Final Report For Publication

OPTAS B

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Project

Coordinator: **RED Scientific Ltd**

Partners: **Airsys ATM**

Flughafen Frankfurt-Main

Project Duration: 11 December 1997 to 11 May 2000

Date: **17 May 2000**

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OPTAS - FRAMEWORK 4 TASK 4.3.2/45

PART B

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**INCORPORATING OUTPUT DELIVERABLES TO
WORK PACKAGES 2, 3, AND 4**

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Version 1.0

17 May 2000

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EXECUTIVE SUMMARY

The 1990s saw a rapid growth in demand and consequently congestion at Europe's airports. This in turn has spurred increased research activity aimed at maintaining or improving capacity, efficiency and safety in the face of these pressures. The OPTimisation of Airport Systems, Part B (OPTAS B) Concerted Action was initiated by the European Commission under the Transport RTD Programme of Framework 4, in order to achieve an overview of the current state of these research activities, so as to assist in establishing priorities for future research.

The work programme for the project comprised two strands:

a) *a series of 4 Workshops attended by delegates nominated by the Member States, representatives of relevant international organisations and invited specialist speakers,*

b) *supporting technical analysis leading to the production of technical briefing documents in advance of each Workshop, and the maintenance of a database of relevant research studies, hosted on the project Website (www.red-scientific.co.uk/optas_b.htm).*

Of these, the Workshops constituted the core of the project. They provided an invaluable forum for the sharing and dissemination of knowledge and for debate between representatives with different viewpoints. It was therefore possible to elicit contributions from all of the major stakeholders in airport research:

➢ *Airport operators*

➢ *Air traffic control providers*

➢ *Airlines*

➢ *Research institutes*

➢ *Manufacturers*

➢ *Specialist consultancies*

➢ *The European Commission*

➢ *Regulatory agencies*

The presentations and discussions at the Workshops covered the following subject areas:

➢ *Passenger handling (including the handling of Persons with Reduced Mobility, new initiatives for passenger security, future terminal design)*

➢ *Environmental Impact*

➢ *A-SMGCS and related issues*

➢ *The use of simulation and modelling*

> *Operational procedures (APATSI, HALS/DTOP)*

> *ATFM (CFMU, Gate to Gate)*

> *Information Management (including Collaborative Decision Making (CDM))*

> *The role of airports in the Single European Sky*

In these discussions, it became clear that it is not always possible to discuss research in isolation from the policy objectives which the research is intended to support. For this reason, a panel of senior decision-makers from a range of stakeholder organisations were invited to contribute to a discussion during the final session of the last Workshop.

The closing discussion served to draw together the findings of the project as a whole. OPTAS B has thus succeeded in bringing together a sufficiently wide range of viewpoints and backgrounds to achieve a broadly based overview of the scope and future direction of airport related research. A number of key findings can be identified:

> *The need for a **top-down and system approach to the definition of research priorities**, in order to promote a common "road map" for continued research and to foster the dissemination of best practice. It is recognised that this must be managed within the international regulatory framework of ICAO, with clear direction from the European bodies, including the European Commission and Eurocontrol.*

> *The need for **standardisation** of*

   ♦ *requirements for passenger mobility and security issues*

   ♦ *safety levels procedures, with a risk based approach to implementation*

   ♦ *airport capacity models*

> *The need for **commonly agreed definitions and metrics** for:*

   ♦ *airspace and airport capacity*

   ♦ *movement rate*

   ♦ *passenger throughput*

> *The need to **remove existing barriers to communication between stakeholders.** In particular, there is widely felt to be a need to extend the concept of CDM to the harmonisation of planning over the medium and long terms and at the strategic level. This will require the establishment of channels for information exchange which do not currently exist.*

> *The need for greater flexibility in the functionality provided by the **CFMU**. In part, this concerns the greater sharing of information between airports and the CFMU.*

> ***A-SMGCS*** *is seen as an important enabling system for surface movement solutions, for enhancing airport capacity and reducing emissions. Its continued development and introduction into service needs to be supported by:*

> ♦ *a tangible cost/benefit analysis*

> ♦ *the establishment of a common/flexible implementation methodology*

> ♦ *contribution to AOPG PT/2 in the development of requirements*

> *The importance of current work on **Arrival, Departure and Surface Management planning tools** (AMAN/DMAN/SMAN) is recognised, but these tools need to be integrated.*

> *The role of **Eurocontrol** is key to many of these issues. Although it is recognised that Eurocontrol is working as well as possible within its present funding constraints (triple 0), it must provide sufficient resources to tackle all the priority issues adequately. The high priority items should be given equal weight and not further prioritised. More support and collaboration is required between the European Commission and Eurocontrol, cutting out the red tape.*

CONTENTS

DEFINITIONS AND INTERPRETATION

Unless the context otherwise requires, the following expressions shall have the following meanings:-

ACI	Airports Council International
ACMTF	Airport Capacity Modelling Task Force
AIRPORT-G	Airport Integrated Research & Development Project for Operational Regulation of Traffic-Guidance
AMAN	Arrival MANager
AND	Approximate Network Delays
AOPG	Aerodromes Operations Group
AOPG/PT2	AOPG Project Team 2
AOT	Airport Operations Team
APATSI	Airport Air Traffic Services Interface
ARAMIS	Advanced Runway Arrivals Management to Improve airport Safety and efficiency
ARTS	AiRport Terminal Simulation
A-SMGCS	Advanced Surface Movement Guidance and Control System
ATC	Air Traffic Control
ATCSCC	Air Traffic Control System Control Centre
ATFM	Air Traffic Flow Management
ATHOS	Airport Tower Harmonised Controller System
ATM	Air Traffic Management
ATOPS	A-SMGCS Testing of Operational Procedures by Simulation
ATS	Air Traffic Service
BAA	British Airports Authority
BETA	operational Benefit Evaluation by Testing an A-SMGCS

CAA	Civil Aviation Authority
CDM	Collaborative Decision Making
CFMU	Central Flow Management Unit
COTS	Commercial Off-The Shelf
CTOT	Calculated Take-Off Time
CWP	Controller Working Position
DA VINCI	Departure and ArriVal INtegrated management system for Co-operative Improvement of airport traffic flow
DAFUSA	Data Fusion for Airports
DARTS	Departure and Arrival Traffic Management System
DEFAMM	Demonstration Facilities for Airport Movement Management
DMAN	Departure MANager
DOP	Daily Operations Plan
EANPG	European Air Navigation Planning Group
EATMP	European Air Traffic Management Programme
EC	European Commission
ECAC	European Civil Aviation Conference
ENPRM	European Notice of Proposed Rule Making
ESME	Enhanced Simulation Modelling Environment
ETFMS	enhanced situation display facility
EU	European Union
F&CM	Flow and Capacity Management
FAA	Federal Aviation Administration
GPS	Global Positioning System
GTG	Gate To Gate
HALS/DTOP	High Approach Landing System / Dual Threshold Operation
HERMES II	HEuristic Runway Movement Event Simulation model

HLA	High Level Architecture
IACA	International Air Carrier Association
IATA	International Air Transport Association
ICAO	International Civil Aeronautical Organisation
ID	Identity
ILS	Instrument Landing System
LAHSO	Land And Hold Short Operation
MACAD	MANTEA Airport Capacity and Delay Model
MAICA	Modelling and Analysis of the Impact of Changes in ATM
MANTEA	MANagement of surface Traffic in European Airports
MATSE	Meeting (of ECAC Ministers) on the Air Traffic System in Europe
MIT	Massachusetts Institute of Technology
NAS	National Airspace System
NASPAC	National Airspace System Performance Analysis Capability
NATS	National Air Traffic Services
OPTAS A	OPTimisation of Airport Systems, Part A
OPTAS B	OPTimisation of Airport Systems, part B
PRC	Performance Review Commission
PRM	Person with Reduced Mobility (landside context) or Precision Runway Monitoring (airside context)
PTR	Passenger Tracking Record
R&D	Research and Development
RACAP	Rapid Airport Capacity Analysis Package
SAMS	SMGCS Airport Movement Simulator
SE	Simulation Environment
SEEDS	Simulation Environment for the Evaluation of Distributed traffic control Systems

SIMMOD	Airport and airspace SIMulation MODel
SIRO	Simultaneous Intersecting Runway Operations
SMAN	Surface MANager
SPT	Simplifying Passenger Travel
SWIM	System Wide Information Management
TAAM	Total Airspace and Airport Modeller
TAPE	Total Airport Performance and Evaluation
TFM	Traffic Flow Management
TMS	Terminal Management System
TOSCA	Testing Operational Scenarios for Concepts in ATM

Unless the context otherwise requires, words denoting the singular shall include the plural and vice versa, and words denoting any gender shall include all genders.

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1.   PROJECT OVERVIEW

1.1.   Background

The 1990s saw a rapid growth in demand and consequently congestion at Europe's airports. This in turn has spurred increased research activity aimed at maintaining or improving capacity, efficiency and safety in the face of these pressures. The OPTimisation of Airport Systems, Part B (OPTAS B) Concerted Action was initiated by the European Commission under the Transport RTD Programme of Framework 4, in order to achieve an overview of the current state of these research activities, so as to assist in establishing priorities for future research.

