisories: no longer is a timeline used, instead the advice is fully integrated with the radar display. It is presented concisely to the controller on the track label, and this enables all the relevant information to be available directly to the controller on a single screen. A preliminary real time simulation was carried out in June with controllers from LFV, the Swedish administration, which generated positive feedback on the approach and the performance of the AMAN. This work will lead to live trials on-site in Stockholm.

CORA (CONflict Resolution Assistant) development continued in 2003 both at Level 1 (graphical interactive support to conflict resolution) and at Level 2 (computer proposes conflict resolution, leaving the controller to implement). This work was funded by the EATM ASA Programme.

A key assumption of the CORA concept is that, in a sector team, the planning controller will be able to plan and prepare some work for the tactical controller. In this respect early trials for CORA Level 1 (2000 & 2001) raised issues such as loss of situational awareness, lack of flexibility, and how best to present clearance reminders to the tactical controller. In October 2003 these issues were addressed by a prototype simulation in the EEC Human Factors Laboratory using the eDEP platform. HMI design solutions were found to support and improve situational awareness and to support a better distribution of workload within the team. It became clear that CORA Level 1 was an important enhancement to a stripless environment. Further improvements were also proposed during the study including: real-time indication of conflicts while editing

trajectories; indications to the tactical controller of reasons for clearances which had been prepared by the planner (route optimisation; conflict resolution etc.) and a function to better facilitate management of tactical clearances. The level of the exercise (early prototyping rather than large-scale simulation) was very much appreciated by the controllers who felt more involved in early design of future tools.

The initial CORA Level 2 algorithm was developed during 2003 by NLR. This will provide automated resolution advice for conflicts detected by MTCD (Medium Term Conflict Detection). The algorithm was then integrated onto NLR’s real-time simulator, and a simulation took place at NLR premises in April 2003. Objectives were to gain feedback on operational concept, controller working method and role change, HMI design, algorithm technical design and performance. The simulation demonstrated the difficulties of designing a satisfactory algorithm which is acceptable to controllers. In particular multi-sector aspects (conflict visible but aircraft not yet assumed, resolutions which impact downstream sectors) need further consideration. Work continues in 2004.

### Communication Infrastructure

Development of the ADS-B/TIS-B Validation Testbed (AVT) continued in 2003. AVT is developed on behalf of, and funded by, the EUROCONTROL ADS Programme and emulates the future European airborne and ground surveillance system architecture in which ADS-B is used as an overlay to existing radar infrastructure. TIS-B is a complement to ADS-B for airborne surveillance applications. AVT is developed to support the validation of ADS-B Package 1 applications, and implementation of the ground surveillance part was completed in 2003. This enabled a number of exercises focusing on the feasibility and tuning requirements of fused ADS-B and radar plots. It was also possible to study the provision, through ADS-B, of additional aircraft derived data (principally controller access parameters and autopilot/ FMS

intent) which can be displayed to the controller and/or used by controller support tools.

Exercises took place at Brétigny using live and simulated aircraft and a mix of live and recorded radar data. Furthermore two separate demonstrations with live traffic were organised in Sweden (Malmo and Arlanda) in collaboration with the Swedish CAA and the EVP project. The exercises showed that with proper tuning of the tracking and fusing algorithms it is possible to achieve measurable improvements in displayed track accuracy using fused ADS-B/radar tracks from multiple surveillance sources. A key issue for further investigation will be to better evaluate the attainable increase in surveillance quality, and to assess its impact on Package 1 applications. In addition, it is necessary to further explore the use of aircraft derived data by controller support tools (notably for trajectory prediction in support of medium term conflict detection and arrival management).

ADS-B link technology assessment also continued in 2003, focusing on the optimisation of VDL-4 for use as a second link to complement Mode S Extended Squitter. The latter is expected to be the first ADS-B technology in operational use, but is anticipated that this may result in capacity limitations in core Europe from 2010. It was shown that a four channel VDL-4 configuration with appropriate modifications would be enough to complement Extended Squitter in core Europe. These modifications necessitate certain changes in VDL-4 standards, so appropriate change requests were submitted to the relevant standardisation bodies.

With regard to VDL-2 for datalink applications, the Aeronautical Communication Technologies Simulator (ACTS) in its VDL-2 version was completed in 2003. This includes dynamic air traffic, realistic message exchanges based on SITA and ARINC data, and a full set of tuneable system parameters. Intensive validation testing was conducted to reach a high level of confidence in the simulator, and it was used to show that Link2000+ implementation is technically viable in the short term with the deployment of the

first VDL-2 channel. Medium and long term deployment still needs to be explored. ACTS will be used to support full optimisation of VDL-2 and other implementation issues, and this will be discussed within ICAO and AEEC in 2004.

Interference between VHF systems onboard a VDL-2-equipped aircraft was studied using statistical analysis, lab testing and flight trials - simulations will be performed in 2004. Even if co-site interference is unavoidable, it has been verified that there is no impact on safety and quality of service to AM-DSB (voice) and Link2000+ applications, and that no operational restrictions are required to keep the impact of interference to an acceptable level.

The EEC VDL-2 test facility was used to validate Link2000+ requirements in support of certification. All objectives defined in 2003 were successfully met, and the first SAS Boeing 737 equipped with the Rockwell Collins ATN/VDL-2 avionics was certified on 18th December for Controller Pilot Data Link Communications (CPDLC) with Maastricht UAC.

EEC was a principal actor in preparation of the SAS certification. Work included the provision of a LINK 2000+ compliant CPDLC end-to-end test capability in support of both air and ground implementations (SAS together with Maastricht UAC). All Interoperability validation was done in the laboratory at Brétigny, with Rockwell Collins avionics connected to the stand-alone ARINC air-ground test station, offering ATN/VDL-2 in an environment as realistic as the operational one. Flight trials were conducted with the Rockwell Avionics installed in the NLR Citation experimental aircraft. In addition dedicated test and training sessions were performed with the SAS pilots, exercising CPDLC from their avionics testbed in Copenhagen.

During 2004 the Link2000+ test facility will be used to support the operational deployment of new pioneer airlines (e.g. Airbus Transport, Lufthansa, FedEx, Air Europa), pioneer ATC centres (e.g. DFS, AENA) and the integration of communications service provider SITA.

## AIRPORT THROUGHPUT (APT)

APT was established in 2003 as part of the EEC realignment and in response to the analysis provided in the Business Plan that airports are going to become the most constraining factor for European aviation.

To address these issues it has focused initially on Collaborative Decision Making (CDM) and Wake Vortex, CDM to provide data commonly usable by all actors at an airport and Wake Vortex to improve runway utilisation.

Additionally an important objective in 2003 has been to position the new RA within the Agency, the European Commission 6th Framework Programme, to establish good working contacts with other European Research Institutes and with airports that are ready to participate in research activities. To this end a work programme has been defined that is well co-ordinated with the EATMP Airport Throughput Programme, the EATMP Airport Domain and external Agency partners.

The overall strategy of the RA is to work along two main axes:

- Medium term - improve procedures and technical applications within the existing airport infrastructure;
- Long term - define a new airport paradigm, where the existing infrastructure not necessarily is sufficient.

In consequence projects have been grouped as follows:

- Airspace and Runway Throughput;
- Surface Movement;
- Collaborative Airport.

### Airspace and Runway Throughput

#### Wake Vortex

The Time Based Separations Project reported on runway capacity calculation under various wind conditions, indicating that 2 to 3 landings per hour can be recovered in 15 knots headwind. Controller

tools and initial hazard analysis together with a PC demonstrator have been delivered.

Having started in 2002, in 2003 it continued its investigation into more realistic time separations to be applied to aircraft on final approach, taking into account different aircraft weights and performances within the same ICAO categories. Results were published in "Time Based – A Way to proceed" Version 2.14 12/5/2003, supported by two other documents "Time Based Note 1 – Runway Capacity Calculation under no or calm wind conditions" Version 3 22/4/03 and "Time Based Note 2 – Runway Capacity Computation under a given wind scenario" Version 2 28/4/03.

In parallel, further investigations into the controller procedures and methods together with the necessary support tools required for implementing Time Based operations were carried out. This resulted in the report "Time Based – Report on Controllers Tools" Version 1.1 27/11/03.

Other preliminary activities preparing the way for later Fast Time Simulation phases included a report "Time Based – Usability of SIMMOD for the Time Based Project" 5/5/03 as well as the production of a PC based demonstrator based on eDEP/ASMT Replay Tool with a preceding report "Specifications for a PC Demonstrator" Version 2.1 8/12/03.

Finally, a preliminary study into potential hazards perceived to be linked to the introduction and operation of Time Based separations resulted in a report "Time Based – Report on Initial Hazard Assessment" Draft 0.1 19/12/03.

#### WakeNet 2 Europe

This project is a continuation of the former European Thematic Network WakeNet that started in April 1998 and ended in June 2002. It is a three-year funded EC 5th Framework Project aiming at promoting multidisciplinary contacts between specialists active in the field of wake turbulence and disseminating relevant information.

WakeNet 2 Europe also aims at enabling the development of a shared view on how to address the existing and foreseeable safety and capacity related problems caused by wake turbulence through Working Groups, Links and world-wide Workshops.

The objectives of the Working Groups are to assess state of the art and to make recommendations for future research. The Links objectives are to establish contact and promote co-operation between specific groups active in Wake Vortex research. Whereas the Workshops objectives are to present and discuss thematic research conducted by different partners in Europe and in North America.

EEC is leading Working Group 1 (assisted by NATS) and Link 1 (together with DFS).

### **Working Group 1**

The objective of this Working Group is to determine if incident reporting could be used to identify, discuss and validate methods that assess the Wake Vortex risk encounters in a real ATM environment and the potential risk of proposed changes in ATM procedures. The participants are NATS, Airbus, DFS, IFATCA, NLR and EUROCONTROL.

A kick off session was organised in October 2003 to establish working procedures between group members and national participation.

A first list of reference documents has been built.

### **Link 1**

The objective of Link1 is to establish active co-operation between USA, Canadian and European partners in the following domains:

- Active Wake Vortex predicting system;
- Operational procedures;
- Data collection specially in the Wake Characterisation and Incidents.

Regular contacts and narrow exchanges between WakeNet 2 EUR and WakeNet USA partners have been established following a Special meeting in Brétigny in June 2003, where the basis for co-operation was defined.

A special "In Ground Effect" workshop was proposed to establish current state of the art on "Wake Vortex behaviour in vicinity of ground" and to discuss between specialists required research to be further conducted.

A survey of the US acoustic data collection campaign conducted in Denver has been provided.

European activities in the Wake vortex domain were reported during Denver WakeNet USA October 2003 session.

Different activities conducted by EEC in the wake Vortex domain, such as Action Plan 14, Time based separation and ATC-Wake were presented during the London WakeNet 2 EUROPE workshop (Nov 2003).

### **ATC-Wake**

ATC-Wake is a EC (Information Society Technologies) 5th Framework Project.

The ATC-WAKE project intends to develop and build an operational platform enabling existing technologies (weather and wake sensors, wake predictors, safe separation predictors) towards operational usable and acceptable system for pilots and controllers.

EEC has managed the Work Package on Operational and system requirements. This work was achieved in August 2003.

The following deliverables were published:

- ATC-Wake Operational requirements (EEC note n° 12 - July 2003);
- ATC-Wake Operational Concept and procedures (EEC note n° 13 - July 2003);
- ATC-Wake Users requirements (EEC note n° 14 - July 2003);
- ATC-Wake System requirements (EEC note n° 15 - July 2003);
- ATC-Wake Final report on system requirements (EEC note n° 16 - August 2003).

EEC is leading on-going fast-time simulations started in September 2003.

#### **Action Plan 14**

The objectives of the Action Plan 14, signed in 2002 between FAA-NASA and EUROCONTROL, are to promote a mutual understanding of US and European views on the effects of Wake Vortex phenomena with particular regard to improving or at least maintaining current levels of safety while increasing capacity and to identify all existing operational issues (safety and capacity) associated with the application of Wake Vortex separation criteria and provide early mitigation where possible.

A Common USA/EUR Status Rapport on Wake vortex Activities was prepared and reported to R&D Com26 in Budapest on Action Plan 14 Activities.

A Specific Wake Vortex session was organised within the Airport track for communication to ATM Seminar of results on Wake Vortex research studies in Action Plan 14.

An increase of European/US Collaboration has been envisaged by identifying the Role of Europe within FAA/NASA ConOps (Operational Concept) team, defining the use of active prediction wake vortex advisory system (ATC-Wake/WakeVAS) and the required methodologies for Safety/Hazard Analysis.

Finally it was decided to define a common USA/EUROCONTROL Road map on the Wake Vortex operational or technical improvements.

#### **I-Wake**

I-Wake is a EC 5th Framework Project that started in May 2002.

The objectives of this project are to integrate and to use an on-board wake vortex detecting system.

#### **S-Wake**

S-Wake is an EC co-funded Project and coordinated by NLR.

The objectives were to develop and apply tools for assessing appropriate (safe) wake vortex separation distances.

In this project, EEC was responsible for review and participation workshops and final meeting (March 2003), and has delivered its work to the NLR and the European Commission.

The S-Wake research project showed encouraging progress in the knowledge of wake vortex characterisation, encounter models and safety assessment. Those improvements allow envisaging near-term operational implementation.

#### **Leonardo**

The main achievement in 2003 for the Leonardo project has been the development of the data display interface for both Charles de Gaulle and Madrid Barajas airports, which are the sites where shadow mode experiments will be conducted. The various links missing between the involved actors have been established and a limited validation was conducted. EUROCONTROL CFMU is participating in the project, but no real impact could be measured because the experiment is not linked to the real operations.

#### **Surface Movement**

##### **Validation of A-SMGCS**

The EEC has undertaken the validation of A-SMGCS level 1 and 2 procedures for the EATMP APT Programme. A-SMGCS level 1 and 2 are the basic levels where surveillance data is made available to the controller together with basic safety-net information such as Runway Incursion Warning. The bulk of the work has been outsourced to a consortium composed by Sofreavia, la Direction de la Navigation Aérienne and Aéroport de Paris. The work started in November 2003 and will last for 12 months. The validation will mainly be based on simulations, live trials will be conducted in a later phase.

#### **Collaborative Airport**

##### **Airport CDM**

The EEC Airport CDM team works closely with the EATMP APT CDM team and the CFMU. During 2003 the Airport CDM project continued

to study and develop CDM applications by working with five major European Airports. The level two documentation for the Airport CDM project, covering CFMU Flight update messages and variable taxi times, was delivered by the EEC and will be incorporated into the CDM Level One Operational Concept and Functional Requirements Documentation.