1.2.   Project Structure

The work of the project was divided into 4 Work Packages (WPs) as follows:

WP1 Project Planning. This included the production and maintenance of the Project Management Plan (PMP), 2-monthly Management Reports and annual Progress Reports.

WP2 Review, Assessment and Consolidation of Study Material. This WP involved gathering relevant study material, which could form the basis of the synthesis activities to be conducted in WP3. The references were collated into a bibliography database, which was then made available to delegates and other interested parties via a Website maintained by the project (www.red-scientific.co.uk/optas_b.htm). These activities were reported in a draft form in a briefing paper issued at the second Workshop.

WP3 Preparation of Synthesis Documentation. Briefing papers were prepared in advance of the last two Workshops, which provided an overview and evaluation of the state of research in the areas covered by the Workshop sessions.

WP4 Workshops and Dissemination Activities. This WP covered the conduct of the Workshops, the preparation of proceedings and follow-up activities to elicit feedback from the participants. It also covered additional dissemination activities, including the setting up and maintenance of the Website.

WP5 Administrative Support. This WP covered the various administrative tasks associated with Workshop organisation, such as arranging venues, informing delegates and processing expense claims.

1.3.   Report Scope

The original Project Management Plan [1] defines the following major deliverables (in addition to the bibliography database):

➢ D2 Report on WP2 – Consolidation. This would report on the activities undertaken to gather references on airport related studies and research programmes.

➢ D3 Report on WP3 – Synthesis. This would provide a critical assessment of the available studies material.

➢ D4 - Workshop Proceedings and feedback.

After discussions with the European Commission Project Officer, it was agreed that these outputs should be combined into a single Final Report. This report therefore documents the work conducted under WPs 2, 3 and 4.

1.4.   Structure of This Report

Each of the major strands of the project are reported in the following sections.

➢ Section 3 summarises the Workshops which formed the core of the project, including the feedback which was obtained from delegates. Much of the value of the Workshops came from the round table discussions and question-and-answer sessions, which are fully documented at Annex B. This Section also reports briefly on the Website which was maintained throughout the project.

➢ Section 4 documents the work of WP2, consolidation. This is based on a draft document which was presented as a briefing paper for Workshop 2, and describes the activities undertaken to gather references and the design and implementation of a bibliography database, which is now hosted on the project Website.

➢ Section 5 presents the results of the synthesis activities of WP3. It is based on the content of the Workshop briefing documents.

➢ Section 6 presents conclusions and recommendations.

In addition, there are 3 Annexes.

➢ Annex A contains a complete attendance list for each Workshop.

➢ Annex B contains detailed minutes of the question-and-answer sessions and the round table discussions held at each of the Workshops

➢ Annex C contains a sample of the feedback questionnaires which were distributed to the participants after each Workshop.

2.   WORKSHOPS AND OTHER DISSEMINATION ACTIVITIES

2.1.   Overview

Four workshops were held during the course of the project. These were attended by delegates nominated by EU Member States and Associated States and by representatives of governmental and international organisations with a stake in airport research (a full attendance list is appended at Annex A). The format of each workshop involved a combination of formal presentations by invited speakers and round table discussions, to which were invited from all delegates to contribute.

Comprehensive proceedings were produced for each workshop, which included a full record of the question and answer sessions and the round table discussions. These are reproduced at Annex B.

It was recognised from the outset that a high level of input from the delegates, in the form of feedback and comments, would be crucial to the success of the project. Initiatives such as the Web forum were put in place in order to encourage this. Unfortunately, the Web forum was not extensively used, with the result that further initiatives were put in place to elicit feedback. The most important of these was a questionnaire, which each delegate was requested to complete and return after each of the workshops. A sample questionnaire (for Workshop 4) is at Annex C.

One specific area for which feedback was invited was the choice of topics for the subsequent workshop. After the 2nd workshop, it was decided to take this process a stage further by asking the delegates to vote on their preferred topics for the 3rd workshop. This approach seemed to work well and certainly contributed to the success of the 3rd workshop. Although time constraints prevented the exercise being repeated for the 4th workshop, the topics were in fact chosen with close reference to the views expressed in the questionnaires.

The workshops were attended by representatives from the following States and organisations:

International Organisations	ATC Providers	Research Institutes	States	Governmental Organisations	Industry	Airport Operators
ACI-EUROPE, ADV, AECMA, AOPG/PT2, DGAC, ECAC, ETP, EUROCAE, EUROCONTROL, IACA, IATA, ICAO,	LRI, NATS	DLR, ONERA	Austria, Belgium, Czech Republic, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Portugal, Spain, Sweden, The Netherlands, United Kingdom	European Commission, FAA, French Ministry of Transport	AIRSYS ATM, ALCATEL ANS, ISR, Alenia Marconi Systems, Dassault Electronique, Isdefe, Halcrow Fox, RED Scientific Ltd, SEA, SIEMENS, SITA	AENA, BAA, Frankfurt Airport

Table 2.1 States and Organisations represented at the Workshops

The format and content of each Workshop, as reported in the proceedings, is summarised below, together with a summary of the feedback which was received from the questionnaires.

2.2. The OPTAS B Web Site

The OPTAS B Website (www.red-scientific.co.uk/optas_b.htm) has been hosted by RED on its own corporate Website. The purpose of the site was to provide a single point of access for information related to the project. This included:

➢ Announcements of Workshop dates, venues etc.

➢ Downloadable electronic copies of project documentation, including Workshop agendas, briefing documentation, proceedings, registrations forms, questionnaires etc.

➢ A downloadable copy of the bibliography database reported in Section 3 below.

➢ Links to other relevant sites, including the European Commission, CORDIS, EUROCONTROL, ICAO, ACI-Europe sites and the OPTAS A project Web page.

In addition, the site provides an email forum which allows delegates to supply feedback comments to the project team and to other registered delegates.

2.3.   WORKSHOP 1

OPTAS B Workshop 1 was held at the European Commission's offices at Beaulieu, Brussels on the 25 Jun 1998. It consisted a single session as follows:

➢ Welcome from the Chairman

➢ Presentation 1 - The OPTAS B Project

➢ Presentation 2 - Use Of R & D To Support Air Transport Issues

➢ Presentation 3 - Persons With Reduced Mobility In The Air Transport Environment

➢ Presentation 4 - R & D To Support Airport Issues For Gate To Gate Air Traffic Management

➢ Presentation 5 - R & D To Support Future Business Needs

➢ Presentation 6 - R & D The Airlines View On Needed Research Activities

➢ Presentation 7 - Environmental General and Specific Lessons

➢ Round table discussion (see Annex B)

2.3.1. Welcome from the Chairman

The chairman, Mr Cesare Bernabei, welcomed everybody to the Workshop. It was emphasised that the European Commission's initiative was to draw into an open forum research and development studies done within the aviation world which address the concerns of ever increasing capacity demands to be satisfied by restricted capacity. The aim was to target a limited amount of the most relevant work to ensure that lessons learnt are given the widest publicity. There was also the need to establish where there are gaps in research and development work and to possibly target resources to cover these gaps.

2.3.2. Presentation 1 - The OPTAS B Project

The Project Co-ordinator from RED, Mr Graham Cole, gave a presentation on the workings of the project.

Main Areas of Work. The jointly agreed approach for OPTAS B can be split into 2 main areas of work, firstly, research and collection and, secondly, dissemination:

a) Research and Collection:

(i) Here the consortium will compile a bibliography of all the studies we find and carry out a short synthesise or summary of each. These findings will be compiled on a Microsoft Access® database for ease of searching and use.

(ii) For the studies which the delegates and we believe have significant findings to offer, a detailed study will be carried out by one of the consortium companies. This will be automatically linked to the bibliography database.

(iii) We will also take as inputs, topics which are discussed at the Workshops, direct study material from delegates and the conclusions of any discussions from the Workshops.

b) Dissemination:

(i) The OPTAS B WEB page, which will be linked to the European Commission's CORDIS information WEB site in due course is the main means of publicly decimating the projects findings. On this site database work and detailed studies will be available for anyone to access.

(ii) We will also organise 4 workshops, including the one already held on the 25 Jun 98, at which we will disseminate further work and discuss the findings.

(iii) However, the key is delegates' participation. It is relatively easy to obtain European Commission, Eurocontrol and other public studies, but what of the other work being carried-out by EU and EUA Nations throughout Europe?

The aim of the OPTAS B project, as stated earlier, is to review, discuss and disseminate studies from the European Commission, international, National and independent organisations which have a positive contribution to the enhancement of airport capacity and systems for the next 7 to 10 years. Where:

a) By European Commission we mean any R & D work done on their behalf in recent past.

b) International means studies done by organisations such as IATA (International Air Transport Association), Eurocontrol or ACI.

c) By National, we mean the work of EU and EUA Nation governments and political organisations.

d) With independent we include any commercial or academic organisations which are producing work involved with airport capacity research and development.

It is obvious that much R & D work is done by the European Commission, Eurocontrol IATA and the like, particularly on the airside topics. But it is also very obvious that there <u>appears</u> to be a lack of work being done on land-side issues. For instance, its all very well for Eurocontrol to progress EACHIP [6] and its Gate-to-Gate concepts or Aerospatiale to introduce the future large aircraft, 3XX, but how do airports and airport infrastructures plan to cope with these initiatives and the more general expected significant rise in demand for air travel?

If one looks at the work freely available at present, one could conclude that airports are not preparing for the future. This is a statement that the consortium and the commission do not believe to be true. On the contrary, we believe that EU and EUA Nations, airport companies and contractors are doing a vast amount of work.

The European Commission and consortium believe that lessons are being learnt and experience is being gained which is not published to a wide audience, not discussed openly, nor is it made available for others to either learn from or develop further. This must be directly due to the fragmentation of the airport industry across Europe into far more individual competitive commercial concerns than say the airline industry.

So the commission, through OPTAS B and other initiatives, intends to draw all this valuable work into the public domain for open discussion and dissemination - so that lessons are not continually being re-learnt across the industry.

The Workshops are intended to be a forum at which EU and EUA Nations can discuss airport capacity work and perhaps direct R & D funding towards initiatives which delegates and the commission view as being significant and valuable to the airport industry of Europe.

The project consists of 5 Work Packages (WP):

a) WP 1, was the initial setting-up phase, which is now complete so we shall say no more. Associated with this initial phase the OPTAS B WEB page was set-up.

b) WP2, is where the consortium does the initial bibliography and synthesis work.

c) WP3, is the detailed study of selected significant studies and linking those to the WP2 Access® database.

d) WP4, is the dissemination phase, through the Workshops and the OPTAS B WEB page.

e) After each Workshop we re-visit WPs 2, 3 and 4 to continue the cycle for 4 times until after the final, 4th, Workshop.

f) And the final WP, number 5, is the administrative support required to keep the project running smoothly.

The first Workshop was designed to lay the foundation for the other 3 that follow over the next year and a half. If necessary, the format of the future workshops may be changed, but for the first Workshop we decided on the format of asking speakers to present topics to stimulate debate and closing with an open forum, at which delegates raised topics which they would like to see discussed at future Workshops.

2.3.3. Presentation 2 - Use Of R & D To Support Air Transport Issues

Mr Eckardt Seebohm from the European Commission's DG TREN, Transport Directorate C, Airport Policy, Environment and Other Common Policies. He discussed the working of the Single Market which is particularly important in the context of airline commercial operations (Directorate C-1), exemplified in Third Package of liberalisation measures, CRS codes of conduct, and Slots regulation. Although, there is not much of an immediate R & D linkage, there is plenty of scope for specialist policy and fact-finding studies which policy units finance themselves. But liberalisation increases demand for airport and en route capacity, hence the need for Slot control.

Another aspect is ensuring that State aid does not distort the aviation market and generally checking that Community law is respected in the air transport field (Directorate C-2). Again there is no direct R & D link, but note that capacity availability and provision must be non-discriminatory.

Air Traffic Management, Airworthiness, Flight Safety (Directorate C-3):

a) Close links to R & D, with particular emphasis on area of Air Traffic Management (ATM).

b) With Gate-to-Gate concept, no artificial division between airport and en-route aircraft movement.

c) Thus we welcome work on, for example:

    (i)   Wake vortex measurement and separation.

    (ii)   Advanced Surface Movement Guidance and Control Systems (ASMGCS).

    (iii)   Airport Tower ergonomics for controllers.

    (All these, and more are included in the European Commission's 4th Framework R & D Programme).

d) Basically these areas of research address the problems of, once again, - capacity.

Airports and Environment (Directorate C-4):

a) Note how these two areas (airports and environment) are put together under one Unit, because until recently the only publicly recognised air transport environmental impact was at airports:

    (i)   Noise.

    (ii)   Land-take.

    (iii)   Access road construction.

    (iv)   Waste treatment.

a) Now we have to grapple with 'greenhouse gas' emissions:

    (i)   At airports in the Landing and Take Off (LTO) cycle.

    (ii)   At altitude en route (Kyoto, economic instruments).

a) Basically there remains a capacity problem - but it has become infinitely more complex. We need environmentally acceptable capacity.

b) That is a tall order but it is not enough in itself. We need R & D back-up and technical guidance to achieve safe, competitive, sustainable mobility, why?

The Capacity Crisis

Airport operators, and perhaps Community functionaries in the air transport field, are sometimes compared to farmers. 'There is always a problem - too hot, too cold, too wet, too dry. However, there really is a capacity problem in air transport, and not just because we have liberalised the market and stimulated growth.

Last year, over 700 million passenger movements were handled at Community airports (75% of them through +/- 30 airports out of >300 in the TENs). That means at least 350 million passenger journeys in Community airspace. And something of the order of 2 billion surface journeys to and from airports by passengers, 'wavers and weepers', employees, etc. Numbers like that already have at least a local crisis dimension. Sometime between 2010

and 2015 - three Word Cup finals from now - those numbers are going to double.   We are encouraging the building of new airport capacity (Spata, Lisbon) and the extension of existing airports (Arlanda, Madrid). But we cannot rely on 'predict and provide' to meet growth rates of between 5 and 7 per cent per year for the foreseeable future. We must make much better use of the airport and en-route infrastructure and facilities that we already have. Particularly apposite in considering ATM procedures, techniques, systems (their architecture and operability), but also important on the ground.

It seems likely that whatever the trends in average aircraft size, we are going to have to find safe ways of squeezing more aircraft into smaller space - safely. Reduced separation (backed by proper research, procedures, software, manpower and training can increase runway capacity without the addition of a single metre of concrete and all the environmental upset the planning permit for that can cause.

We must also start thinking not only of Gate to Gate but of Door to Door. There is no point whatsoever in pouring research effort and construction money into overcoming aircraft congestion, merely to move the congestion problem onto roads outside the airport gate.

We are looking more and more to the support of air transport by connecting airports to high speed, heavy and city-link rail systems. Not just for passenger access but to offer an alternative over appropriate distances, so freeing airport slots and en route airspace. There has been a Cost 328 programme on this very interaction, but we need more R & D work on airport inter-modality - that includes demonstration projects. Let us see a totally seamless Door to Door journey for passengers and freight, for smoother and thus faster higher capacity flow. (Smart ticketing, integral design of physical facilities, concern for those with reduced mobility - don't forget that includes the slow elderly walkers, the middle-aged, blind, deaf and lame, and the young mothers with pushchairs).

Quantification: We do accept that it is no use us crying for help in a crisis unless we can measure the size of the problem. What is the capacity of an airport? We have for years tried, with professional bodes, to arrive at a measurement methodology. It is certainly more than:

(1)   Declared capacity in runway movements per hour.

(2)   Design capacity to a given Level of Service in the check-in area.

(3)   The rate of security search or number of bags matched (to new 100% standards soon).

It must surely be a model-able concept, of the whole airport, airside and land-side, its en route interface and its access modes, so that airport designers and operators, not just modellers, can understand and apply model results to ensure the most efficient use of resources. We have had the TAPE (Total Airport Performance and Evaluation) prototype under Framework Programme 4, now we have the OPTAS A running. We know of work going on at the French DGAC. And it seems the Eurocontrol sponsored, Airports Database Users Group is also looking at it. No doubt that is a partial list. We say yes, to these variety of approaches, a degree of cross checking, even an element of professional competitiveness, but no to wasteful duplication.

Last but not least, we see new perspectives in aeronautics as a theme of Framework Programme 5. Those perspectives must be environmentally acceptable air transport. Considering the earlier mentioned problems of expanding physical airport capacity and

bearing in mind Muenchen (J Stauss) 30 years gestation from conception to birth and Heathrow Terminal 5's Public Inquiry running into its third year, environmental constraints are perhaps the major problem for airport capacity expansion.

Some environmental work is already being addressed by DG Information Society and DG Research - engine design, nacelle insulation, emission reduction at source, NOX/CO_2 trade-off problems. We need progress in order to devise, implement and enforce a reasonable programme of stringency and/or economic measures to reduce environmental impact.

We also need to explore with the Workshop delegates, at the transport research programme level, the environmental impacts of aviation and the consequences of their alleviation. That is one area I want to see discussed at the OPTAS B Workshops, as a 2-way dialogue, and ensure that a real respect for our environmental responsibilities is built into the OPTAS-B programme as well as other research tasks.

2.3.4. Presentation 3 - Persons With Reduced Mobility In The Air Transport Environment

Mrs Danae Penn from the European Commission's DG TREN, Transport Directorate B2, gave a presentation on the use of public transport by People of Reduced Mobility (PRMs). This includes the mobility, sight or hearing impaired and also passengers with large baggage and persons carrying or accompanied by children.