CDM Manual

Brussels Airport initial trials are ongoing based on the proposals developed earlier. The aim is to improve departure punctuality and gate management by improved management of pushback times.

Brussels Airport departure planning screen showing Target Off Block Times (in green)

A large CDM symposium was conducted in Barcelona to promote and discuss CDM issues and this helped to attract new airports to the project. London Heathrow, Athens and Lisbon started CDM studies towards the end of the year and these new studies will be of particular interest due to the congestion problems at Heathrow and the two major events scheduled for the summer 2004, the Olympic Games in Greece and the European Football competition in Portugal.

Other key Airports such as Amsterdam, Paris and Munich have also been discussing CDM with EUROCONTROL and a close co-operation is foreseen in 2004. A Cost Benefit Analysis (CBA) study has been commissioned and will, together with the CDM promotional film and Implementation Manual which were also prepared by the EUROCONTROL team, play an important part in the introduction of CDM at all major airports in the ECAC area.

Proposals for changes required to reach CDM level 1 in Stockholm Arlanda, Helsinki Vantaa and Milano Malpensa Airports were delivered in 2003, and are now available as EEC Notes. The 3 airports are now considering how to implement the proposed changes.

A co-operation with the University of Aachen has started with the aim to map airport landside processes and establish the state-of-the-art with regard to ongoing research within the domain. The first results are expected to be delivered during the spring of 2004.

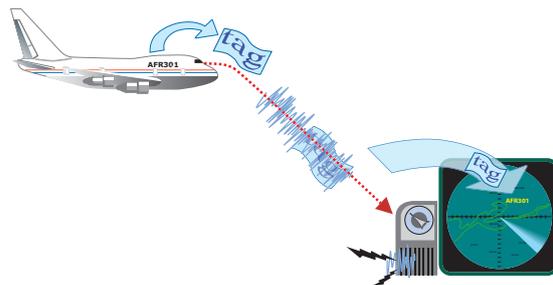
## INNOVATIVE RESEARCH (INO)

Fully in line with the Business Plan objectives, 2003 has seen great progress in strengthening innovative research providing many encouraging and fruitful results:

### Advanced Concept Development

Exploration of a new control paradigm based on large volume of airspace, linked to ACARE proposals, has focused on the shift of controller working practices, in an adapted airspace. Simulation has shown subsequent gains in capacity while reducing the conflict solving

work load, confirming the initial hypothesis that larger volumes of airspace offer the possibility for more organised responses to unpredictable events in traffic planning. A follow-up project will concentrate on the synchronisation of traffic, from flow planning to tactical control and on dual-mode of operations: large-volume (Super-Sector) and city-pair tube-control (Sector-Less). Five papers have been published at international conferences on this topic (from INO-01 to INO-05).



*Principle of Watermarking Aircraft Identity into Air-to-Ground VHF communications*

## Advanced Technology Investigation

### Aircraft Identification Tag (AIT)

A study into the adaptation of digital watermarking techniques for pilot-controller VHF (Very High Frequency) voice communication has provided remarkable results that could open the door to significant short-term applications. Baptised Aircraft Identification Tag (AIT) the study demonstrated that aircraft identification, e.g. call-sign, can be automatically added as a digital signature to a voice air/ground communication without any modification to the existing equipments. In consequence the aircraft call-sign can be automatically detected through VHF communications thus enhancing security protection with a very promising low Message Error Rates.

As collaboration with the University of Technology of Graz this study investigates the use of digital watermarks, which are widely used in mass market applications to protect intellectual property rights of the creator of music, pictures and movies, for the ATC VHF (Very High Frequency) voice communication environment.

The AIT watermark is the automatically added digital signature to a voice air/ground communication as shown in the figure. As this digital signature (watermark) is implemented at the voice frequency level only no modification of the existing ATC transport layer equipment (transmitter - receiver, aircraft - ground) is required. The watermark is not noticeable in the voice transmitted over VHF and is available in real-time with the transmitted speech. It is expected that the digital signature of AIT would bring high benefits for ATM's safety and security. At the ATC-centre this digital signature, available in time with the still ongoing pilots speech, could be used to focus controllers attention through a supplementary visual stimulus (i.e. track high lighting), to the associated speaking track on the Radar display. This would increase controllers' situation awareness and decrease the potential supplementary workload caused by call sign understanding problems. ATM security aspect will be addressed as AIT's signature creates a barrier for fake voice communications of jokers or terrorists.

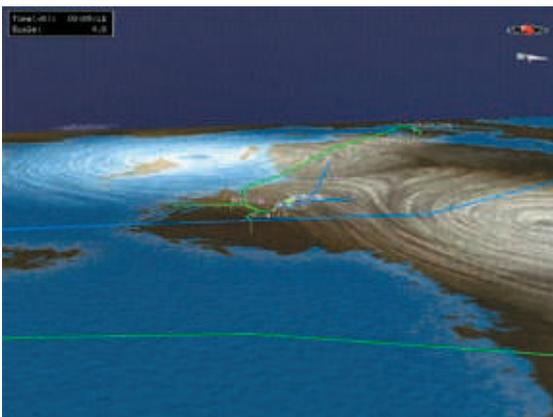
Experimental results showed very promising low Message Error Rates (MER) in function of the Signal Watermark Ratio (SWR) up to  $10^{-4}$ . The university predict further significant high improve of transmission speed and the decrease of the message error rate through special applied research. A demonstrator based on a standard Digital Signal Processor, confirmed the high robustness for real VHF transmissions and for simulated channel degradations by additional noise, tone and fading. Further results are discussed in (INO-23).

## Visualisation and Interaction Technologies

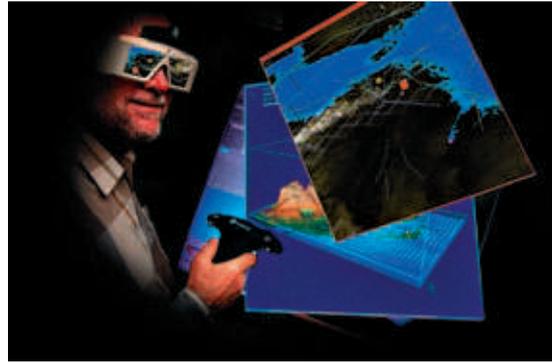
Also showing great potential is the study on the applicability of Stereoscopic 3D visualisation and multi-media interaction techniques for future controller working positions. The human-in-the-loop experiment assessing comparative accuracy and time performance in 2D and 3D stereoscopic environments has shown that controllers perform quicker with 3D stereoscopic displays, without any detriment to accuracy. This positive result reinforces initial expectations and has orientated the study towards pilot-testing of an application for airport tower control.

Exploratory work has been developed in collaboration with the University of Linköping at Noorkopings, Sweden. The early demonstration platform was used to acquire controller's comments for improvements. The platform, developed in 2002, and the requirements collected from it established the baselines for improvements developed in 2003.

Representation and display of weather information such as 3D airflow with different techniques such as iso-lines, vector glyphs with non-linear scaling, particle advection, and line integral convolution (see figure below).



*Line integral convolution across a plane through the 3D data showing air movement. Areas move intensely white mark regions where the air movement is most strong*

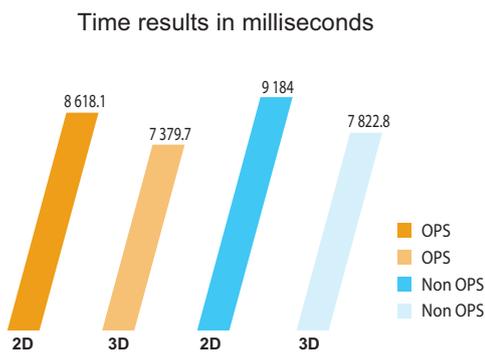


*Stereoscopic 3D visualisation*

Other developments in 2003 included the integration of voice-control into controller's interaction with the display environment, and the representation of conflicts.

Demonstrated to meteorologists and airport staff in Sweden, the enhanced platform was used to solicit a number of new possibilities and suggestions for future development working with both current recorded data, such as precipitation radar information provided particularly in the regions close to airports and vital for the location of storms and other hazards, and with 4D (3D data evolving across time) predicted data for flight planning. These elements are the focus for the 2004 work plan.

The experimental work has been developed at the EEC by means of three PhD theses contributing 8 papers at international conferences (INO-24 to INO-31) of which one Best Paper Award (INO-24). Empirical assessment of an altitude judgment-related task (identification of critical altitude within air traffic scenes) with 14 former operational controllers was performed. The study was comparative, assessing accuracy and time performance across 3D stereoscopic and 2D displays. After the test, every controller was asked to fill in a questionnaire, which was used for the analysis. The results of the tests revealed that controllers performed quicker using the 3D displays, without any detriment to the accuracy, since no significant difference was found in terms of correct responses with the two types of displays.



Results of the experimentation on performance and accuracy of controllers in 2D and 3D Stereoscopic environment

Another study entailed the usability assessment of an interaction metaphor to be used with the 3D stereoscopic display. Since traditional 2D interaction techniques are obsolete for the 3D stereo technology, new ways of interacting with the 3D interface are required. The PhD student in charge of studying new interaction techniques created two new interaction metaphors. For one of them, a usability study was conducted in order to discover possible flaws and benefits. The method of the Cognitive Walkthroughs was deployed. The results of the assessment revealed few problems; some solutions were also proposed to improve the technique analyzed (INO-30).

### Analytical Studies and Analysis of ATM Fundamentals

The major cause for delay in air transport is assumed to come from operational effects of uncertainty associated with Air Traffic Planning. These effects are propagated downstream through the network of adjacent sectors and control centres and have a consequent impact on controller tasks. Analytical Studies are aimed at analysing the different uncertainty drivers from a scientific perspective to provide a portfolio of new scientific knowledge. This knowledge can offer an insight to enable better understanding of the difference between prediction and reality, and thus better control of the delay. In 2003, seven PhD theses and three university studies contributed to this axis with 18 articles to major international

conferences or professional journals (INO-06 to INO-14, INO-19 to INO-22, INO-32 to INO-36).

Among these contributions:

- Rudi Ehrmantraut received the Best Paper Award for the ATM Track at the 22nd Digital Avionics Systems Conference, Indianapolis, 2003 on the topic of Full-Automation In High-Complexity Airspaces (INO-19). The approach is to investigate new concepts of strategic in-flight traffic organisation that would complement the automated conflict management function.
- Antonia Cokasova received the Best Communication Award at the prestigious US/Europe ATM Research & Development Seminar in Budapest, June 2003 on the Air-Rail Multimodal Transport from the Passengers Perspective (INO-32).
- Peter Choroba received the Best Paper Award at the TRANSCOM conference (INO-12).

### Other Issues

In addition to these encouraging results, valuable progress has been made in the definition and control of procedures for the selection of students and studies. The Annual Innovative Research Workshop was attended by more than 50 scientists coming from over 14 member states and all have shown strong interest and appreciation of our research activities. The Innovative Research Advisory Board congratulated the investigation on Aircraft Identification Tag and recommended several improvements to the concept development and analytical modelling work.

In 2003, four new PhD theses, one university study and two new partnerships with national research establishments were initiated. Thirty-six papers were published in international conferences and journals.

## SOCIETY, ENVIRONMENT AND ECONOMY (SEE)

Formed at the start of 2003, work is organised around four main threads:

- Noise nuisance around airports;
- Fuel burn and emissions;
- Air quality issues around airports;
- Sustainable aviation.

### Noise nuisance around airports

Though being rapidly caught-up by local air-quality, aircraft noise is still the largest source of aviation-related complaint among people living close to airports.

Aircraft noise research was reorganised into two umbrella projects: RIANNA and MONICA.

#### RIANNA - Research Into Aircraft Noise Nuisance Assessment

This covers all SEE's work on aircraft noise modelling and work in 2003.

Significant improvements have been introduced into the European Harmonised Aircraft Noise Contour Modelling Environment (ENHANCE) due to the requirements of the Sourdine II project. These have included, most importantly, the ability of the tool to use the new version of INM (v7) enabling aircraft configuration to be taken into account during approach and landing. This is vitally important for Sourdine II since it enables much more accurate modelling and therefore better pinpointing of differences in the impact of new procedures.

SEE has played a major role in the ECAC AirmoD working group responsible for rewriting ECAC Doc. 29 – the guidelines for aircraft noise modelling in Europe, now the "Interim Aircraft Noise Model" for the EC Common Noise Policy. Our role has been especially prominent in the design of the noise and performance database that will accompany the new version of this document. To this end we have produced a web site that will

enable registered users access to this data, once the database has been populated;

The "Interim" model will be used for community-wide noise studies in 2007. In 2012, a new model will be used – Harmonoise. So far this model only deals with road and rail noise. During 2003 SEE participated in the preparation of a successful bid and contract with the EC for extending this model to the fields of industrial and aircraft noise. This project – called Imagine – officially started on 1st December 2003 and will kick-off in January 2004.

#### MONICA – Mitigation Of the Noise Impact of Civil Aviation

Complementary to RIANNA, MONICA covers SEE's work on reducing aircraft noise impact. In 2003 notable progress in this work has seen SEE performing fast-time simulations of Paris CDG airport. These simulation campaigns – calibration, baseline and future scenarios – are designed to show the benefits of new noise abatement procedures proposed by the Sourdine II project in terms of capacity and safety. It is intended that the output trajectories will be used for noise and emission analyses. New versions of the TAAM simulator suggest that this will be possible.

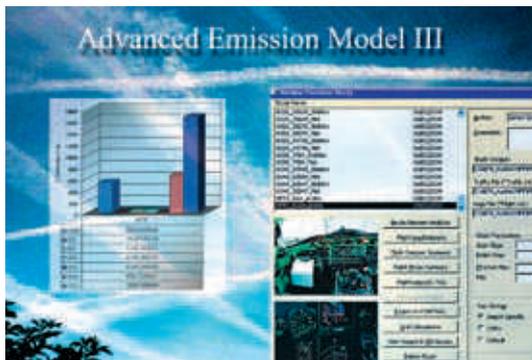
SEE has also contributed to the EC X2-Noise thematic network, co-ordinating efforts at reducing aircraft external noise, throughout 2003, notably at workshops and seminars in Central and Eastern Europe – Krakow, Kyiv and Prague – which will lead to a revision of the ACARE Strategic Research Agenda on Aircraft Noise.