The traditional enemy of PRMs is the architect, despite the fact that non-discrimination of disabled people is a requirement of the Treaty of Amsterdam and the policy of accessible public transport is set out in several European Commission documents, including the Resolution of the Ministers of Transport in 1991 requesting the Commission to draw up a Community Action Programme on the accessibility of transport to PRMs, the Commission's 1992 White Paper on the Future Development of the Common Transport Policy, and the Action Programme itself. This includes a standards directive on accessible airports and aircraft, to be based on the work of the ECAC (European Civil Aviation Conference) Facilitation Sub-group on transport of persons with reduced mobility. Airports must therefore consider PRMs.

In 1990, the 269/90 Manual Handling of Loads (European Commission Directive) laid down rules concerning handling loads such as carrying wheelchairs and heavy objects. It is now against the law to lift such things.

There are estimated to be 36 million disabled tourists in Europe (Touche Ross Survey). It is further estimated that for every 1000 people 3 are wheelchair users. Disabled tourists account for 36 million movements per year. PRMs number 30 to 40% of the population, which is increasing as the general population gets more elderly. These PRMs need quality of service, comfort and speed of travel. PRMs are categorised into the following groups:

Disabled	2.9%
Aged	14.8%
Children	7.1%
Pregnant	0.2%
Travellers with baggage, children walking or in pushchairs	5 to 15%

Table 2.2 PRM Categories

The step-less airport is considered to be the best solution to PRM (Person with Reduced Mobility) mobility. Many initiatives have already come from airports, such as low floor buses, first developed to assist aircrews with their baggage, were later developed in Germany and now revolutionise travel by bus throughout Europe and are accessible by wheelchair users.

Airport planners and operators should try out being a PRM, first play a hard game of tennis to simulate the fatigued PRM, then try and progress through your airport, either with luggage, blindfolded, or with children. Thereby thinking as a PRM and realising what problems your airport poses to them.

Have an accessibility audit conducted by whomever is responsible for the fixtures and fittings at your airport. Improve relations with airlines and travel agents (the Tourism Unit in DGXXIII of the European Commission has a handbook on this topic).

Airports should develop and publish a handbook, like Paris CDG, which can be read by PRMs before they come to the airport. It should give the best advice to PRMs making their journey through the airport as easy as possible. Airports should not forget the transfer PRMs who often need assistance to arrive timely for departure. Transfer straight from aircraft to aircraft, without going through the terminal is a distinct advantage for PRMs. Initiatives in all of these areas, with improved throughput of passengers, have a direct relationship to improvements for business and other enhanced class travellers.

Airports are in a 'win – win' situation, improved quality of service, comfort and speed help all, not just PRMs.

2.3.5. Presentation 4 - R & D To Support Airport Issues For Gate To Gate Air Traffic Management

Mr Eric Miart from Eurocontrol gave a presentation on supporting airport issues for gate to gate air traffic management.

Eurocontrol Revised Convention. The main reasons for the revision of the Eurocontrol convention were:

a) A need for an improved institutional and legal framework consonant with the current and possible future activities and to strengthen the Organisation's action in the implementation of the major programmes in the field of European Air Traffic Management within the political context defined by Member States.

b) A need to provide a framework covering the needs of all those involved – the Member States and the Co-operating States, the European Union, the relevant international organisations and the airspace users (civil & military), the ATM service providers, airports – to avoid any duplication of effort in Europe.

c) A need to adapt legal situation to the actual circumstances and to review the decision-making machinery within Eurocontrol to facilitate effective action for the improvement of Air Traffic Management in Europe, making more extensive use of the decisions by majority rather than unanimity, improving the representation of the users in the decision-making processes and ensuring adherence to all rules, standards and specifications developed by the Organisation.

Gate to Gate can be defined as:

a) Seamless service to flights.

b) No artificial barriers in operations.

c) Consistent decisions.

The basis for complying with this concept is the development of the ATM Strategy for 2000+ and the clear identification of programmes linked to strategic objectives and delivering benefits in a cost beneficial way.

In 1990, ECAC Strategy for the 90's + APATSI (Airport Air Traffic Services Interface) was devised. The split of responsibility was at the approach fix for the arrival segment & after departure for the departure segment. This did not really work well as it was an artificial split, not gate to gate, and so too much co-ordination was required. Eurocontrol has not yet all the necessary expertise to carry on with airport matters. However, Eurocontrol is aware of the problem, and will catch up soon with the internal "EATCHIP Adaptation Process" being completed.

The ATM Strategy for 2000+. ATM Strategy for 2000+ is a single gate to gate document providing a framework of change. 2015 has been set as a practical planning horizon, with the document building on previous and current work. The ATM Strategy 2000+ is based on agreed and monitored system performance objectives and aims to create an umbrella strategy under which sits mature operational and technical strategies, e.g. ASM, R&D, CNS. ATM Strategy 2000+ requires the commitment of the states, providers and users, and is supported by the institutional change that will secure implementation of the strategy. It also aims to provide clear rules/principles for decision-making and resource allocation, and a dynamic process through time. The ATM Strategy for 2000+ is mainly looking /focusing on performance needs (i.e. capacity increase), it is not an air transport strategy.

Nevertheless, it is recognised that the airport network capacity and the airspace capacity have to be consistent, and that, at a given airport, the ATM system shall be able to accommodate the traffic levels resulting from the demand and the use of infrastructure and land-side operations.

The general principles for the management of the strategy:

a) What is the management framework of the ATM Strategy for 2000+ ?

b) Here you find a "V" approach model that describes the general principles for the management of the strategy.

c) Framework: the ECAC Institutional Strategy. The general principles are based on agreed uniform objectives and consider the needs, safety issues, CBA, system engineering and resources. The general principles are:

    (i)   CIP procedures/mechanisms + enhancements.

    (ii)   Regional approach wherever beneficial & possible.

    (iii)   Local implementation: a State responsibility.

      (iv)   Overall management by Eurocontrol, where specialist domains create expertise.

ATM 2000+ Strategy Roadmap follows the path of Performance Objectives, Operational Improvements, and Enablers. One more process is airport Air Trafic Control (ATC) which implies change through time and calls for Research and Development (R&D).

An ATM R&D strategy has been prepared to support the ATM 2000+ Strategy and improve the efficiency of R&D in ATM. "Airport capacity and Ground Operational Efficiency" is recognised as being one of the main R&D areas (see yellow book, issue 3.2, dated 11th March 1998). With appendix C providing some of the R&D programme's detailed objectives. The yellow book is available on request, to Eurocontrol.

Airports R&D Needs. Lets now present some current axes for R&D already on going within EUROCONTROL (this list of 17 items has been established by the IAG and is supported by airports and airlines). No specific order has been given to the list and it should be noted that aerodrome and surrounding airspace R&D needs merge. However, this list comprises of needs only and does not represent a complete programme at this stage:

a) AMAN (Arrival MANager), DMAN (Departure MANager), PHARE Arrival & Departure Managers, PARADIGMS (integrated Arrival, Departure and Ground Movement System + prototype of advanced R-NAV).

b) Advanced Surface Movement Guidance and Control System (A-SMGCS) assistance tools related to surveillance, control, alert, routing, planning, and guidance. AGATE OCD, phase II business case by end 1998.

c) CADS (Computer Aided Departure Sequencing) demo prototype.

d) Wake Vortex as part of the study carried out by Eurocontrol under the ASM 6 project.

e) Runway capacity modelling addressing the provision of a tool set to support the development of new procedures e.g GNSS/EGNOS (NAV4), SAPPHIRE precision approach module (NAV4), navigation system applications (NAV1).

f) Use of radar vectoring to increase the airport capacity (not yet started).

g) RNAV/FMS procedures: mainly SIDs & STARs, airport + TMA ATC procedures (PANS-RAC), TMA NAV/RNP system requirements , PANS-OPS procedures, TMA Organisation.

h) Database of current and future Airport projects (more or less the above and continuing lists).

i) ATM environmental issues.

j) ASADO project (ODIAC Task Force D/L, airport surface movement surveillance & data communications service).

k) FDP (part of ODP5 project).

l) Development & validation of airport procedures (ASM3 Project).

m) Development & validation methodology for ATC (ASM3 Project).

n) ATC Capacity Studies (ASM6) + CODA Delay Analysis (ASM7) + Airport Database (former APATSI DB).

o) ATFM/Airports: concerns the deliberations of the Eurocontrol Air Traffic Flow Management (ATFM) group (EAG) which shall advise the Eurocontrol DG on issues related to the development and operations of the common European ATFM System within the framework of a uniform European ATFM System (EATMS).

In summary, ATM has Airport R&D needs but not all are necessarily budgeted for in the Eurocontrol Agency or the United States. Eurocontrol is happy that other organisations have some budget. European Commission R&D objectives are larger than those of the Eurocontrol Agency however, there exists an overlap and or/common part.