### Fuel burn and emissions

Recent research indicates that the effect of cirrus cloud forming from aircraft contrails could be having a significant effect on global warming and climate change. In this context we started late in 2003 a project called CONTRAILS in cooperation with the European Space Agency (ESA) to identify the relationship between changes in cirrus and air traffic density.

### **Advanced Emission Model and Toolset for Emissions analysis**

The Advanced Emission Model (AEM) reached a stage of maturity in 2003, with the focus being on validating the model with airline operational data (from aircraft Flight Data Recorder). Following initial difficulties with this work, due to the sensitivity and availability of airline data, a number of cooperative airlines have now provided data and an initial validation report is planned for early 2004.



*Toolset for Emissions Analysis*

Integrating AEM into a toolset for emissions analysis (TEA) was part of the development plan in 2003. One of these tools was a meteorological database server for providing forecast and analysis data. This server is a "state of the art" system, based upon the MM5 (Mesoscale Model version 5) model developed by the National Centre for Atmospheric Research (NCAR) and Pennsylvania State University. MET SERVER will provide the surface and upper air meteorological data needed (pressure, geopotential height, temperature, horizontal and vertical winds speed and humidity) for local and global emission studies and contrail estimations.

The third part of this toolset determines the probability and extent of contrail formation from aircraft as a function of aircraft emissions and the atmospheric meteorological conditions.

A new project called CONTRAILS in collaboration with the European Space Agency (ESA) started towards the end of 2003. Contrails will be mapped intensively for one year (2004) using several

satellite sensors to capture diurnal variation. Cirrus cloud coverage and properties will also be mapped to help establish the relationship between changes in cirrus and air traffic density. An independent assessment of the EUROCONTROL contrail formation model will be made by comparing model based contrail maps with the satellite derived contrail maps.

### **AERO2K**

AERO2K is a European Commission project, where EUROCONTROL and a consortium of partners are tasked to supply policy makers and scientists, working on global climate change, with a new improved set of world aviation emissions data. We produced a comprehensive global civil aircraft movement inventory for the reference year 2002 and delivered this to the consortium partners in July 2003. The final project emission inventory is planned to be available mid 2004.

### **Emission Studies**

A study, using data from the Italian real-time simulation experiments for the Mediterranean Free Flight (MFF) Programme, performed with AEM3 identified potential savings of about 1 - 1.2 % for fuel burn and directly proportional emissions. Indication suggests NO<sub>x</sub> emissions could be reduced by up to 1%. A further study is planned in 2004.

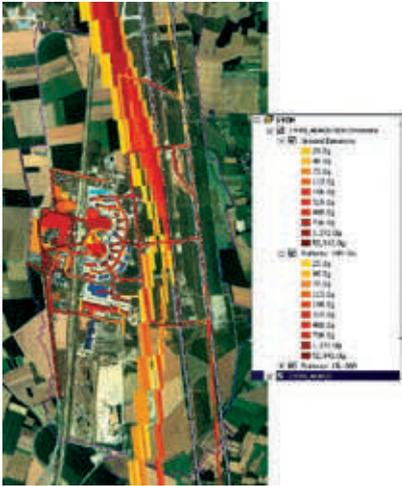
### **Air Quality Issues**

Airport local air quality issues are becoming more and more important. Airport operators will be pressed to provide emissions inventories based on actual and predicted traffic that show what type, where and when the emissions occur. The inventories include a wide variety of sources of combustion emissions.

The EEC Airport Local Air Quality Studies (ALAQS) project, started in 2002 in partnership with environmental specialists from Lyon St Exupéry and Zurich airports, focused on two main threads:

- establishing a thorough airport emissions inventory database with validation studies based on Lyon St Exupéry airport;

- development of a Geographical Information System (GIS) tool to visualize the three dimensional distribution of the emissions around an airport – the ALAQS-AV tool.



ALAQS screen shot

This resulted in:

- acquisition of the English version of the emissions and dispersion model LASPORT and evaluation of its features;
- two detailed studies on emission calculation methodologies for GSE (Ground Support Equipment) and roadways, (June and August 2003);
- development of the Arc-GIS based ALAQS-AV emission inventory tool;
- pilot study for an emission inventory for Lyon Saint-Exupéry airport;
- comprehensive ALAQS Concept Document describing the local air quality methodologies and tools.

### Sustainable Aviation

In a two phase study into the concept of sustainable development in Air Transport, the notion of “sustainability” has been explored.

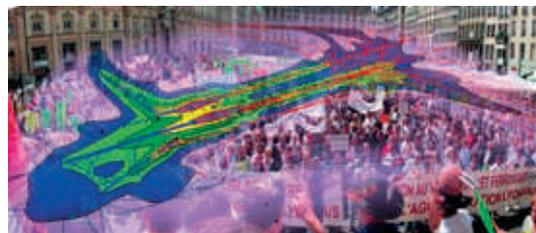
Phase 1 of the study reports on how the three fundamental pillars of Sustainability - namely, Society, Environment and Economics - are interpreted by a range of key actors, including international and inter-governmental

organisations, airlines, Air Navigation Service Providers, the ATM Industry, aircraft and engine manufacturers. Whilst recognising that air transport is a driver for economic and social development, the weight given to each of the three pillars by the different actors largely reflects the “political” message that they wish to disseminate.

The second and more challenging phase of the study scheduled for 2004, will try to identify a set of pricing options and/or regulatory mechanisms consistent with the various interpretations of sustainability.

### Attitudes to Aircraft Annoyance around Airports (5A)

Airports offer local and national benefits but communities living in their vicinity are subjected to airport related annoyance (noise, air and water pollution). Air traffic continues to grow and 60% of European airports are already limited by their “environmental capacity” caused by aircraft noise disturbance.



Started in June 2002, 5A considers how different factors (socio-economic, cultural, age, status, education and situation) modify the way in which a given level of noise translates into a level of reported annoyance around the three study airports: Manchester, Lyon, Bucharest.

Quality of life issues were identified by focus groups in 2002 during the first, qualitative, phase of this project. The second, quantitative, phase consisted of the design of a questionnaire integrating focus groups finding into an attitude survey. Two hundred people were surveyed around each of the three study airports. The different factors relative to the quality of life and aircraft noise annoyance were treated both in the

attitudinal section and, in the "Stated Preference" (SP) section, in the form of a definition of an order of preference of values for these factors (ref: SEE/2003/002). The attitudinal responses indicated a reasonably high degree of consensus across the three countries. Any differences could be explained in terms of variations in socio-economic conditions, individual perception and/or the characteristics of the airport.

Aircraft noise is not highly ranked in terms of importance in the quality of life questions, but it is ranked higher when looking at aspects which respondents are more dissatisfied with. Noise from aircraft is most likely to interfere with activities in Manchester and Lyon, while road traffic noise is most problematic in Bucharest. Perceptions of the annoyance caused by different types of aircraft are similar across countries.

Respondents are aware of the benefits of living near an airport, particularly for travel in Manchester and jobs in Bucharest. Respondents in Lyon were most likely to have complained about aircraft noise. Very few people complained in Bucharest.

This pilot study has involved an original application of SP methodology allowing a monetary value to be assigned to aircraft noise annoyance. The ability to obtain plausible variations in values according to income level is encouraging. As an example, the values for a change of one aircraft per hour during the daytime are 1.10 EUR per week in Lyon, 0.87 EUR per week in Manchester and 0.58 EUR per week in Bucharest.

The next step in 2004 is to substitute the number of aircraft movements in the SP with modelled noise data and to compare modelled noise and perceived noise where the respondents live.

### **Flight efficiency and its impact on environment**

Direct flight between departure and destination airports has the potential for significant savings in fuel, through shorter distances and optimum flight profiles, with the consequent environmental benefits.

In 2003 the EEC's ENV-KPI project, in conjunction with the Performance Review Unit (PRU) and the EUROCONTROL Environment Domain, continued its work on flight efficiency and environmental performance indicators measuring the effectiveness of the ATM system in terms of distance, time, fuel and economic impact of the en-route flight phases. The study (cf. EEC/ENV/2003/001) indicates benefits in the order of 8.9% less distance flown and 9.6% less fuel burnt.

Internal costs of flight efficiency are defined as the amount of direct airline operating costs that could be avoided under the hypothesis of direct trajectories. External costs of flight efficiency are estimated to be the cost reduction of climate change impacts that could be obtained with direct trajectories. The preliminary results - based on initial hypotheses - indicate that the potential savings that could be achieved if optimum profiles were feasible, compared with actual flight profiles reach 1,764 million EUR for airlines' "internal costs", and 327 million EUR for environmental "external" costs, which in total represent respectively 113% and 43 % of the annual European air traffic management delay and capacity costs.

This work will continue in 2004 with the main axes focusing on:

- better understanding of the factors affecting flight efficiency during the different phases of flight;
- the factors that influence the trade-offs often necessary between choice of the most direct route and route actually flown. These factors are related to safety, airspace utilisation, noise constraints at airports, airline economics and aircraft performance.

The outcome of this work will provide indicators quantifying the environmental and economic efficiency of the ATM system for given aircraft types (number of seats) and airport pairs.

### **SOPHOS (ESAO)**

The ESAO (Environmentally Sustainable Airport Operations) project continued the development and implementation of the SOPHOS web based expert system. SOPHOS will provide Airport Managers, ATS Providers and Airspace Users with

support, guidance and practical tools to manage Airport Environmental Capacity.

Even with effective management, environmental impact around airports will generally increase with time. Thus, unless airport operators manage the environmental capacity effectively, these issues will become an increasingly significant constraint on European airport development and operation. Indeed, it is emerging that some major airports in Europe could reach their environmental capacity before they reach their operational capacity.

ESAO will assist ECAC ATM airport stakeholders to manage collaboratively environmental issues at airports. In particular it should ensure that stakeholders can work together to:

- Support airport growth;
- Avoid or minimise constraints;
- Maximise throughput within regulations;
- Proportionately reduce environmental impact/costs.

In meeting these objectives ESAO will also:

- Provide the opportunity for harmonisation;
- Enable economies of scale;
- Reduce time-scales and improve ultimate effectiveness;
- Reduce the risk of implementing poor environmental practices.

Work in 2003 has focused on ensuring that the advice and information provided via SOPHOS is relevant, easily understood and helpful. In the first version, ESAO is limited to environmental impacts on airport ATM capacity so SOPHOS work focused on initial functionalities such as Recommended Practice, Economics, Environmental Performance Indicators (EPIs), Collaborative Environmental Management (CEM) functionalities, all related to noise issues.

### **Sociological study into Organisational Transparency**

This study, in support of a PhD thesis, explores the ATM safety efforts undertaken to implement the European Safety Regulatory Requirements by looking at the societal origins and the constituents of the increasing demand for transparency. This second year PhD looked at the notion of risk in our societies, its social construct and the ways

it is communicated. It considers the relationship between transparency and confidence in high risk industries. It also analysed the tension between “objectivity” and “expertise” in codifying risks in different industries. Fieldwork undertaken with several ANSPs has shown how a demand for more transparency may lead to an exploitation process where existing practices and organisational learning are debated and questioned.

### **Public Perception of ATM Survey**

Two small studies have explored:

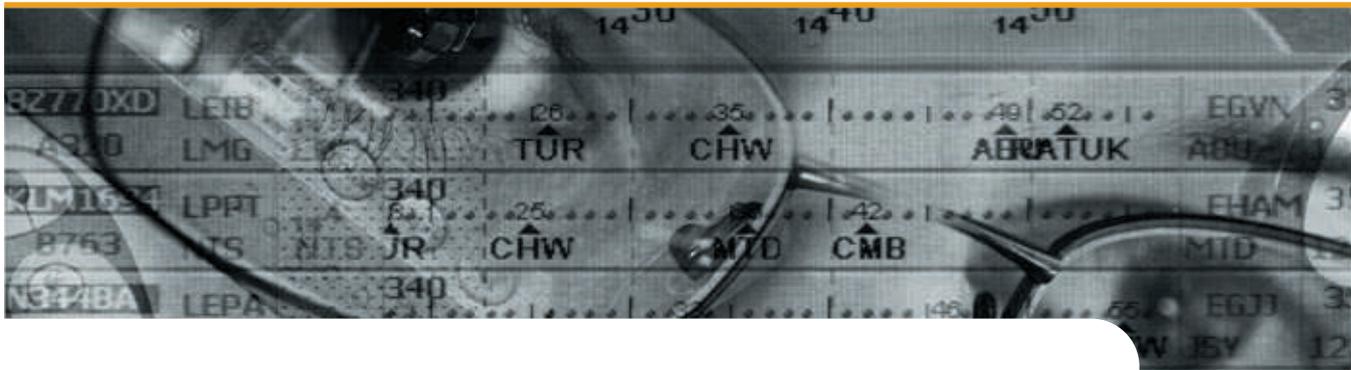
- the findings of existing ATM surveys;
- how the European press has reported on ATM in the past two years.

The results show that very few ATM specific surveys have been performed in the past, and that there is a very marginal understanding by the public of Air Traffic Management and the Controller’s job.

The press review analysed 7 media from 4 countries in 2001-2003. The quantitative analysis showed that ATM is treated as part of the air transport sector rather than as a standalone subject. Its more frequently mentioned aspects, safety and airport nuisances, appear on an ad-hoc basis only. Strikes and institutional/economic aspects related to ATM are mentioned in wider contexts, such as public service matters or European infrastructures.

The qualitative analysis highlighted that there is no common European press view; instead the view given by the press on ATM is fragmented and very much nationally tinted – foreign ATM is never mentioned for example. A certain level of transparency on the ATM job seems to favour a positive approach to ATM as well as sound appreciation of responsibilities, whereas destructive judgments come when the transparency seems to be imposed from outside – by justice for example.

Finally, pollution related issues arise in the UK from the taxation perspective, whereas noise in the press often leads to (local) political arguments which in turn seem to amplify the noise perception.



# KEY METHODOLOGIES

To support the Research the EEC has developed key methodologies (Safety, Validation) and technical infrastructure (ATC simulation and experimentation platform, Human Factor Laboratory).

## Safety

In the wake of the tragic mid-air collision over Lake Constance, the High-Level European Action Group on ATM Safety (AGAS) identified a need for targeted R&D to improve safety in European ATM.



In 2003 safety management changed from a Business Area to a team-based activity intended to act transversally across EEC projects and

Research Areas. A main objective of this change was to include safety explicitly in all mainstream activities of the EEC, and to raise the safety culture generally across activities and projects.

Some of the key results we have achieved in 2003 are:

- The ACAS Monitoring Cell detected a series of incidents relating to the new terminology in TCAS Version 7 which had led to pilot confusion and unsafe action in a number of cases. An explanation of the problem and a warning advisory note was sent out.
- The EEC-developed Automatic Safety Monitoring Tool (ASMT) was requested by the DFS and ENAV and is being delivered. ASMT has now reached the end of its R&D phase and in 2004 an ASMT implementation in Europe will be led by EUROCONTROL HQ. (ASMT is already used by NATS, Bratislava, and Maastricht).
- The Safety Research Team developed a means of using the Target Level of Safety (TLS) in safety cases, a key requirement for ATM industry risk assessment.
- A safety focus has been integrated in six projects in NCD, SSP and APT. In 2004 this will be increased to twelve projects and include an overall risk picture for SSP's proposed future operational concept. For NCD, collaboration on investigating complexity and safety for the Maastricht centre and for APT, safety activities

related to continuous approach and ground monitoring systems (ASMGCS).

- In an endeavour to improve the safety culture of the EEC, a safety culture survey revealed a reasonable level of safety understanding but plenty of scope for improvement. Subsequently a Strategic Safety Research Plan has described how safety should better fit in EEC's activities. A second safety culture survey will be carried out in 2004, and the implementation plan for a Safety Management System (SMS) for the EEC will commence this year.

EEC expertise participated also in the final Operational Concept Validation Strategy Document ver.1.3 available on the above web site.

### Validation

The validation development work concentrated on two principle areas of activity targeted at improving the quality and consistency of EEC Validation activities. They are:

- Gate-to-Gate (G2G) (5th Framework programme) validation methodology development,
- Action Plan 5 (Joint FAA/EUROCONTROL) Operational Concept Validation activities

A "Validation Methodology" was reviewed by G2G partners and accepted by European Commission in May 2003.

G2G developments resulted in a draft EUROCONTROL Concept Validation Methodology.

The plan for 2004 is to make available a European Concept Validation Methodology that all projects sponsored by EUROCONTROL or the European Commission will be expected to apply.

The Action Plan 5 activity aims to improve communications within Europe and between Europe and US organisations involved in the evaluation of ATM Concepts. A joint workshop on Validation Scenarios took place in Rome during March 2003. The output of this workshop was a best practise paper on scenarios for real and fast time simulations available on Internet at <http://www.eurocontrol.int/faa-euro/start.html>.





# TECHNICAL INFRASTRUCTURE

## Human Factors Laboratory (HFL)

The importance of Human Factors is recognised in the EEC Business Plan and has led to the establishment of a Human Factors Laboratory, completed in 2003. It facilitates human factors experimentation at an early stage in the development of new systems and tools. It also offers a prototyping platform and a variety of human factors equipment, such as eye movement tracking and psycho-physiological measurement devices. Projects that used the HF Lab in 2003 include:

- The SuperSector project;
- RA Downlink;
- The Conflict Resolution Assistant (CORA) project;
- CARE Uncertainty.

As a complement to the lab and in cooperation with the HUM domain, Human Factors training was given to EUROCONTROL personnel.

## EATMP Reference Industry-based ATM Simulation and Trials Platform (ERIS)

The ERIS Programme provides simulation and trials platforms to support the validation activities of the European Air Traffic Management Plan (EATMP) and the European Commission. ERIS is an important enabler for the EATMP Validation

Programmes and a link between these and the EC's Applied Research Programmes. ERIS also addresses the need for open systems architecture with which to validate future ATM concepts and to progress from the definition and design phases to implementation.

A major target for ERIS in 2003 was to replace the ESCAPE real-time ATM simulator platform with ACE (Avenue-compliant ESCAPE). Avenue is the EC-sponsored standard for a flexible and open ATM platform for experimentation and validation. The software re-engineering took up the major part of ERIS effort over the whole year and reached a successful conclusion. As a result the EEC is in a position to support fully the validation activities of the EC Single European Sky initiative.

In parallel with this significant investment ERIS has adapted the simulator to support ten experimental simulations for EEC research projects. Three special versions of ESCAPE were delivered for this purpose. New features include an Arrival Manager supplied by Barco-Orthogon and enhancements were made to Airborne Separation Assurance features (ASAS), Datalink and Medium-term Conflict Detection (MTCD).

In October as part of the Project "Aircraft in the Future ATM System", the Airbus Iron Bird test bed in Toulouse was linked using "pre-operational"

equipment with the ESCAPE Simulator in Brétigny for validation of Datalink. In November a live trial of MTCD was run at UAC Maastricht. It was considered by its participants as the most successful trial to date, with optimistic assessments of MTCD's contribution to accommodating increase in sector traffic.

### **ESCAPE**

ESCAPE is the reference platform for the EUROCONTROL Air Traffic Management Programme. A major target for ERIS in 2003 was to replace the ESCAPE real-time ATM simulator platform with ACE (Avenue-compliant ESCAPE).

ESCAPE has been adapted to support new features including an industry supplied Arrival Manager and enhancements to Airborne Separation Assurance features (ASAS), Datalink and Medium-term Conflict Detection (MTCD).

### **Multi-Cockpit Simulator**

The Multi aircraft Cockpit Simulator (MCS) is a sophisticated Pilot Position developed for the EEC. It allows professional pilots to participate realistically in a simulated ATC scenario.

MCS is used to satisfy 3 distinct needs:

- Participation of "high fidelity simulated" aircraft in real-time air traffic simulations:
  - the effects of real-life pilot inputs and reactions can be included in an experiment;
  - pilots may form an opinion on aspects of the simulation via first-hand experience.
- Investigation of new ATC concepts such as trajectory negotiation via air-ground datalink and the free flight concept;
- Investigation of new airborne philosophies and equipment such as ASAS or airborne HMI.

During 2003 MCS was used in two important experiments:

- The Mediterranean Free-Flight (MFF) project's "Air weeks" in February was a distributed simulation with 3 cockpit simulators (MCS in Brétigny, RFS in Amsterdam, ACS in Rome) connected to an ESCAPE platform running at ENAV in Rome.
- The AVT (ADS-B Validation and Trials platform) project was set up with ESCAPE and MCS to

conduct live trials in Arlanda, Sweden. MCS connects directly to ARTAS and its data merges with the live data presented to the controllers.

2004 will see further involvement in live trials by adding the possibility to receive live TIS-B data in the MCS, and to display the data on a CDTI (Cockpit Display of Traffic Information). Integration of an industrial CDTI system is envisaged. The MCS platforms will migrate from Windows-NT to Windows-XP, development on datalink implementation will be continued, and for ASAS a connection to the auto-pilot state machine is in preparation.

### **eDEP (EUROCONTROL Early Demonstration and Evaluation Platform)**

eDEP is a low-cost, lightweight, web-enabled ATM simulator platform, offering an ideal environment for research and advanced concept projects to rapidly prototype applications. The platform is written in Java, enabling it to be run across the web on various hardware platforms (Windows, Linux, Unix). For simple demonstration purposes, eDEP may be run on a single PC, or may equally be distributed across a network for the needs of small-scale simulation. More information is available at [www.eurocontrol.fr/projects/edep](http://www.eurocontrol.fr/projects/edep).

In 2003 eDEP was used by the following projects:

- EVP (European Validation Platform): development of an advanced AMAN demonstrator (approach and en-route), prototyping several delay sharing algorithms, with feedback from Irish, Swedish and Italian controllers;
- TCAS RA Human factors experiment: the experiment, involving 30 controllers over two weeks, involved superimposing real TCAS incidents, and pre-recorded pilot/controller RT, over simulated traffic scenarios. The TCAS RA demonstrator will be present at ATC Maastricht 2004;
- CORA2: a two week mini-experiment revisiting the CORA1 operational concept of "prepared clearance", which involves the Planner controller preparing, in advance, solutions (i.e. clearances) for his/her tactical controller;
- EMAN: prototype of an en-route traffic sequencing and management tool;

- Super Sector: evaluation of the concept of large controller teams collaboratively managing “super sectors”;
- CARE: human factors experiment evaluating the use of trajectory and conflict uncertainty information.

### Simulation Facility Management (SFM)

During the course of the year 2003, a significant number of real-time simulations and experiments have been performed at the EEC:

- R&D experiments within the context of projects such as AMAN, CoSpace, AFAS and DOVE 2 which have been running on the medium and small scale real-time simulation facilities of the EEC;
- 6STATES, PSDF and LNK2000+ which used the large scale simulation facility;
- GENSPACE real time simulation which is a generic facility used specifically for the training of EEC staff on ATC issues.

On top of that live trials and real-time simulations have been performed on external sites:

- MTCD and AVT live trials respectively at Rome (Italy) and Arlanda (Sweden);
- MFF real-time simulation at Rome (Italy).

In parallel to the yearly simulation activity, the technical validation and deployment of the next generation of the real time simulation facility (ACE) has started in 2003 and the use of this new facility is planned for 2004 at the EEC premises.

In addition to the simulation and validation projects internal to the EEC, support to operation of the real-time simulator has been provided in 2003 for external users such as IANS, MUAC, CRDS, ENAV and SICTA. In this context a Service Level Agreement has been signed between the EEC, IANS, MUAC and CRDS which formalizes the support and maintenance activities to be provided to external ESCAPE users.

Due to the number of platforms currently deployed, two different User Groups have been created and have met regularly in 2003:

- The AudioLan User group composed of ENAC, ENAV, IANS, MUAC, EEC and CRDS which is looking for a common industrial solution for support and maintenance on the AudioLan product. The issuance of a common Call For Tender has been performed at the beginning of 2003 and an industrial partner has been selected.
- The ESCAPE User group composed of ENAC, ENAV, SICTA, IANS, MUAC, EEC and CRDS which is discussing issues related to the general support, maintenance and evolution of the real-time simulation facility.

Finally, a specific activity has been launched end of 2003 in order to investigate the harmonization of model-based simulation tools and to define a common strategy for the associated development and support.

### Software Engineering Unit (SEU)

Software production is an important part of the EEC activities. Located in Development And Integration CoE, the Software Engineering Unit (SEU) aims at:

- Improving the productivity of software projects;
- Selecting and adapting existing international standards to the development of a software engineering methodology;
- Providing effective assistance in implementing software development best practices;
- Evaluating, introducing and supporting software engineering tools and environments.

Methods, techniques and tools are already well introduced at the EEC. They are tailored to an experimental environment where quality and frequent changes must be finely balanced.

*The continuity of the usual support...*

On request from the projects, SEU has continued to provide expertise and services covering key activities in software development.

### **Change Management and Configuration Management**

CM-Synergy, ARS-Remedy, critical tools for the management of software engineering in the Centre, were consistently supported. Without them software engineering would be chaotic.

### **Methodology**

Support to the model centric approach -- where all information of a project, from requirements to test cases are captured in a model using UML (Unified Modelling Language) – continued inside the Centre and was also provided to some HQ projects like OATA and FDM. As a consequence the associated tools (dubbed Ntools) that extract information of a model to create various types of documents were enhanced to adapt them to new users' needs.

### **Software practices, Testing and Validation**

In 2003 an assessment of our development practices was undertaken, based on the CMM (Capability Maturity Model) criteria. Its purpose was to identify areas of improvement and to address them. One of its first outcomes was that our test management practices could be more efficient, and that the effective use of a tool would be beneficial. As a result the decision has been taken to redefine our testing processes and to use Test Director to manage them. The deployment of this tool started at the end of the year.

### **Software Project management and Quality**

Support in the domain of Software Quality and Software project management was consistently provided during 2003. One tangible aspect of the provided support is the production of documents, like SQAs (Software Quality Assurance plans), PMPs or SMPs (Project/Service Management Plans) that are key helpers to achieve better project management, and thus improve project results.

*A new task ...*

In 2003, the Software Engineering Unit was tasked to promote and support the outsourcing of EEC projects. Outsourcing projects to Industry

is a key issue that has been highlighted in the EEC Business Plan. It is stated that an increasing number of EEC projects must be outsourced. The general level of knowledge and experience in this domain is low. Most EEC Project Managers have currently no significant experience into how to outsource projects.

The SEU activities consisted in developing a general methodology describing the way to proceed, and in supporting the EEC Project Managers willing to externalise significant work packages of their projects.

That led to the following results:

- EEC Outsourcing Guidelines;
- Start the outsourcing process for the following projects:
  - SFM CoE: Audiolan (Voice over IP) project;
  - ERIS programme: IPAS (Preparation and Analysis System), PWP (Piloting Workstation) and ACE (AVENUE Compliant ESCAPE) projects.





# BUSINESS ENABLERS AND SUPPORT **ACTIVITIES**

## Development Platform and Information Technology services (ITM)

2003 was rich in events for ITM. First of all, the IT strategy was reviewed together with the user group representatives following an annual process. This strategy now defines the ITM work programme for the next three years.

The stabilisation of IT assets is one of the major concerns of ITM. We managed to achieve it during the year 2003. In the future, IT asset consolidation will be a major item in our work programme in order to keep them stable and to make them more visible.

The current IT Facility Management contract began in January 2000 for a five year period and therefore, will terminate in December 2004. ITM prepared the launch of a new call for tender for the next five-year period – 2005 to 2009. In order to optimise outsourcing and costs, the EEC participated at the Agency level to the publication of a common call for tender with MIS and the CFMU. This is fully compliant with the outsourcing strategy defined in the Business Plan. Experience from the previous contract clearly demonstrated significant benefits in using this approach.

Some significant improvements were made in several technical fields:

- The Agency telephone systems (PABX) are now connected via the Agency IT network. All communications between the EEC and HQ are now transmitted via this network thus reducing associated costs.
- Consolidation of web servers: all web servers are now installed under a standard configuration which allows better optimisation and easier administration.
- ITM started the migration of users' "home" disks onto the NAS (Network Area Storage) system. Consequently, the administration of these disks is easier and centralised on one secure system.
- The helpdesk system was migrated to the new version (5.0) of the ARS Remedy software with the help of SEU. The new helpdesk system is more user-friendly and integrates IT assets, allowing users to visualise their IT equipment configuration.

Finally, several important and significant projects were undertaken or started during this year:

- Network migration: the old network based on Asynchronous Transfer Mode was replaced by a new one based on gigabit Ethernet. The new architecture is simpler, more powerful, easier to maintain and contains enhanced functionalities.
- PC migration: users' PC workstations were migrated from Windows NT to XP. This project has been undertaken at the Agency level in close co-ordination with other SBUs.