2.3.6. Presentation 5 - R & D To Support Future Business Needs

Mr Robert Drew from BAA plc UK, gave a presentation on future business needs. In the next 15 years aviation traffic is expected to double. There is obviously a limited space for expansion and environmental constraints are very real. Its a frightening prospect. The Heathrow Terminal 5 enquiry has concentrated on environmental issues. Annual growth since 1989 over the top 10 European airports has continued to grow, with the exception of 1991 which was due to the Gulf War. Transfer movements continue to increase at hub airports which mean double the amount of aircraft movements per passenger. Building more infrastructure is not always the answer, other options need to be explored. There are strict constraints on what we can do, so we need to be creative and innovative. R & D is essential to this improvement.

Demand at Heathrow has doubled in the last 10 years for transfer passengers, other non-transfer movements have increased by one third over the same period. The extra transfer movements puts a double strain on the airports capacity.

The drivers for traffic growth are the reduced cost of tickets through deregulation, growth of the global economies, global business and companies and the marketing of tourism globally.

Building infrastructure is not the main answer, maximising the utilisation of assets by processing off airport, changing the way we do things through R & D, mixing long-haul and short-haul operations to make better use of terminal capacity by redistribution and to make the transfer from long to short haul easier. Encouraging alliances between long and short haul carriers. Apron space is a primary constraint for the longer term, therefore, multiple type stands and greater flexibility for parking large and smaller aircraft will be beneficial. Improvements in decision making software, thereby optimising elements such as stand allocations and to optimise the use of apron space are needed.

Improvements to airport transport systems are required. Further development is needed with rail and bus operators. Off airport remote check-in supported by these operators is a way to go. British Airports Authority (BAA) already operates remote check in at London Paddington Railway Station for Heathrow and London Victoria for Gatwick. These help passengers, including PRMs, and gives the airport the ability to manage baggage delivery better. Manchester Airport also has a remote baggage check system working in the local area.

Making different handling agents share check-in facilities and communications and data management systems is efficient and should be encouraged. Airlines have to be brought along to this way of working.

Improved information sharing, with the sharing of information around companies so that delays can be anticipated and managed. Short term demand forecasting prompting changes in structure and the forming of trouble shooting teams within an airport who can be targeted at a short term problem to resolve it with the minimum of delay.

Forthcoming activities on which further research is needed are passenger and baggage tracking to anticipate delays and identifying problems before they occur. This fits with the Gate to Gate initiative where we want to be able to anticipate late departures.

Machine readable passports, electronic ticketing, smart cards and ATB2 all have a place in improving passenger flow and therefore capacity.

Improved passenger flow by the segregation of passengers, this could be a major problem, but could possibly be addressed by 'virtual' segregation of people. Enhanced and new simulations have a part to play, with the use of virtual reality front ends to applications. The use of design flow rates, where airline forecasts are inputted into a schedule generator/analyser would be useful.

We must make the best use of the capacity we have and be sensitive to different demands on functional components.

In summary, the rapidly growing demand is at crisis point. Heathrow is losing traffic due to capacity constraints to other airports such as Gatwick, pending Terminal 5. R & D is important in addressing these problems and there is an element of not sharing and talking within the industry and with customers. Airports need to meet the growth in demand profitably, maintaining safety and service. It is crucial that airport resources are fully and effectively utilised to this end. Airports must work closely with their airline customers to achieve this. Technological developments offer scope for process improvement, information sharing and efficient resource planning.

2.3.7. Presentation 6 - R & D The Airlines View On Needed Research Activities

Capt Christian Bousmanne from IATA gave a presentation on the airlines view of required research. Competition between airlines to attract the ever-increasing number of air travellers has resulted in a high airline demand upon airports to increase capacity. This competition is not just between European airlines but includes the many non-European airlines that use, and demand the use of, European airports.

R&D so far has developed good foundations with early work on cost-effectiveness, but the working effort of R&D within the air environment is being under taken through many non-compatible systems, e.g. various European Nations, International Organisations, etc. Research has to start with the same basic standards and values that are validated and accepted by everyone. Once this has been achieved we can then have full harmonisation of the whole system to obtain the maximum benefit from R&D. This is an immediate requirement as the air travel environment is fully saturated, time is not running out, it has already run out.

First we need to consolidate the overall picture of the air travel industry, what has been achieved and what are the actual technologies. Then define the need and requirements of

the industry, otherwise the diversity between all the different bodies involved in the industry might not provide optimised solutions.

Environmental problems are more political problems. R&D must research the full extent of solutions available, ignoring the environmental constraints, because environmental constraints may change in the future. R&D must not be limited by current environmental policies.

IATA fully supports the European Commission in this OPTAS B project. The air travel industry has a real need for the collaboration of expertise.

Finishing Question – Why not develop a Collaborative Decision Making process (CDM) in R&D?

2.3.8. Presentation 7 - Environmental General and Specific Lessons

Mr Alfredo Inglesias of DGAC and Dr Carlos Garcia-Suarez from Environment Transport and Planning of Spain gave a double presentation on this topic. In the next 20 years the noise problem from aircraft is going to increase. It is difficult to have a harmonised system in Europe. Noise output from newer aircraft is a lot less than from older aircraft. Chapter 1 aircraft have been phased out, Chapter 2 aircraft will be phased out by the year 2002.

Noise level have actually been reduced overall, but the number of complaints has increased due mainly to individuals perceptions of the level of noise, these are cross boarder. It is difficult to harmonise an environmental system across Europe.

In 1990, civil aviation accounted for 12% of transport derived emitted CO_2. This is forecast to increase greatly. The Kyoto Protocol aims for this figure to be reduced to 8% by the year 2015. There are still a large number of older aircraft in operation in the world's freighter aircraft fleet such as the DC8 and B707.

Aviation presently accounts for 20% of total transport, this is expected to rise to 40% of total transport. Noise from aviation is the major problem for the increased capacity of the civil aviation industry now and in the future. Areas in which noise will be prove problematical are noise at night , opposition to the 60db levels as peoples perception of the effect of noise can mean complaints at around the 30-35db level, pressure for an environmental tax on aviation fuel, demands for the best operational solution are high and drives to get rid of the remaining older types of aircraft by non-registration/non-licence.

The long term scenario for rules is likely to be not less than 20-25 years. R&D is needed to address noise perception around airports. There is a need for R & D technology, better communications and social activities to address new environmental concerns and the perception of noise.

The Environment, Transport and Planning presentation concentrated on the environmental considerations and problems encountered during the building of an extra runway at Madrid airport. The runway is parallel to the existing North runway.

A noise monitoring system is in place. People complain differently, based upon class and area. However, monitoring reduces the impact. Legal cases have been brought against the airport and its expansion plans. Systems should conform to ISO 14001, started in 1996, as an environmental standard. Houses effected by the new runway will have to be insulated at an estimated cost of 100M ECU. Alternatives to this expenditure are being investigated.

Political conflict has been experienced. Madrid Airport belongs to Madrid City, who support the expansion, not the surrounding population or towns or cities who all have their own political administrations and different views. This has caused political clashes between political bodies.

2.3.9. Any Other Business

The next Workshop should be scheduled in late Jan 99. This was agreed by a vote.

2.3.10. Workshop 1-Questionnaire Response and Results

Thirty-seven questionnaires were distributed to all attendees of workshop 1 and from this there were ten responses. Questions 1-a and 1-b refer to the topics in workshop 1. The suggested topics for workshop 2 were a) A-SMGCS and Airside Simulation, and b) Landside Operation, especially Inter-modality and Landside Simulation. These two topics then lead on to question 2-a.

Question 1-a: "Were these topics of interest to you and your work?" - Table 1 summarises the responses to this question.

Topic	Yes	No	No Answer
Use of Research and Development to Support Air Transport Issues	9		1
Persons With Reduced Mobility in the Air Transport Environment	7	2	1
Research and Development to Support Airport Issues for Gate to Gate Air Traffic Management	9		1
Research and Development to Support Future Business Needs	9		1
Research and Development, the Airlines View on Needed Research Activities	9		1
Environmental General and Specific Lessons	8	1	1

Table 2.3: Summary of Answers to Question 1-a

There was also a provision for comments and the following comments were made:

"All very useful, but as we requested at the time we need consolidation on current European Commission/EUROCONTROL R & D to avoid the shameless waste of money and time utilised at present."
        Mr D Holder, IACA

"A good, varied set of presentations which set the scene at a general level."
        Mr N May NATS, United Kingdom

"This topic is interesting, but it is rather related to quality standards and costs than limiting airport capacity."

Mr A Pfeffer, Vienna Int. Airport, Austria – (Referring to the Persons With Reduced Mobility topic).

"Persons with reduced mobility in the air transport environment, yes to me, no to my work"

Mr E Miart, EUROCONTROL

"Our major interests are as priority:
1. How to optimise the current capacity (airside - landside);
2. Adequate capacity between ground and airspace: no weak link in the chain;
3. How to develop a durable growth taking into account the environmental issues."

Mr M Noel, Belgium

Question 1-b: "Do you feel that these topics are key issues within the European airport community?". Table 2 summaries the responses to this question.