- Flat screens: ITM started a pilot use of flat screens (LCDs) following a market study. Apparently, this was much appreciated by users and the replacement of old screens by LCDs will start in 2004.
- Firewall: the old firewall was replaced by a dedicated appliance. Like the new network, this firewall is simpler, more powerful and easier to maintain.
- Backup: the backup system was renewed and harmonised with a single supplier. It works faster and all data are now saved in the backup window without overflowing.

### **Administrative & Management Information software (AMI)**

2003 was a big step for the AMI Business Enabler. For the first time, AMI had to manage both "Business applications" and its new mission "Web activities" during the whole year. A significant improvement programme, started in 2002, has been further developed in these two areas.

#### **Web Management**

The new version of the Intranet has been implemented in close coordination with the Web Steering Committee (WSC) and the Internal Information Monitoring Group (IIMG). Design and navigation have been totally reviewed according to the new graphic charter. The contents have been restructured and its quality has been improved in order to keep an up-to-date level of information.

During the year 2003, AMI participated to various Agency-wide projects in order to integrate EEC needs:

- AMI participated to the Extranet Project which supervised the implementation of the EUROCONTROL's One Sky Online (collaborative and secure facility to share information with stakeholders).
- The EUROCONTROL Internet site was re-designed and the Experimental Centre pages had to be updated accordingly. The new site contains static pages maintained by the MIM Business Enabler and dynamic project pages.

For this purpose, a mechanism, developed by AMI, extracts project information from ACB (local project management tool).

#### **Business applications**

The business application area has also been very active. Two main projects were managed by AMI:

- The first one, totally technical, consisted in migrating databases in order to be compliant with corporate standards. All EEC applications were migrated from INFORMIX to the latest version of the ORACLE database system.
- The second was the replacement of the "Leave and Flexitime Management" tool. The selected Product (GFI Chronotique) will provide staff with a Web Interface to monitor leave requests and time management. The study and the product installation have been completed and the test phase has been achieved successfully by the end of the year. This new system will be used in 2004.

To improve the existing Information System, an Application Steering Committee has been created with the objective of defining policy and strategy, setting priorities, ensuring adequate funding and resources and monitoring the execution of the agreed work programme.

At the end of the year, a Call for Tender has been launched to outsource maintenance and support of existing business applications. This is in line with the strategy for outsourcing as defined in the Business Plan. The new contract will be operational in 2004.

### **Transport, Infrastructures and General Services (TIG)**

Two important infrastructure projects were the main activities of the TIG Business Enabler during 2003.

#### **New conference room**

The Experimental Centre had conference rooms with capacities of no more than 30 persons. During some meetings like EMM (EEC Management Meeting) or ECCG (Experimental Centre Consultation Group), the number of participants

may reach approximately 60 and there was no room convenient for them.

Therefore, at the beginning of the year 2003, it has been decided to convert two small rooms and the adjacent corridor into a new conference room well suited to this kind of meetings.

The objective was to have it ready for the ECCG meeting on April 1st, 2003. This challenge could be achieved even though provisional furniture and equipment had to be rented. Final works and installation of purchased equipment and furniture were performed after the meeting and completed before the second ECCG meeting in October.

### **Air conditioning upgrade**

The second important project had to be initiated as a response to the problems encountered during the heat wave of the summer. During this period, the air-conditioning installations were not sufficiently powerful and it has been impossible to maintain in the building acceptable working conditions for the personnel.

At the end of August, an audit on the air-conditioning installations was launched. The report highlighted important technical problems in the production of cold water.

In September, the EEC immediately made provisions to replace one of the defective units of cold water production. The work was completed as of the end of the year.

The new unit is now operational and will be able to provide full power should next summer weather need it.

### **Human Resources Management (HRM)**

Staffing levels in HRM reduced with the retirement of one member of staff who was not replaced. This is the culmination of an effort to provide the most cost efficient HR service to the staff of the EEC and IFPU2, which has resulted in a reduction in staffing levels from eleven to seven between 2001 and 2003.

### **Planning Human Resources**

The EEC Staff Plan was approved as part of the EEC Business Plan in 2003. The Staff Plan is now a stable HR tool for the monitoring and development of the pool of skills available, and required in the future, to support the EEC strategy.

### **Administering Human Resources**

During 2003, a number of administrative processes were decentralised from DHR Brussels to HRM, while some local processes were improved to allow the provision of a more timely service to our clients. As an example, significant gains in time and effort have been achieved in the administrative support to staff mobility and time management

### **Staff Development**

An important support to staff development continues to be the EEC Training Plan, which is focused on providing training opportunities for all staff, based on the strategic business needs of the Centre, as well as on individual training requirements. In 2003, the average number of training days per staff reached the target set for the year of 8 days.

### **Social and Medical Unit (SMU)**

The Social and Medical Unit (SMU) provides services to staff in the following domains:

- Sickness insurance EEC and IFPU2;
- In-house sickness fund;
- Management of absences;
- Occupational medicine;
- First call medical help.

In addition to the continuous services, in 2003, following activities were also achieved:

- Writing of a guide to the EUROCONTROL Sickness and Accident Insurance Scheme;
- Search for a new centre for preventive medicine;
- Co-ordination, with the other Central Office members, of an internal audit on randomly selected 206 files (51 by EEC). This audit was mainly intended to further harmonize the working procedures to be used by the different Claim Offices when processing medical claims;

- Meetings and studies to maintain management and processing of sickness fund in house;
- Implementation of a new system for flexitime and registration of absences;
- Close co-operation with the new Welfare Officer to give appropriate answers to individual needs.

### Welfare Officer

2003 was a year of transition. After several months of inactivity due to the recruitment of a new officer, the Welfare Service is again operational since September 2003.

Welfare Officer's missions are various and complementary. They include:

- Individual Missions, to help staff deal with their social situations, to provide them with administrative support and to follow-up the social aspect of moves;
- Collective Missions, providing information on social issues and enforcing prevention (Health, ASAP policy...);
- Specific Missions, like welcoming new staff, EUROKIDS daily management or assistance to deal with French taxes.

The last quarter of 2003 was therefore devoted to the effective resumption of these different missions, with the assistance of the various internal partners:

- Social Medical Unit (SMU);
- Human Resources Management;
- Staff Committee;
- Safety Protection Prevention (SPP);
- Welfare Officers (Brussels and Maastricht);
- Management;
- EUROCONTROL Headquarters.

In particular, the three units, SMU, SPP and Welfare service collaborate with the aim of sensitizing staff to prevention.

### Service for the Prevention and Protection at Work (SPP)

At the EEC health risks, safety risks and environment issues are priority items for the Management. The Core management Team have strongly supported preventive actions and promotion initiatives undertaken by the SPP team.

In 2003, main activities included:

- Further development of the culture of prevention and protection for staff as well as for visitors;
- Introduction of a new smoking policy;
- Organisation of an Environment day on the 5th June 2003 in the framework of the World Environment Day;
- Initiation of an assessment study of the centre in order to put in place an environmental management system;
- Organisation of several training sessions on first aid and handling of extinguishers;
- Two studies on comfort and hygiene (summer and winter) in the Centre performed by an independently approved organisation;
- Compulsory periodic checks of the technical installations (electricity, heater etc. ...) by an independently approved organisation;
- Development of an external traffic plan for the surroundings of the EEC aiming at ensuring safety of all vehicle and personnel movements;
- Development of prevention plans for all the external companies working in the EEC during more than 400 hours (compliant with the French Decree of February 20, 1992);
- Periodic inspections of the correct implementation of health and safety measures aiming at protecting staff and visitors from hazards or risks;
- Setting up of a logbook of inspections and assessments of the hot and cold water systems in the centre;
- Organisation of two fire drills;
- Organisation of a tour of the EEC by the Arpajon fire officers.

In the last 3 years, the following working accidents were recorded:

	2001	2002	2003
Accidents at the workplace with incapacity	2	3	2
Accidents at the workplace causing no incapacity	1	1	1

## Continuous Improvement (CI)

### *Sustained continuous improvement at the EEC*

Continuous improvement, quality and business excellence are key enablers to the EEC research activities. They are set within the corporate framework of EFQM (European Foundation for Quality Management) which is complemented with the local continuous improvement culture which has been built over many years. The 2003 highlights and main results are described below. The main driver of strategy is funding. The level of funding of continuous improvement has increased in 2003. The figures consolidate expenditure and the cost of internal effort and are in kilo euros.

	2001	2002	2003
Continuous improvement funding	119	264	384

### **Regular continuous improvement activities**

The heart of the continuous improvement cycle is the annual EFQM self assessment. The most demanding award simulation method was used for the second year in succession. A comprehensive report explaining how the EEC responds to the criteria in the EFQM model, was evaluated by an external team, which was led by an accredited EFQM senior assessor, in order to guarantee objectivity. Once again, the EEC demonstrated a steady improvement towards business excellence as can be seen from the trend in overall score.

	1998	1999	2000	2002	2003
EFQM self assessment overall score	203	287	306	350	402

The most significant areas for improvement identified in the feedback report were used to derive improvement projects. These covered the following aspects:

- Stakeholder segmentation model;
- Linkage between mission, strategy, goals, matrix, performance indicators;
- Key processes;
- Better identification of customer benefits.

These projects are planned to terminate in Q2 2004.

A corporate staff satisfaction survey is conducted annually. For the first time in 2003, the survey was synchronised with the conduct of the survey in other directorates in the Agency. The work was undertaken by an external specialist consultancy in order to guarantee objectivity and anonymity. The table summarises satisfaction levels for the EEC. Satisfaction levels are the sum of "agree" and "strongly agree" and are ordered in decreasing level of satisfaction. Not all subjects were addressed in the 2000 survey.

	2000	2002	2003
Overall job satisfaction	70%	65%	66%
Working conditions	56%	70%	80%
Teamwork	70%	77%	70%
Responsibility and job challenge	67%	67%	65%
Communication		22%	32%
Advancement and personal growth	38%	25%	28%
Directorate leadership		29%	26%
Organisational clarity		17%	19%

The profile across the different categories is consistent between 2003 and 2002. There are improvements in most of the categories. The survey was conducted at the end of 2003. Actions will be formulated for implementation during

2004 with particular emphasis on the weaker categories.

The suggestions box continued to be well supported, 58 suggestions being submitted in 2003.

	2000	2001	2002	2003
Total suggestions	52	46	44	58

On average 50 suggestions per year are generated, which is normalised to 100 suggestions per 1000 staff per year (EEC has approximately 500 people working on site). This compares very favourably with similar schemes in private industry and even more so when compared with public service norms. Suggestions are equally divided between process improvement and improvement to working and social conditions.

Training in the EFQM model and techniques is an important part of manager training. There are two levels, self-assessment training and the more advanced assessor training. The table shows the number of people receiving training.

	2002	2003
Self-assessment	1	5
Assessor	0	1

One notable achievement in 2003 was the qualification of Dirk Schaefer as a European Quality Award (EQA) assessor. During 2004 he will be a member of one of the EFQM teams which will assess EQA submissions from organisations across Europe.

The timeliness of EEC deliverables as compared with the schedule agreed with the customer is a very important quality factor. The table shows the percentage of deliverables which are delivered within the announced semester.

	2001	2002	2003
Timeliness	72%	68%	75%

### Specific continuous improvement activities in 2003

In Q3 2003 an evaluation of project management maturity at the EEC was undertaken based on an established project management capability maturity model. Research Area Managers and Heads of Centres of Expertise were interviewed. Overall, the EEC is at level 2 on a 5 point scale. The principle areas for improvement were identified.

Process mapping and documentation has been pursued in 2003. Processes are documented and are placed on the section of the intranet appropriate to the process owner. A complete list of process descriptions ordered by functionality can be referenced using a special keyword query. The table shows the structure and numbers of processes.

Programme support	8
Medical Service	1
People	16
Informatics	11
Finance	18
General Services	1
Communication	3

A new project, titled "Values of the EEC" was launched in July 2002 and has continued through 2003.

Everyone has their individual values but at a group level values express the way the members of a community wish to live together. To put it differently: a set of values defines the criteria for being member of a community.

By "values of the EEC" we mean to show that it is our goal to make both the currently applied values at the Centre and the ones it wants to develop in the future, consistent. Furthermore the project has an important role to play in clarifying some fundamental aspects of how the life of the Centre functions.

The main objectives of the project are:

- To enhance the Centre efficiency;
- To make sure that the "declared values" of the EEC correspond to both its "operating values" and its

“aspired values” and that the behaviour of the Centre reflects these values.

A three step approach was adopted.

The first step, a staff survey to identify the declared, operating and aspirational values, is completed and corresponds to a description of the “value landscape” of the EEC as far as existing and desired values are concerned, and of the behaviour recognised as contributing to the creation of the Centre’s culture.

The second step addressed the “sharing” of the reference system once the “value landscape” with all its diversity, its contradictions, its tendencies and aspirations had been described. This took the form of presentations and discussions and a formulation of the change strategy.

The first two steps were completed in July 2003.

The third step (implementation of the reference system) is clearly the most important. This is being achieved through a set of 3 focus groups:

- The objective of focus **group 1** is to define how we can share a common professional reference system to promote professionalism and rigour in all professions represented in the Centre.
- The objective of focus **group 2** is to study how to develop ethical behaviour.
- The objective of focus **group 3** is to reinforce the federating role of the EEC by promoting openness and co-operation.

Completion of the project is planned for summer 2004.

The Director General has set an objective that the Agency should achieve the EFQM recognised for excellence award in 2005. During 2003 the EEC provided the leadership to initiate the project and to deliver the first early draft of the EFQM submission document. This work was done in the framework of the Agency Group for Excellence where the EEC actively participates.

Triggered by the EFQM self assessment and by a review of the EEC organisation, a knowledge

management project was initiated in 2003. The main aim was to see how knowledge management could facilitate the core business of ATM research. The following main documents have been delivered:

- KM questionnaire;
- EEC information management infrastructure survey;
- EEC knowledge assets survey;
- KM strategy;
- Communities of Practice Practitioner’s Guide;
- Watch for ATM intelligence.

The CRDS in Budapest was visited in Q4 2003 to promote knowledge management and to define how the CRDS will participate in the real time simulations community of practice.

The EEC internal continuous improvement web site underwent major improvement and restructuring to facilitate accessibility and usability, especially for archived information.

The EEC is looking to increase its commitment to corporate social responsibility within the framework of the EFQM model. Regarding environmental issues there were three initiatives in 2003, firstly world environment day, secondly the introduction of environment performance indicators, and thirdly a feasibility study on ISO14001 implementation.

The EEC celebrated the United Nations Environment day in order to raise awareness of staff for environmental issues in general and for water (the theme of the day) in particular. Many events, presentations, films, stands were organised and a member of the United Nations staff delivered a lecture. A survey conducted soon afterwards showed that 65 % of people on site participated in the event, and that 71% of participants agreed that it was a valuable learning opportunity.

Processes were set in place to start measuring a set of environment related indicators. These covered utilities consumption, waste disposal, and recycling. We are in a learning phase and this will be followed by target setting and improvement actions.

An external audit was commissioned to determine if the EEC was in conformity with applicable environmental regulations and to perform a gap analysis in view of an eventual implementation of an environment management system based on ISO14001. Based on the results an implementation plan is being drafted.

# PUBLICATIONS

The Experimental Centre communicates its research activities, product documentation, simulator development and simulation results through EEC internal publications as well as through participation in international conferences, publication of results in conference proceedings and publications in scientific journals and books.

## Contributions 2003 to Conferences, Books, Journals...

This section contains a selection of these contributions of the Experimental Centre grouped by Research Area.

### Network Capacity and Demand (NCD)

NCD-01	<p><b>The future air transport system in Europe: Vision and Perspectives</b> (Patrick Ky) ATCA Civil-Military Air Traffic Management Conference and Exhibits, Prague, Czech Republic</p>	May 2003
NCD-02	<p><b>La gestion des flux de trafic aérien en Europe : état de l'art, problèmes et planification</b> (Serge Manchon) Séminaire Optimisation SNCF - Session " Sillon " - organisé par la Direction des Opérations, la Direction de la Recherche et de la Technologie, la Direction de la Stratégie et le pôle de compétences "Techniques et Mathématiques de la prise de Décision " du réseau de la recherche; Paris, France</p>	June 2003
NCD-03	<p><b>Use of Generalized Activity Network Models for Analysis of European ATM Development Projects</b> (Peter Kostiuk, Scott Houser, Patrick Ky) ATM-2003 5<sup>th</sup> USA/Europe ATM R&amp;D Seminar, Budapest, Hungary</p>	June 2003
NCD-04	<p><b>The future air transport system in Europe: Vision and Perspectives</b> (Jean-Marc Garot, Patrick Ky) AIAA/ICAS International Air &amp; Space Symposium and Exposition, Dayton, Ohio, USA</p>	July 2003
NCD-05	<p><b>Presentation of the Collaborative Decision Making process in pre-tactical ATFM</b> (Serge Manchon) General CDM Meeting, Seattle, WA, USA</p>	November 2003

NCD-06	<b>The future air transport system in Europe: Vision and Perspectives</b> (Patrick Ky) ATCA, Washington, USA	October 2003
<b>Sector Safety and Productivity (SSP)</b>		
SSP-01	<b>Towards the use of spacing instructions for sequencing arrival flows</b> (Isabelle Grimaud, Eric Hoffman, Laurence Rognin, Karim Zeghal) ICAO Operational datalink Panel (OPLINKP), WGA, WP/12, Annapolis, Maryland, USA	November 2003
SSP-02	<b>Introducing a new spacing instruction. Impact of spacing tolerance on flight crew activity</b> (Eric Hoffman, Nayen Pene, Laurence Rognin, Karim Zeghal) Human Factors and Ergonomics Society (HFES), 47 <sup>th</sup> Annual Meeting, Denver, Colorado, USA	October 2003
SSP-03	<b>Validating a new task distribution between air traffic controllers and flight crews</b> (Laurence Rognin, Nathalie De Beler, Isabelle Grimaud, Eric Hoffman, Karim Zeghal) Human Factors and Ergonomics Society (HFES), 47 <sup>th</sup> Annual Meeting, Denver, Colorado, USA	October 2003
SSP-04	<b>Effect of Automatic Dependent Surveillance Broadcast (ADS-B) transmission quality on the ability of aircraft to maintain spacing in a sequence</b> (Eric Hoffman, Dan Ivanescu, Chris Shaw, Karim Zeghal) Air Traffic Control Quarterly, International Journal of Engineering and Operations, Special Issue: Aircraft Surveillance Applications of ADS-B, Vol. 11(3)	September 2003
SSP-05	<b>Effect of entry conditions on airborne spacing when sequencing multiple converging aircraft</b> (Dan Ivanescu, Chris Shaw, Eric Hoffman, Karim Zeghal) American Institute of Aeronautics and Astronautics (AIAA) Guidance, Navigation, and Control Conference, Austin, Texas, USA	August 2003
SSP-06	<b>Effect of mixed aircraft types and wind on time based airborne spacing</b> (Eric Hoffman, Dan Ivanescu, Chris Shaw, Karim Zeghal) American Institute of Aeronautics and Astronautics (AIAA) Guidance, Navigation, and Control Conference, Austin, Texas, USA	August 2003
SSP-07	<b>Spacing instructions in approach: assessing usability from the air traffic controller perspective</b> (Isabelle Grimaud, Eric Hoffman, Laurence Rognin, Karim Zeghal) American Institute of Aeronautics and Astronautics (AIAA) Guidance, Navigation, and Control Conference, Austin, Texas, USA	August 2003
SSP-08	<b>Towards the use of spacing instruction: assessing the impact of spacing tolerance on flight crew activity</b> (Isabelle Grimaud, Eric Hoffman, Nayen Pene, Laurence Rognin, Karim Zeghal) American Institute of Aeronautics and Astronautics (AIAA) Guidance, Navigation, and Control Conference, Austin, Texas	August 2003
SSP-09	<b>Analysis of constant time delay airborne spacing between aircraft of mixed types in varying wind conditions</b> (Eric Hoffman, Dan Ivanescu, Chris Shaw, Karim Zeghal) 5 <sup>th</sup> USA / Europe Air Traffic Management Research and Development Seminar, Budapest, Hungary	June 2003
SSP-10	<b>Absolute versus relative navigation: theoretical considerations from an ATM perspective</b> (R. Graham, Eric Hoffman, Christian Pusch, Karim Zeghal) 5 <sup>th</sup> USA / Europe Air Traffic Management Research and Development Seminar, Budapest, Hungary	June 2003

SSP-11	<b>An integrated approach to validate the CoSpace concept</b> (Eric Hoffman, Isabelle Grimaud, Laurence Rognin, Karim Zeghal) 22 <sup>nd</sup> European Annual Conference on Human Decision Making and Control, Linköping, Sweden	June 2003
SSP-12	<b>Améliorer la gestion du trafic aérien: étude d'une nouvelle coopération contrôleurs - pilotes</b> (Isabelle Grimaud, Eric Hoffman, Laurence Rognin, Karim Zeghal) Syndicat National des Pilotes de Ligne (SNPL), magazine „Pilote de Ligne“, N°37, ISSN 1251-8425	Spring 2003
<b>Airport Throughput (APT)</b>		
APT-01	<b>CDM Malpensa, State of Operations</b> Mongénie, Eletheriou, Florent <a href="http://www.euro-cdm.org">www.euro-cdm.org</a>	July, 2003
APT-02	<b>CDM Helsinki Vantaa, State of Operations</b> Delain, Payan <a href="http://www.euro-cdm.org">www.euro-cdm.org</a>	July 2003
APT-03	<b>CDM Malpensa, Proposal for change</b> Mongénie, Florent <a href="http://www.euro-cdm.org">www.euro-cdm.org</a>	September 2003
APT-04	<b>CDM Stockholm, Proposal for change</b> Payan <a href="http://www.euro-cdm.org">www.euro-cdm.org</a>	November 2003
APT-05	<b>CDM Helsinki Vantaa, Proposal for change</b> Payan <a href="http://www.euro-cdm.org">www.euro-cdm.org</a>	November 2003
APT-06	<b>CDM at Arlanda and Vantaa Collaborative De-icing procedures</b> Delain <a href="http://www.euro-cdm.org">www.euro-cdm.org</a>	November 2003
<b>Innovative Research (INO)</b>		
INO-01	<b>Bridging the Predictive and Adaptative Issues in Air Traffic Management : The Synchronous Paradigm</b> (Gilles Gawinowski, Jean Nobel, Jean-Yves Grau, Didier Dohy, Vu Duong) in proceedings of the 22 <sup>nd</sup> Digital Avionics Systems Conference, Indianapolis, Indiana	October 2003
INO-02	<b>Operational Concepts for SuperSector</b> (Gilles Gawinowski, Jean Nobel, Jean-Yves Grau, Didier Dohy, Laurent Guichard, Sandrine Guibert, Jean-Pierre Nicolaon, Vu Duong) 5th ATM R&D Seminar, Budapest, 2003	June 2003
INO-03	<b>Supporting Air Traffic Controller picture by displaying en-route flight plan data on a time-based line</b> (Jean-Yves Grau, Jean Nobel, Laurent Guichard, Gilles Gawinowski) in proceedings of the 22 <sup>nd</sup> Digital Avionics Systems Conference, Indianapolis, Indiana	October 2003
INO-04	<b>Dynastrips: A Time-Line Approach to Improve ATCOs Air Traffic Picture</b> (Jean-Yves Grau, Jean Nobel, Laurent Guichard, Gilles Gawinowski) Aviation Psychology Conference, Columbus, 2003	April 2003

INO-05	<p><b>Safety Assessment for validating new concepts in Air Traffic Control</b>  (Jean-Yves Grau, Fabrice Drogoul, Laurent Guichard, Sandrine Guibert, Gilles Gawinowski)  Aviation Psychology Conference, Columbus, 2003</p>	April 2003
INO-06	<p><b>Survey of Co-ordination of En Route Air Traffic Conflicts Resolution Modelling Methods</b>  (Huy-Hoang Nguyen)  In proceedings of the First International Conference of French-Spoken Vietnamese Computer Scientists, Hanoi, Vietnam</p>	February 2003
INO-07	<p><b>Using Disjunctive Scheduling for a New Sequencing Method in Multiple-Conflicts Solving</b>  (Jacques Carlier, Vu Duong, Dritan Nace, Huy-Hoang Nguyen)  in Proceedings of the IEEE 6th International Conference on Intelligent Transportation Systems Shanghai, Shanghai, China</p>	October 2003
INO-08	<p><b>A general framework to model the dynamic nature of the convective weather in the aircraft routing algorithms</b>  (Arnab Nilim, Laurent El Ghaoui)  in Proceedings of the IEEE 22nd Digital Avionics Systems Conferences, Indianapolis, Indiana</p>	October 2003
INO-09	<p><b>Multi-Aircraft Routing and Traffic Flow Management under Uncertainty</b>  (Arnab Nilim, Laurent El Ghaoui and Vu Duong)  in Proceedings of the 5th USA/EUROPE ATM R&amp;D, Budapest</p>	June 2003
INO-10	<p><b>A Linear Programming Approach for Route and Level Flight Assignment</b>  (Dritan Nace, Jacques Carlier, Linh Doan, and Vu Duong)  in Proceedings of the 5th USA/EUROPE ATM R&amp;D, Budapest</p>	June 2003
INO-11	<p><b>A vision of wake vortex research for next 20 years</b>  (Peter Choroba)  in Proceedings of the 5th USA/EUROPE ATM R&amp;D, Budapest</p>	June 2003
INO-12	<p><b>Dynamic air traffic control wake vortex safety and capacity system</b>  (Peter Choroba)  TRANSCOM 2003 Conference, University of Zilina</p>	June 2003
INO-13	<p><b>A general approach for assessment of capacity benefit for dynamic air traffic control wake vortex safety and capacity system</b>  (Peter Choroba)  New Trends in Civil Aviation 2003 - Seminar, Technical University of Brno</p>	September 2003
INO-14	<p><b>The concept of integrated air traffic control wake vortex safety and capacity system</b>  (Peter Choroba, and Vu Duong)  in Proceedings of the IEEE 6th International Conference on Intelligent Transportation Systems Shanghai, Shanghai, China</p>	October 2003
INO-15	<p><b>Towards a System of Systems: Transparent Integration of Air-Ground Telecommunications using the Connector Technology</b>  (Rüdiger Ehrmanntraut)  in proceedings of the 10th Saint Petersburg International Conference on Integrated Navigation Systems</p>	May 2003
INO-16	<p><b>Towards a Concept Definition of TIS-C</b>  (Rüdiger Ehrmanntraut, Achille Castrogiovanni)  in proceedings of the 22<sup>nd</sup> Digital Avionics Systems Conference, Indianapolis, Indiana</p>	October 2003

INO-17	<p><b>System of-Systems Integration of Air-Ground Telecommunications with the Software Connector</b> (Rüdiger Ehrmanntraut) in proceedings of the 22<sup>nd</sup> Digital Avionics Systems Conference, Indianapolis, Indiana</p>	October 2003
INO-18	<p><b>Enabling Air-Ground Integration: Definition of a Total Information Sharing Protocol</b> (Rüdiger Ehrmanntraut) in proceedings of the 22<sup>nd</sup> Digital Avionics Systems Conference, Indianapolis, Indiana</p>	October 2003
INO-19	<p><b>Towards an Operational Concept For Integrated Adaptive And Predictive ATM</b> (Rüdiger Ehrmanntraut) in proceedings of the 22<sup>nd</sup> Digital Avionics Systems Conference, Indianapolis, Indiana</p>	October 2003
INO-20	<p><b>Airspace Sectorization by Constraint Programming</b> (Dac-Huy Tran, Philippe Baptiste, Vu Duong) In proceedings of the First International Conference of French-Spoken Vietnamese Computer Scientists, Hanoi, Vietnam</p>	February 2003
INO-21	<p><b>Sectorisation dynamique de l'espace aérien européen</b> (Philippe Baptiste, Dac-Huy Tran) Actes du 5e Congrès de la Société Française de Recherche Opérationnelle et d'Aide à la Décision, Paris</p>	February 2003
INO-22	<p><b>Optimized Sectorization of Airspace with Constraints</b> (Dac-Huy Tran, Philippe Baptiste, Vu Duong) in Proceedings of the 5th USA/EUROPE ATM R&amp;D, Budapest</p>	June 2003
INO-23	<p><b>Safety and security increase for Air Traffic Management through unnoticeable watermark Aircraft Identification Tag transmitted with the VHF voice communication</b> (Horst Hering) in proceedings of the 22<sup>nd</sup> Digital Avionics Systems Conference, Indianapolis, Indiana</p>	October 2003
INO-24	<p><b>Three-dimensional Stereoscopic visualization for Air Traffic Control Interfaces: a preliminary study</b> (Monica Tavanti, Ha Le-Hong, Nguyen-Thong Dang) In Proceedings of the IEEE "22nd Digital Avionics Systems Conference", Indianapolis, Indiana</p>	October 2003
INO-25	<p><b>Visualization and Interaction on Flight Trajectory in A 3D Stereoscopic Environment</b> (Nguyen-Thong Dang, Ha Le-Hong, Monica Tavanti) In proceedings of IEEE "22nd Digital Avionics Systems Conference", Indianapolis, Indiana</p>	October 2003
INO-26	<p><b>Empirical Analysis of the Applicability of 3D Stereoscopic in Air Traffic Control</b> (Nguyen-Thong Dang, Ha Le-Hong, Monica Tavanti) In Proceedings of IEEE 6th ITSC2003, International Conference on Intelligent Transportation Systems Shanghai, China</p>	October 2003
INO-27	<p><b>A Multidisciplinary Framework for Empirical Analysis of the Applicability of 3D Stereoscopic in Air Traffic Control</b> (Nguyen-Thong Dang, Ha Le-Hong, Monica Tavanti) In proceedings of IEEE CIRA03 "Computational Intelligence in Robotics and Automation for the new Millennium", Kobe, Japan</p>	July 2003