Topic	Yes	No	No Answer
Use of Research and Development to Support Air Transport Issues	8		2
Persons With Reduced Mobility in the Air Transport Environment	5	2	3
Research and Development to Support Airport Issues for Gate to Gate Air Traffic Management	8		2
Research and Development to Support Future Business Needs	8		2
Research and Development, the Airlines View on Needed Research Activities	8		2
Environmental General and Specific Lessons	8		2

Table 2.4: Summary of Answers to Question 1-b

The following comments were also made:

"From our point of view it was useful, albeit concerning with regard to just how little is known about the R & D projects going on. We are able to provide some advice as we have to try and participate in all of them. Consolidation of effort is required now!"

Mr D Holder, IACA

"All subjects are of importance. The only difficulty is ranking and prioritising subjects within available time."

Mr F Cruise, Aer Rianta, Ireland

"It is not to say that the topics I marked are NOT important, only that they have lessor importance."

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Dr. T Goodovitch, Tel Aviv University, Israel

"The "Persons with reduced mobility in the air transport environment" issue is more of a political nature, what I could call a choice that "civil society" has to make."
        Mr E Miart, EUROCONTROL.

"Additional operational improvements of airport operations can only be achieved with a more global and inter-modal approach. So, all of these topics must become key issues."
        Mr D Dippe, Geramny

Question 1-c: "Do you feel that the OPTAS B workshop 1 was well run and organised?" - To this question all who responded answered yes.

Question 1-d: "Do you have any other comments about workshop 1" - To this question the following suggestion was made:

"Good amplification to enable participants to hear properly is needed."

        Mr D Holder, IACA

Question 2-a: "Are there any other topics you would like to see presented and discussed at workshop or any other of the future workshops?" - The following topics were suggested and comments made.

"It would be useful to know just how many projects are ongoing. For instance A-SMGCS to my knowledge has at least four working groups from various organisations that we know! One wonders how many others there are?"
        Mr D Holder IACA

"Methodologies for capacity assessment, especially simple and easy to use "rules-of-thumb"
        F Cruise, Ireland

"Future Workshops: EUROCONTROL's Airport cell, European Commission's 5th Framework Projects.
A-SMGCS: Feedback from EUROCONTROL/Federal Aviation Administration (FAA) Technical Interchange Meeting in November."
        Mr N May, NATS, United Kingdom

"I my self and many other participants felt confused about the "message" of the 1st meeting. I think it would be a good idea to focus on topics that can contribute to solving the following problem:
- Almost no new airports will be built - yet the traffic growth is estimated to be approximately 100% in 10-15 years. The problem for most airports is how to improve the capacity of the existing infrastructure."
        Mr O Stenstrom, Swedish CAA, Sweden

"Impact of new aircraft types on the environmental (noise, emissions), probably there are studies carried out by Boeing and Airbus.
New procedures and technologies in ATM and their impact on capacity (MLS, curved approach, etc.)
Examples for optimising airport capacity (case studies)."
        Mr A Pfeffer, Vienna Airport, Austria

"1- Improved airport procedures;
2- Wake Vortex studies and Wake Vortex separations;
3- Environmental issues awareness;
4- Capacity enhancement initiatives;
5- Sequencing tools: AMAN & DEMAN, Runway management;
6- Safety net tools for runway and surface operations at airports;
7-Airport design optimisation;
8-Navigation aids for surface operations at airports;
9- Collaborative planning and collaborative decision making (CDM) at airports;
10- Meteorological issues at airports (air & land side);
11- Environmental constraints at airports (air & land side);
12- Aircraft noise certification issues Vs airport needs (linked to neighbouring populations)."

Mr E Miart, EUROCONTROL

"Topic 1 - A-SMGCS: it 'd be interesting to have a first evaluation of the new A-SMGCS recently in operation in Oslo-Gardemoon, especially the performances of radar capacities in identifying the correct aircraft identifications on the ground, matching up these information with other traffic flows.
Topics related to the interface ground/air in order to avoid lost capacity, due to weak link in the chain, would be interesting.
Also modelling a durable growth, according to environmental issues, would be of great interest."

Mr M Noel, Belgium

"Use of fast time simulations to investigate the influence of different measures on airport capacity, operational aspects, etc."

Mr D Dippe, Germany.

Question 2-b: "Do you have any other comments about the proposed format of workshop 2?" - The following comments were made:

"January 22nd may be preferable as there is an Airports Database User Group meeting on January 21st which I and several other delegates will be attending"

Mr N May NATS, United Kingdom

"Some Possible topics would be:
- Automation (RFID +++);
- Improved information exchange (between airport actors including apron and control towers);
- Inter-modality (how to prepare for);
- Service level agreements (between airports and airlines);
- 100% screening of hold baggage."

Mr O Strenstrom, Swedish CAA, Sweden

Question 3: "Do you feel that the OPTAS B workshops are of value to the airport industry?" - Again to this question all who responded answered yes and the following comments were made.

"But they could be more useful if the end result meant or lead to better overall collaborative decision making."
>   Mr D Holder, IACA

"Any forum that tries to integrate European R & D on airports is of value."
>   Mr N May, NATS, United Kingdom

"I think the values increases the closer the topics relate to what is described concerning my response to question 2-a (the issue of improving airport capacity using the current airport infrastructure)."
>   Mr O Stenstrom, Swedish CAA, Sweden.

"I think that the OPTAS B initiative as a whole is of utmost importance and value to the airport community, the aircraft operator and the ATM community world-wide."
>   Mr E Miart, EUROCONTROL

Internet Open Forum

"First of all I would thank you for the organisation of the first Optas-B Workshop in Brussels. In the following there are some suggestions for the next Workshop. As you and Mr. Bernabei required during the meeting I propose three themes, one general, another relative to the problems inside the airport and the last one relative to the problems outside the airport. Efficiency and safety at airport: statistics and analysis relative to delays, incidents and accidents at airports. Analysis of the dynamic of these events, reasons causing the events themselves, and eventually the identification of the responsibilities can help different actors involved in airport management to improve efficiency and safety at airports; furthermore this information can offer manufacturers ideas for their business. Simulation of A- SMGCS: the availability of a Simulation Environment is needed to introduce a new way of operating at airport, with new roles, new procedures and new automatic tools, and to train airport's operators. In particular the possibility of operating in real-time can offer a valid help to designers and to operators. In this way novelties can be tested and new procedures can be learnt without interfering with the normal operations at airport. Accessibility to the airport: if the point of view of the passengers is considered this is one of the principal problems. It's useless to decrease the departure delays of few minutes if transport times from the city to the airport are unacceptable. I hope that some researches in these fields produced interesting results that could be reported during next meeting if these topics are of some interest also for the other delegates."

>   Mr Sebastiano Bottalico - Alenia – Italy - e-mail: sbot@lti.alenia.it .

"I very much enjoyed the OPTAS-B workshop on 25 June. I thought that in general, the presentations were very relevant to the work being undertaken. Of particular interest to me were the presentations given by Cesare Bernabei, Eckardt Seebolm, Eric Miart, Robert Drew and yourself. If the objectives of the project can be met, then I'm sure that a very valuable output will be produced. You asked for topics for presentation / discussion at the next workshop. Of particular interest to me are:

➢   A-SMGCS.

➢   The Airports' Database.

➢   Noise modelling."

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Neil May

Head of Airport Capacity Studies (ORA1) Strategy & Development Directorate National Air Traffic Services Ltd.

Mr Neil May - NATS – UK - email:N.May@rd1-nats.demon.co.uk

Summary: The questionnaire responses give the impression that the first workshop was received well. The majority of the delegates found the topics discussed of interest to them and their work and of importance to the airport community. Many topics were suggested for the second and further workshops and it was noted that there is a requirement for an analysis of the state-of-the-art in airport R & D, especially with regard to the topics that will be covered in the second and further workshops.

2.4.   <u>WORKSHOP 2</u>

OPTAS B Workshop 2 was held at Alenia Marconi Systems, Rome, on the 20th and 21st of January 1999. The first day consisted of 2 sessions, as follows:

➢ Welcome from the Chairman

➢ Presentation 1 – OPTAS B

➢ Session 1 – A-SMGCS

    ➢ Presentation 2 – DEFAMM

    ➢ Presentation 3 – FAA International Perspective

    ➢ Presentation 5 – Oslo Airport A-SMGCS

    ➢ Round table discussion (see Annex B)

➢ Session 2 – Airside and Landside Simulation

    ➢ Presentation 6 – Airport Landside Simulation

    ➢ Presentation 7 – OPTAS A

    ➢ Round table discussion (see Annex B)

The second day consisted of a single session, followed by a demonstration of SEEDS (Simulation Environment for the Evaluation of Distributed traffic control Systems) by the hosts, Alenia Marconi Systems.