INO-28	<b>Air traffic control and 3D dimensional displays: a multidisciplinary approach</b> (Ha Le-Hong, Monica Tavanti, Nguyen-Thong Dang) In proceedings of "TRANSCOM 2003, 5th European conference of young research and science workers in transport and telecommunications", Zilina, Slovak Republic	June 2003
INO-29	<b>TRAMS, Visualising Mode S Aircraft in ITI</b> (M. Tavanti, Geraldine Flynn) In proceedings of "HCI International 2003", Greece	June 2003
INO-30	<b>Interaction In 3D Stereoscopic Visualization for Air Traffic Controller</b> (Nguyen-Thong Dang) In proceedings of RIVF'03, Vietnam. Studia Informatica Universalis ISBN:2-912590-15-9. pp 71-76	February 2003
INO-31	<b>3D Visualization In Air Traffic Control</b> (Ha Le-Hong) In proceedings of RIVF'03, Vietnam. Studia Informatica Universalis ISBN:2-912590-15-9. pp 65-70	February 2003
INO-32	<b>Air-Rail Intermodality from Passenger Perspective</b> (Antonia Cokasova) 5 <sup>th</sup> EUROPE/US ATM R&D Seminar, Budapest	June 2003
INO-33	<b>Intermodality from Passenger Perspective</b> (Antonia Cokasova) Seminar on New Methods in Civil Aviation	November 2003
INO-34	<b>Comparison of transport modes</b> (Antonia Cokasova) World's Congress, Aviation in the 21 <sup>st</sup> Century, Kiev 2003	September 2003
INO-35	<b>What is intermodality?</b> (poster and full paper) (Antonia Cokasova) 19 <sup>th</sup> Dresden Conference of Traffic and Transportation Sciences	September 2003
INO-36	<b>Dynamic air traffic control wake vortex safety and capacity system</b> (Peter Choroba) Slovak Journal "Communications," (published in special edition of this journal as best paper in session at TRANSCOM 2003	September 2003
<b>Society, Environment and Economy (SEE)</b>		
SEE-01	<b>ATM Flight Efficiency and its impacts on the Environment</b> (Sylvie Chesneau, Ian Fuller, Jean-Claude Hustache)	July 2003
SEE-02	<b>Attitudes Towards and Values of Aircraft Annoyance and Noise Nuisance</b> (Abigail Bristow, Mark Wardman and al.)	July 2003
SEE-03	<b>The Mediterranean Free Flight Programme (MFF)</b> (Frank Jelinek, Sandrine Carlier, James Smith)	July 2003
SEE-04	<b>A Review of Complaints and Social Survey at Manchester Airport</b> (Ken Hum, Helen Morley, Callum Thomas)	November 2003
SEE-06	<b>Air Transport and Environment Economics</b> (Jean-Claude Hustache)	July 2003

**EATM Reference Industry-based ATM Simulation and Trials Platform**

ERS-01      **EUROCONTROL's large-scale research and training simulator**  
 (Roger Jerram, Marc Brochard)  
 Presented at the conference "Simulation of the Environment" (the Royal  
 Aeronautical Society, London)      November 2003

**Safety**

SAS-01      **Culture Aspects of Competence in Air Traffic Control**  
 (Deirdre Bonini, Barry Kirwan)  
 Ergonomics Society, Heriot-Watt University, Edinburgh, UK      April 2003

SAS-02      **Estimation of the benefits of improved icing forecasts**  
 (Jörg Bendisch, Garfield Dean, Bodo Gerlach, Thomas Hauf, Oliver Kraft,  
 Christopher Leifeld)  
 Geophysical Research Abstracts, Vol.5, 11219      2003

SAS-03      **An overview of a nuclear reprocessing plant human factors programme**  
 (Barry Kirwan)  
 Applied Ergonomics 34, 441-452      2003

SAS-04      **Task Analysis**  
 (Barry Kirwan)  
 Chapter in Industrial Ergonomics Handbook. p. 218 – 233(In Japanese)      July 2003

SAS-05      **Individual and group approaches to human error prediction – a tale of three systems**  
 (Steve T. Shorrock, Barry Kirwan, Ed Smith)  
 Third IBC Conference on Human Factor, London 27-28 UK      February 2003

SAS-06      **Misunderstanding of Adjust Vertical Speed Adjust Aural with Additional Data**  
 (Garfield Dean, Tim Baldwin)  
 Surveillance & Conflict Resolution system Panel Working Group A, Stockholom      May 2003

SAS-07      **ACAS RA Downlink Study**  
 (Garfield Dean)  
 Surveillance & Conflict Resolution system Panel Working Group A, Honolulu      November 2003

**Operational Advisor**

SOA-01      **Potential benefits of a Time-based Separation Procedure to maintain the Arrival Capacity of an Airport in strong head-wind conditions**  
 (Elsa Freville, Jean-Pierre Nicolaon, Antoine Vidal, Peter Crick)  
 Europe/USA ATM Seminar, Budapest, Hungary      June 2003

All EEC publications are classified as **Reports**, a document which conforms to strict quality criteria regarding both scientific content and presentation, or as **Notes**, a more informal document.

They have unique identifiers in the format “nnn” (Report) and “nn/00” (Note) and are available on our web site <http://www.eurocontrol.fr>.

## REPORTS

379	<b>Transmission to Mode S (TRAMS) Real-Time Simulation</b> (G.M. Flynn, M. Tavanti)	March 2003
380	<b>EACAC 2001 Real-Time Experiment – Volume I</b> (I. Grimaud, E. Hoffman, L. Rognin, K. Zeghal)	March 2003
380-2	<b>EACAC 2001 Real-Time Experiment – Volume II - Annexes</b> I. Grimaud, E. Hoffman, L. Rognin, K. Zeghal)	March 2003
381	<b>DOVE 1 Fast-Time Simulation</b> (P. Conroy)	May 2003
382	<b>6 States East and West Real-Time Simulations</b> (R. Lane, R. Deransy)	May 2003
383	<b>DOVE 1 Real-Time Simulation</b> (S. Oze, Thales IS, M. Whiteley, R. Deransy, R. Mc Gregor)	August 2003
384	<b>RVSM and TCAS in European Airspace</b> (G. Dean, T. Baldwin)	July 2003
385	<b>Simulation en Temps Réel Paris Départ Sud (PSDF2)</b> (B. Kerstenne)	October 2003
386	<b>CoSpace 2002 Controller experiment assessing the impact of spacing instructions in E-TMA and TMA – Volume I</b> (F. Aligne, I. Grimaud, E. Hoffman, L. Rognin, K. Zeghal)	December 2003
386-2	<b>CoSpace 2002 Controller experiment assessing the impact of spacing instructions in E-TMA and TMA – Volume II</b> (F. Aligne, I. Grimaud, E. Hoffman, L. Rognin, K. Zeghal)	December 2003
387	<b>European ACAS Operational Monitoring 2001 Report</b> (G. Dean, T. Baldwin)	December 2003

## NOTES

01/03	<b>CoRe - Capture and Exploitation of Requirements</b> (A. Pasquini)	February 2003
02/03	<b>CoRe - Style Guides for ATM Development</b> (M. Cooke, P. Marti)	February 2003
03/03	<b>CoRe - Recommendations for HMI Evaluation in the Context of CWP Development</b> (O. Pierret, JM. Rousseau)	February 2003
04/03	<b>GNSS Sole service feasibility Study</b> (France Développement Conseil – Vincennes, France)	May 2003

05/03	<b>CEATS 2007 UAC Capacity – Options for a phase implementation</b> (S. Vincent, M. Dalichampt)	May 2003
07/03	<b>Delay Forecast 2003 based on National Capacity Enhancement Plan</b> (S. Vincent, M. Dalichampt)	May 2003
08/03	<b>Individual and Group Approaches to Human error identification</b> (S. Shorrock)	July 2003
08-2/03	<b>Individual and Group Approaches to Human error identification – Volume II</b> (S. Shorrock)	July 2003
09/03	<b>Aircraft Performance Summary Tables for the Base of Aircraft Data (BADA) – Revision 3.5</b> (A. Nuic)	July 2003
10/03	<b>Revision Summary Document for the Base of Aircraft Data (BADA) – Revision 3.5</b> (A. Nuic)	July 2003
11/03	<b>User Manual for the Base of Aircraft Data (BADA) – Revision 3.5</b> (A. Nuic)	July 2003
12/03	<b>ATC Wake - Operational Requirements</b> (G. Astégiani et al)	July 2003
13/03	<b>ATC Wake – Operational Concept and Procedures</b> (G. Astégiani et al)	July 2003
14/03	<b>ATC Wake – Users Requirements</b> (G. Astégiani et al)	July 2003
15/03	<b>ATC Wake – System Requirements</b> (G. Astégiani et al)	July 2003
16/03	<b>ATC Wake – Final Reports on system Requirements</b> (G. Astégiani et al)	August 2003
17/03	<b>An economic model for European Air Transport</b> (I. Laplace-M3 Systems, A. Marsden)	September 2003
18/03	<b>Flight Delay Propagation Synthesis of the Study</b> (W. Vigneau)	October 2003
19/03	<b>CDM Stockholm Arlanda WP 1</b> (O. Delain-Sofréavia, A. Payan-Quaternove)	October 2003
20/03	<b>Traffic Complexity Indicators and Sector Typology Analysis of US and European Centres</b> (G.M. Flynn, C. Leleu, L. Zerrouki)	November 2003
21/03	<b>Pessimistic Sector Capacity Estimation</b> (G.M. Flynn, A. Benkouar, R. Christien)	November 2003
22/03	<b>Coverage of 2002 European Air Traffic for the Base of Aircraft Data (BADA) – Revision 3.5</b> (C. Sheehan)	November 2003



# GLOSSARY

## A

5A	Attitudes to Aircraft Annoyance around Airports	AERO2K	Global Aircraft Emissions Database
ACARE	Advisory Council for Aeronautics Research in Europe	AFAS	Aircraft in the Future ATM System
ACAS	Airborne Collision Avoidance System	AGAS	High-level European Action Group on ATM Safety
ACC	Area Control Centre	AGC	Air Ground Co-operation programme
ACCESS	Assessing ATC Capacity	AIT	Aircraft Identification Tag
A-CDM-D	Air Collaborative Decision Making Demonstrator (EC project)	ALAQS	Airport Local Air Quality Services (EEC)
ACE	Association des Compagnies aériennes de la Communauté Européenne	AMAN	Arrival MANager
ACE	ATM and CNS systems Engineering (EEC)	AM-DSB	Amplitude Modulation - Double Side Band
ACE	ATC Communications Environment	AMI	Administrative & Management Information Software (EEC)
ACE	ATM Cost effectiveness	AMN	Airspace domain EUROCONTROL
ACE	AVENUE Compliant ESCAPE	AMP	Avionics Monitoring Project
ACG	ATM/CNS Consultancy Group	ANC	Air Navigation Commission (ICAO)
ACNUSA	Autorité pour le Contrôle de la Nuisance Sonore Aéroportuaire	ANCAT	Abatement of Nuisances Caused by Air Transport
ACTS	Aeronautical Communication Technologies Simulation	ANS CZ	Air Navigation Services of the Czech Republic
ADREP	Accident Data REPorting	ANSP	Air Navigation Service Provider
ADS	Automatic Dependant Surveillance (Broadcast)	AOC	Aircraft Operating Company
ADS-B	ADS-Broadcast	APT	Airport Throughput (EEC)
AEA	Association of European Airlines	ARDEP	Analysis of Research and Development in EUROCONTROL Programmes
AECMA	European Association of Aerospace Industries	ARINC	Aeronautical Radio Incorporated (US)
AEEC	Airlines Electronic Engineering Committee	ARN	ATS Route Network
AEM	Advanced Emission Model	ARS-Remedy	Action Request System - Remedy
AENA	Aeropuertos Españoles y Navegación Aérea (E)	ARTAS	ATM Radar Tracker and Server
		ASA	Airborne Separation Assurance
		ASAP	Alcohol and Substance Abuse Policy (EEC)
		ASAS	Airborne Separation Assurance System

ASAS-TN	Airborne Separation Assurance System Thematic Network	CEM	Collaborative Environmental Management
ASMGCS	Advanced Surface Movement Guidance and Control Systems	CENA	Centre d'Etudes de la Navigation Aérienne (France)
ASMT	Automatic Safety Monitoring Tool	CEO	Chief Executive Officer
ASTER	Aviation Safety Targets for Effective Regulation	CFMU	Central Flow Management Unit
ASTP	ADS Studies and Trials Project	CI	Continuous Improvement (EEC)
ATC	Air Traffic Control	CIP	Convergence Implementation Plan
ATCA	Air Traffic Control Association	CMIC	Civil Military Interface Standing Committee
ATCO	Air Traffic Control Officer	CM	Configuration Management
ATC Wake	ATC Wake vortex safety and capacity optimisation system	CMM	Capability Maturity Model
ATFM	Air Traffic Flow Management	CNS	CNS Studies (EEC)
ATFCM	Air Traffic Flow Capacity Management	CNS	Communications, Navigation and Surveillance
ATFMC	Air Traffic Flow Management Communications	COCA	Complexity and Capacity
ATM	Air Traffic Management	CoE	Centre of Expertise
ATMAS	ATM Automated System	CORA	COntlict Resolution Assistant
ATN	Aeronautical Telecommunications Network	CORBA	Common Object Request Broker Architecture
ATS	Air Traffic Services (provider)	CoRe	Core Requirements for ATM working positions
AVENUE	ATM Validation Environment for Use towards EATMS	COSAAC	Common Simulator to Access ATFM Concepts
AVT	ADS-B/TIS-B Validation and Trials platform	COSIBA	Common Simulation Project for the Balkans
		COTRAC	Common Trajectory Co-ordination
		CPDLC	Controller/Pilot Datalink Communications
<b>B</b>		CRCO	Central Route Charges Office
BADA	Base of Aircraft DATA	CRDS	CEATS Research, Development and Simulation Centre
BP	Business Plan	CRM	Collision Risk Model
BSD	Business Development (EEC)	CSPDU	CEATS Strategic Planning and Development unit
<b>C</b>		CUAC	CEATS Upper Airspace Control Unit
C2G	Constraints to Growth	CWP	Controller Working Position
CAA	Civil Aviation Authority		
CAEP	Committee on Aviation Environmental Protection (ICAO)	<b>D</b>	
CAIA	Collaborative ATFM Interface with ATFM	DAI	Development and Integration (EEC)
CAIRDE	Civil Aviation Integrated Radar Display Equipment (Ireland)	DANCE	Data ANalysis CEntre
CAMES	Co-operative ATM Measures for a European Single Sky	DAP	Downlink of Aircraft Parameters
CAP	Controller Access Parameters	DARTS	Decision Aid for Real-Time Synchronisation
CARE	Co-operative Actions of R&D in EUROCONTROL	DATMAS	Danish ATM Automated System
CBA	Cost Benefit Analysis	DEEC	Director of EUROCONTROL Experimental Centre
CBM	Core Business Manager (EEC)	DEFAMM	Demonstration Facilities for Airport Movement Management tool
CDM	Collaborative Decision Making	DERA	DEfense Research Agency
CDTI	Cockpit Display of Traffic Information	DF	Directorate Finance (HQ)
CEATS	Central European Air Traffic Services	DFS	Deutsche FlugSicherung (German ATS)

DGAC	Direction Général de l'Aviation Civile	ESA	European Space Agency
DHR	Director Human Resources	ESAO	Environmentally Sustainable Airport Operations
DIR	Director (EEC)		
DMAN	Departure MANager	ESARR 2	EUROCONTROL SAFETY Regulation Requirement
DNA	Direction de la Navigation Aérienne	ESCAPE	EUROCONTROL Simulation Capability And Platform for Experimentation
DP	Development Plan	ESTB	EGNOS Satellite Test Bed
DSI	Denmark/Sweden Interface	ETFMS	Enhanced Tactical Flow Management System
DOVE	Datalink Operational Validation Experiments	ETG	European Tripartite Group (GNSS)
DYNAV	DYNAMIC route AVailability	ETTSG	European TAAM Technical Sub-Group
		EU	European Union
<b>E</b>		EUROCAE	EUROpean Organisation for Civil Aviation Electronics
EACAC	Evolutionary Air-ground Cooperative ATM Concepts	EVP	European ATM Validation Platform
EAG	European ATFM Group	EVP/CORA	EATMP Validation Platform for CORA
EATMP	European Air Traffic Management Programme		
EC	European Commission	<b>F</b>	
ECAC	European Civil Aviation Conference	FAA	Federal Aviation Administration
ECCAIRS	EC Global Aviation Safety Reporting System	FACET	Fast ACC Capacity Evaluation Tool
ECCG	Experimental Centre Consultation Group	FAM	Future ATFM Measures
ECHOES	EUROCONTROL Consolidation of HMI for Operations Experimentations and Simulations	FAP	Future ATM Profile
ECIP	European Convergence and Implementation Plan	FDP	Flight Data Processing
eDEP	EUROCONTROL early Demonstration and Evaluation Platform	FDPS	Flight Data Processing System
EDMS	Emission Dispersion Modelling System	FIN	Finances (EEC)
EEC	EUROCONTROL Experimental Centre	FIP	Finance, Infrastructure, Information, Personnel providers (EEC)
EFQM	European Foundation for Quality Management	FIR	Flight Information Region
EGNOS	European Geo-stationary Navigation Overlay Service	FLIPCY	Flight Plan Consistency Check
EMAN	En-route traffic sequency and MANAGEMENT tool	FMD	Flight Management Division
EMC	EATMP Management Committee (EUROCONTROL)	FMS	Flight Management System
EMM	Enlarged Management Meeting (EEC)	FPA	Financial Planning and Analysis (EEC)
ENAC	Ecole Nationale de l'Aviation Civile	FP	Framework Programme (of the European Commission)
ENAV	Ente Nazionale di Assistenza al Volo	FP6	6th Framework Programme
ENHANCE	European Harmonised Aircraft Noise Contour modelling Environment	FRAP	Eight States Free Routes Project
EOIG	EGNOS Operations and Infrastructure Group	FREER	Free Route Encounter Resolution
EPI	Environmental Performance Indicator	FYP	Five Year Programme
EQA	European Quality Award	<b>G</b>	
ERA	Economic Regulation Analysis	G2G	Gate to Gate
ERIS	EATMP Reference Industry-based Simulation & Trials Platform (EEC)	GAM	Generic Airport Model
ERS	See ERIS	GASEL	General ATFM Simulation Engine & Library
		GBAS	Ground Based Augmentation Systems
		GFAER	Greece, FYROM, Albania Real Time Simulation
		GWG	GBAS Working Group
		GIS	Geographical Information System

GLONASS	GLObal NAVigation Satellite Systems (Russia)	IPAS	Integrated Preparation and Analysis System
G-MARS	GBAS Monitoring And Reference Station	IPSky	Internet Protocol in the Sky
GMD	General Meeting of Directors	IPv6	Internet Protocol version 6
GMU	GPS Monitoring Units	IREN	Incident Reporting European Network
GNS	Satellite Navigation (EEC)	ISA	Innovative Slot Allocation
GNSS	Global Navigation Satellite System	IST	Information Society Technology
GSE	Ground Support Equipment	IT	Information Technology
		ITM	Information Technology Management (EEC)
<b>H</b>			
HAZOP	Hazard Identification Technique	<b>K</b>	
HADES	Help Tool for Airspace Design EEC Studies	KM	Knowledge Management
HCI	Human Interface with the Computer	KPI	Key Performance Indicator
HEIDI	Harmonisation of European Incident Definitions Initiative for ATM	<b>L</b>	
HF	Human Factors	LAN	Local Area Network
HFL	Human Factor Laboratory (EEC)	LAQ	Local Air Quality
HIPS	Highly Interactive Problem Solver	LCIP	Local Convergence and Implementation Programme
HiRIS	Human Resources Information System	LFV	ATS Stockholm
HLG	High Level Group of the European Commission	LMI	Logistics Management Institute
HMI	Human Machine Interface	LPS SR	Letové Prevádzkové Služby Slovenskej Republiky (Slovakia)
HMU	Height Monitoring Unit	LRI	Hungarian ATS provider
HQ	Headquarters (EUROCONTROL)	<b>M</b>	
HRM	Human Resources Management (EEC)	MA-AFAS	More Advanced Aircraft in the Future Air traffic management System
<b>I</b>		MADAP	Maastricht Automatic Data Processing and Display System
IAA	Irish Aviation Authority	MATOS	Modelling Actor's Tasks to Organise Specifications
IANS	Institute of Air Navigation Services	MCS	Multi aircraft Cockpit Simulator
IATA	International Air Transport Association	MEDUP	MEDiterranean Upgrade Programme
ICD	Interface Control Document	MER	Message Error Rates
ICAO	International Civil Aviation Organisation	MFF	Mediterranean Free Flight
ICAO-CAEP	ICAO Committee on Aviation Environmental Protection	MIM	Marketing and Information Management (EEC)
ICS	Internal Communication Support (EEC)	MIS	Management Information Service
IFATCA	International Federation of Air Traffic Controllers Associations	MIT	Massachusetts Institute of Technology
IFPS	Initial Flight Plan Processing System	MM5	Mesoscale Model version 5
IFPU-2	Initial Integrated Flight Plan Processing Unit -2	MMU	Manchester Metropolitan University
IIMG	Internal Information Monitoring Group	MSP	Multi-Sector Planning
IMASSA	Institut de Médecine Aérospatiale du Service des Armées	MODE-S	Mode Select (SSR Selective Interrogation Mode)
IMPACT	Innovative Methodology for the Projection of ATM Concepts onto the Training of ATCOs	MONICA	Mitigation Of the Noise Impact of Civil Aviation
INM	Integrated Noise Model	MTCD	Medium Term Conflict Detection
INO	Innovative Research (EEC)	MUAC	Maastricht Upper Area Control
INTEGRA	Advanced ATM Tool Integration Project		

**N**

NAS	Network Aera Storage
NASA	National Aeronautics and Space Administration (US)
NATS	National Air Traffic Services (UK)
NCAR	National Centre for Atmospheric Research
NCD	Network Capacity and Demand management (EEC)
NLR	Nationaal Lucht-en Ruimtevaartlaboratorium (NL)
NMC	Network Management Cell
NUP 2	New Up-Date Programme

**O**

OATA	Overall ATM/CNS Target Architecture
OCA	Oceanic Control Area
OCD	Operational Concept Document
OCP	Obstacle Clearance Panel
ODT	Operational Requirements and Data Processing Team
OPQ	Occupational Professional Questionnaire
OPS	Operational Services (EEC)
OTS	Off-the-Shelf

**P**

PACT	Portable EEC Capacity Tool
PATA	Polish Air Traffic Agency
PC	Provisional Council (EUROCONTROL)
PDA	Personal Digital Assistant
PDM	Process Definition, Implementation and Management (EEC)
PETAL	Preliminary EUROCONTROL Tests of Air/ground Datalink
PI	Performance Indicator
PMM	People Management Meeting (EEC)
PMP	Project Management Plan
POEMS	Pre-Operational European MODE S
PPD	Pilot Preference Downlink
PRC	Performance Review Commission
PRIF	PROC Interface Tool
PROC	PROCurement (tool)
PROVE	European ATC Pre-Operational Validation and Experimental trials platform
PRU	Performance Review Unit (EUROCONTROL)
PSDF	Paris South Departure Flow
PSG	Programme Steering Group
PSO	Programme Support Office (EEC)

PSSA	Preliminary System Safety Assessment
PWP	Pilot Working Position

**R**

RA Downlink	Resolution Advisory Downlink
RAIDS	Real-Time ATFM Interactive Demonstrator/Simulator
RIANNA	Research Into Aircraft Noise Nuisance Assessment
R&D	Research and Development
RDC	R&D Coordination (EEC)
RNAV	Area Navigation (ICAO)
RPF	Rapid Prototyping Facility
RT	Real Time
RTCA	Requirements and Technical Concepts for Aviation
RTD	Research and Technological Development
RVSM	Reduced Vertical Separation Minima

**S**

SARP	Standards and Recommended Practices
SAS	Safety Analysis and Scientific (EEC)
SBAS	Satellite Based Augmentation Systems
SBM	Support Business Manager (EEC)
SBU	Service Business Unit
SC	Staff Committee
SCS	Strategy Concept & System (EATMP Unit)
SCTA	Service Technique du Trafic Aérien
SDP	Simulator Development Programme
SDR	Special Advisor (EEC)
SEE	Society, Environment and Economy (EEC)
SEU	Software Engineering Unit (EEC)
SFM	Simulator Facility Management (EEC)
SHAPE	Solution for Human Automation Partnerships in European ATM
SHIELD	Safety through Harmonised Implementation of European Local Database
SICTA	Italian Consortium for Applied ATM Research
SID/STAR	Standard Instrument Departure/STandard Arrival Route
SIMMOD	Simulation Mode
SITA	Société Internationale de Télécommunications Aéronautiques
SMGCS	Surface Movement Guidance and Control System
SMS	Safety Management System

SMU	Social & Medical Unit (EEC)	UML	Unified Modelling Language
SOA	Senior Operational Advisor	UMST	Universal Mobile Telecommunications System
SOURDINE II	Study of Optimisation Procedures for Decreasing the Impact of Noise around Airports	URD	User Requirements Document
SPF	Strategic Performance Framework	<b>V</b>	
SPP	Service for Prevention and Protection at Work (EEC)	VDL	VHF Datalink Mode
SQS	Safety, Quality Management and Standardisation (EATMP Unit)	VHF	Very High Frequency
SRA	Strategic Research Agenda	<b>W</b>	
SRC	Safety Regulation Commission	WakeVAS	Wake Vortex Advisory System
SR&P	EUROCONTROL Supplier Relations and Policy		
SRS	Standard Routeing Scheme		
SRU	Safety Regulation Unit (EUROCONTROL)		
SSP	Sector Safety and Productivity (EEC)		
STCA	Short Term Conflict Alert		
STORIA	Software Tool for Online Recording and Interactive Analysis		
SurvITE	Surveillance Integrated Test bed for EATMS		
SWR	Signal Watermark Ratio		
<b>T</b>			
TAAM	Total Airspace and Airport Modeller		
TABASCO	Time-Based Conflict Detection		
TALIS	Total Information Sharing		
TAM	Terminal Control Area		
TCAS	Traffic Alert and Collision Avoidance System		
TEA	Toolset for Emissions Analysis		
TEN-T	Trans European Network - Transport (European Commission funding)		
TF	Task Force		
TIF	ATN Trials Infrastructure Project		
TIG	Transport, Infrastructure & General services (EEC)		
TIS	Traffic Information System		
TIS-B	Traffic Information Service-Broadcast		
TLS	Target Level of Safety		
TMA	Terminal Manoeuvring Area		
TMU	Total vertical error Monitoring Unit		
TOKAI	TOol Kit for ATM Investigators		
TORCH	Technical, Economical and Operational Assessment of an ATM Concept (achievable from the Year 2005)		
TRACEr	Technique for the Retrospective and Predictive Analysis of Cognitive Errors		
TTM	Tactical Traffic Management		
<b>U</b>			





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