➢ Session 3 – Current European Commission funded projects

    ➢ Presentation 8 – ATHOS

    ➢ Presentation 9 – MANTEA

    ➢ Presentation 10 – ARAMIS (Advanced Runway Arrivals Management to Improve airport Safety and efficiency)

    ➢ Presentation 11 – DAVINCI

    ➢ Presentation 12 – SAMS

    ➢ Presentation 13 – ATOPS

    ➢ Presentation 14 – AIRPORT-G (Airport Integrated Research & Development Project for Operational Regulation of Traffic-Guidance)

    ➢ Presentation 15 – SEEDS

    ➢ Round table discussion (see Annex B)

2.4.1. Welcome from the Chairman

The Chairman, Mr Cesare Bernabei, welcomed everybody to the workshop and explained that the reason the second workshop was being held in Rome was so that there could be a presentation on SEEDS on the second day. Delegates were reminded of the importance of their co-operation in this project, especially through feedback on the workshops and through providing details of relevant studies that their country/organisation have undertaken. No supporting slides were shown.

2.4.2. Presentation 1 – OPTAS B, Day 1 AM

The OPTAS B project co-ordinator, Felix Dux, gave a brief presentation to remind delegates of the objectives and details of the OPTAS B project. The main objective of the OPTAS B project is to achieve a comprehensive overview of the current state-of-the-art of research into airport capacity. This will be done by collating and reviewing studies from the European Commission, International, National and Independent (commercial or academic) organisations.

The approach has been divided into two sections, research and data collection, and dissemination and delegate feedback. The research and data collection will result in a consolidation document briefly describing each study found and focusing on the topics chosen for discussion at each workshop. There will also be a bibliography database containing summary information on each study. The primary vehicle for dissemination and delegate feedback is a sequence of four workshops that are being held over two years. These workshops are supported by the OPTAS B web site, which has all the latest reports and version of the database available for download, and an open forum to allow delegate feedback. Due to the apparent lack of use of the open forum facility on the web site since the first workshop, questionnaires are also being distributed to each delegate to elicit extra feedback. The OPTAS B web site has been up and running since before the first workshop which was held in June 1998.

The broad topics of the second workshop are:

➢ Day 1:

    ➢ A-SMGCS

    ➢ Landside Modelling

    ➢ Integrated Landside/Airside Modelling

➢ Day 2:

    ➢ Current European Commission Projects

It is suggested that the two future workshops be held in late June 1999 and November 1999. Delegates will be asked for suggested dates in the follow up questionnaire to this workshop.

2.4.3. Presentation 2 – DEFAMM

Walter Kailbach of Alcatel Air Navigation Systems gave a presentation on the DEFAMM project. The ICAO/AWOP definition of A-SMGCS is "a modular system consisting of different functionalities to support the safe, orderly and expeditious movement of aircraft and

vehicles on aerodromes under all circumstances with respect to traffic density, visibility conditions and complexity of the aerodrome layout ...".

The DEFAMM objectives were to implement a demonstrator system for advanced surface movement guidance and control functions. To show users the functions through which they would gain benefits of increased traffic management efficiency at maintained or enlarged safety levels. Finally to obtain feedback from the users of the acceptability of the demonstrators means. The DEFAMM project is the first realisation of an A-SMGCS with the main functions of surveillance, control, routing/planning and guidance in operation. This system is an essential element of gate-to-gate air traffic management and has the support of both controller and pilots.

The requirements were analysed by examining several documents including EUROCAE WG-41 reports, ICAO AWOP A-SMGCS documents, RTCA recommended requirements, the DFS SMGCS program plan and ADP operational specifications. Available technology and the fact that the DEFAMM system is not intended to be fully operational but a demonstration showing the functions and benefits determined the final selection of requirements.

The required functions were surveillance, control, routing/planning and guidance. There was also the need for a Human Machine Interface (HMI) and supplementary functions such as technical system control, data recording for off-line test evaluation and a datalink sub-network.

The project involved four test sites, Bergamo, Paris Orly, Braunschweig and Köln/Bonn.

The DEFAMM project had various test tasks including the verification of subsystem and complete system functionality, the demonstration of a complete A-SMGCS installation and its functions and to elicit feedback from the users.

The DEFAMM project concluded that the functionality of all subsystems and the integration of these subsystems into a complete system has been verified. It was also found that testing in an operational environment was difficult but necessary. The project is at the stage were many detailed results have been obtained and are currently under review and analysis. "DEFAMM may be regarded as the Touch Down but a long Taxiing to the Gate is still necessary".

2.4.4. Presentation 3 – FAA International Perspective

Stephen Wallace of the FAA gave a presentation on the FAA international perspective on the air transport community. Slides for this presentation can be found in "03-FAA97.ppt" for MS PowerPoint 97.

The FAA is concerned with three aspects, safety (operations), security (terrorism) and system efficiency (traffic flow).

There are twelve FAA International Representatives, nine of which are based overseas

The FAA are trying to work more closely with the JAA. Currently aircraft operating in both Europe and the United States have to meet both FAA standards and JAA standards. The FAA and the JAA are tying merge these standards so that aircraft only have to comply with one set of rules.

In 1998 no flight by a US airline carrying more than ten passengers suffered a fatality. The FAA is still trying to improve safety, however, especially when taking into consideration the forecasted increase in aircraft movements over the next few years.

The problems of passenger interference, such as passengers under the influence of alcohol, may be solved by creating passenger black lists and the possibility of offending passengers serving a jail sentence.

The FAA International Aviation Safety Assessment Programme operates to ICAO standards. FAA inspectors visit all airlines that wish to operate within the US and the US government makes public all the safety information gathered about these airlines.

The FAA is especially concerned with lesser-developed countries' airports. The levels of safety at these airports can be quite poor and therefore be hazardous to the U.S. and European airlines that operate into and out of these airports.

2.4.5. Presentation 5 – Oslo Airport A-SMGCS

Joeri De Ruytter of ADB gave a presentation on the A-SMGCS project at Oslo Airport Gardermoen. The consortium for this project consisted of ADB, the consortium leader, Cardion, Siemens AS and HITT (Holland Institute of Traffic Technology).

The main characteristics of the system are:

➢ Dual X-Band Radars

➢ Digitised Video

➢ Tracking and Labelling

➢ Conflict Alerting

➢ Route Selection and Control

➢ Integrated with ALCS

➢ Integrated Controller Workstation

Features of the Human Machine Interface (HMI) include surveillance information, identification, tracking and labelling, conflict alerting, taxiway lighting control, route suggestion and control and an alarm window.

The surface movement radar installation was completed at the beginning of 1998 and the A-SMGCS became operational on the 15th August 1998. Final acceptance for the ADB work in the project was given on the 1st November 1998. The system is not complete though, as the ICW is not yet ready.

2.4.6. Presentation 6 – Airport Landside Simulation

Paul Clifford from Halcrow Fox gave a presentation on airport landside simulation [59]. All facilities used by passengers have to be considered when simulating an airport landside so that they can be designed to avoid conflicts. The level of detail can go right down to seating in the departure lounge or the number and location of toilet. Processing rates for service

points use the mean, minimum and maximum process rates as inputs. With capacity there is a recognised difference between theoretical capacity and operational capacity.

The landside model does not include the runways and apron of an airport. The flight schedule used for arrivals is the on block time of the aircraft as this is when passengers are assumed to start disembarking. For departure flights the estimated time of departure is used. The number of passengers on an aircraft is determined by either a user input of the actual number of passengers or an aircraft capacity and a proportion that the aircraft is full.

The levels of service in each area use the IATA guidelines, which are then quantified. A good terminal design improves the level of service which in turn improves the chance of a passenger catching a flight. The models can then be used to determine whether an airport terminal design could handle the increase in passengers caused by an increase in airside movements.

There is an element of chaos within the routing choice for passengers therefore the system needs to know all possible routes available to a passenger. The model can then calculate the proportion of passengers that had to walk further than an accepted distance to catch their flight, or to leave the airport.

Baggage and trolleys are taken into account and the fact that trolleys cannot be taken into certain areas of the model has to also be considered.

Landside simulation allows a modeller to compare the current situation at an airport with new designs. The modeller could then assess the changes in level of service at different areas within the airport and delays incurred by the passengers.

Future aspects that need to be considered in the development of landside simulation are integrating with an airside model, visualisation/virtual reality and greater use in retail planning.

2.4.7. Presentation 7 – OPTAS A

Felix Dux from RED Scientific Ltd gave a presentation on the OPTAS A project. The objectives of the OPTAS A project are to employ an integrated suite of commercially available simulation tool to model future landside and airside scenarios, and to create a high level integrated airside/landside airport model.

The approach involved surveying 9 European airport, selecting the landside and airside tools to be used, applying the selected tools to the defined future scenarios, creating a high level model using System Dynamics and then validating the high level model against the selected tools. All nine airports were surveyed using questionnaires and seven of these airports were visited for further analysis.

The case studies have been defined to cover a wide range of possible future scenarios, both landside and airside, that may positively or negatively affect the airports capacity and efficiency. The evaluation of the commercial modelling tools did not aim to provide a definitive answer to which tools are best but helped to decide which tools are best suited for the needs of this project.

The integrated high level model will aim to allow quick high level modelling of an airport. It is envisaged that this sort of tool would be the first step for airport planners and complement the decision of whether to invest or not in a more detailed modelling tool.

The project is at the stage where airports have been surveyed, the modelling tools chosen and initial definition of the future scenarios has been undertaken. The high level model development is in progress and scenarios will be run in the detailed models in the near future. It is aimed to finish the project by mid May 1999 so that results can be documented and presented at the next OPTAS B workshop.

End of Day 1

2.4.8. Presentation 8 – Airport Tower Harmonised Controller System (ATHOS)

Stephane Paul from Alcatel ISR gave a presentation on the ATHOS project. Slides for this presentation can be found in "08-ATOHS97.ppt" for MS PowerPoint 97. Note that Stephane Paul gave the first three presentations of day 2 and so questions for all three presentations occurred after the third presentation.

The main objective of ATHOS was "To ensure the safe and efficient movement of aircraft in or near airports in all weather conditions and in conditions of increasing traffic density by supporting the role of controllers, pilots and operators through the application of appropriate telematics systems". This involved developing a prototype future Controller Working Position (CWP) taking into account that an A-SMGCS would be in operation. To achieve this the MANTEA project was used to create the simulation environment.

It was found during this project that under simulation conditions controllers could handle up to 250% more traffic, this was thought to be because there was not the stress of real life. This means that the controller knew there were no real aircraft under his/her control so if a mistake was made this would not result in real life effects. Therefore instead of analysing the improvements in performance the project looked at the human factors involved.

In the future it is hoped that the Human Machine Interface (HMI) developed in ATHOS will be used in other projects.

2.4.9. Presentation 9 – MANTEA

Stephane Paul from Alcatel ISR gave a presentation on the MANTEA project. Slides for this presentation can be found in "09-MANTEA97.ppt" for MS PowerPoint 97. Note that Stephane Paul gave the first three presentations of day 2 and so questions for all three presentations occurred after the third presentation.

The main objective of MANTEA was to "Develop decision-support tools required to support complex decisions regarding airport traffic management". The decision support tools were divided into two groups, those for airport tower controllers and those for airport authorities.

The decision support tools identified as required for a controller are routing/planning, conflict detection and resolution services, surveillance and human machine interface (HMI).

The decision support tools for airport authorities aimed to develop a set of models which will assist airport operators and managers in strategically planning for optimising airfield capacity given any particular level of demand or level of service.

Test cases of situations were carried out at Rome Fiumicino Airport and Paris Orly Airport. At Rome Fiumicino small scenarios of 2 or 3 aircraft were run and at Paris Orly scenarios containing full aircraft schedules and full systems were run. The validation scenarios have been completed at Rome and are still ongoing at Paris.

The MANTEA project has tried to produce a set of easy to use PC based tools with a quick run-time.   These tools can then give a global estimate of the current situation being modelled.

2.4.10. Presentation 10 – ARAMIS

Stephane Paul from Alcatel ISR gave a presentation on the ARAMIS project. Slides for this presentation can be found in "10-ARAMIS97.ppt" for MS PowerPoint 97. Note that the questions for ATHOS, MANTEA and ARAMIS follow this presentation.

ARAMIS is an experimental arrival manager based on sophisticated aircraft and weather models. The focus of this project is on enhancing the accuracy of sequencing.

Within the aircraft model the computed aircraft trajectories were compared against the actual aircraft trajectories.

The weather model used, WAFTAGE and normally covers a complete country. Therefore it had to be adapted to only model the area of the aerodrome.

It was aimed to obtain Actual Times of Arrival (ATA) within ±5 seconds of the Target Time of Arrival (TTA).

The controller decided that they did not want the display to show the current label information. They would have preferred the labels to show the manoeuvres that the pilot was required to make to reach these targets instead.

The project has resulted in a working prototype that provided quantitative measurements, the impact on final ETA accuracy and has been validated with the controllers.

2.4.11. Presentation 11 – DAVINCI

Rafael Melcon from ISDEFE gave a presentation on the DAVINCI project. It has been recognised that there are user needs for the efficient integration and co-ordination of Airport Traffic Management Systems (APTMS). Therefore the DAVINCI project was initiated to address these user needs.

The project has progressed using four phases. Phase I is the assessment of the current situation, phase II is the DAVINCI solution, phase III is the development of a demonstrator and phase IV is the deployment and evaluation.

26 European airports were sent questionnaires and then interviewed and this revealed 77 distinct systems. From this it was realised that there needs to be an improved link between the airports and the ATC providers. There needs to be a clear agreement on information exchange, a central cove of information and a common language for the transmission of data. Airport operators want more information about the aircraft and ATC operators want more information shared between ATC and the airlines.

The solution is to introduce co-operation between planning tools, e.g. runway planning, taxi planning etc.

2.4.12. Presentation 12 – SAMS (SMGCS Airport Movement Simulator)

Phillipe Dubernet from Dassault Electronique gave a presentation on the SAMS project. Slides for this presentation can be found in "12-SAMS95.ppt".

The objectives of the SAMS project were to develop a real time man-in-the-loop A-SMGCS platform capable to test and demonstrate new support tools and new A-SMGCS procedures in all weather conditions.

The SAMS platform consisted of three main features, a LATCH simulator (B747 cockpit) based at DERA Bedford in the UK, a TOWSIM simulator based at Braunschweig in Germany and a A-SMGCS simulator based at NLR in the Netherlands.

The SAMS project pulls together the experiences and results of projects such as ATHOS, MANTEA, AIRPORT-G, DEFAMM, ARAMIS and other European Commission projects.

The achievements to date with the SAMS project are system operational concepts defined with a very strong involvement of end-users and this definition led to a document released as Project D1. Also the definition of the SAMS platform architecture, the platform architecture document released as project D3, the validation plan document is in progress (First draft issued) and the interface control document has been released.

2.4.13. Presentation 13 – A-SMGCS Testing of Operational Procedures by Simulation (ATOPS)

Neil May from NATS (National Air Traffic Services) gave a presentation on the ATOPS project. The ATOPS project consortium involves a combination of links with other on-going A-SMGCS projects, simulation facilities providers and end-users. This project also has links with official ATC bodies and other relevant European studies. The ATOPS project aims to identify operational procedures that use A-SMGCS and are expected to enhance the operational efficiency of an airport's movements. This will be done by the use of questionnaires and "in-person" interviews.

Procedures that are applicable and within the scope of the ATOPS project will then be chosen. Over five weeks of simulation the project will conduct simulation and record performance data for the chosen procedures. The results will be analysed and conclusions developed along with recommendations for 5th Framework Programme. The report will specify the operational benefits of implementing such procedures and provide an outline of testing that could be performed in the 5th Framework.

Finally the simulations will be validated as a means of testing A-SMGCS procedures. This will address both the baseline scenarios and the A-SMGCS scenarios.

2.4.14. Presentation 14 – AIRPORT-G

Phillipe Dubernet from Dassault Electronique gave a presentation on the AIRPORT-G project. The project considered three areas, parking and security, SMGCS architecture and taxi planning/guidance. Surveillance functions of an A-SMGCS system can be used to help monitor all aerodrome activities. The surface movement radar can be used for detection of people and vehicles and then video cameras can be used for identification. This does cause an operational conflict though as two groups of people, ATC and security, will both want to use the surface radar at the same time.

The AIRPORT-G final documents are available and public on CD-ROM, can be requested from David Callahan at the European Commission DGXIII.

2.4.15. Presentation 15 - SEEDS

Sebastiano Bottalico from Alenia Marconi Systems gave a presentation on the SEEDS project. The main objectives of the SEEDS project were to implement training of A-SMGCS operators, define new procedures and roles in the airport, support A-SMGCS operator's decisions with automatic tools and new interfaces, A-SMGCS definition and validation, A-SMGCS new technology performance evaluation and HPCN methodology in the industrial practice.

The synthetic environment features real-time simulation with a man-in-the-loop, full interaction between the various airport actors and between the actors and traffic generation, and input information and stimuli from external entities. The actors involved in the system are controller, pilots, planners and drivers. These actors can communicate with each other and can be either human beings or processes. The SEEDS functions include traffic generation, controller and pilot visualisation, surveillance functions, control functions, guidance functions and Planner functions. SEEDS considers the Malpensa 2000 airport which has 2 ILS (Instrument Landing Systems) cat III B parallel runways and the SEEDS virtual airport which has 3 runways, 2 of which are parallel.

SEEDS expects to produce a HPCN architecture for an A-SMGCS simulation environment. This could then be used to define and validate proprietary A-SMGCS, to validate international standards in the field, to train airport operators of the future A-SMGCS and to be connected to other ATM subsystem simulators. Also some prototype configurations with a low-medium cost will be set-up and tested, at the end of the project, for the Malpensa 2000 airport and the SEEDS virtual airport.

Following the SEEDS slide show presentation there was a demonstration of the SEEDS tools working in their current state. During this time delegates had the opportunity to ask the SEEDS operators individual questions.

2.4.16. Closing Words

The Chairman, Cesare Bernabei, stated the usefulness of these workshops was very much dependant on the feedback from delegates and the information that they provide. Any comments would be preferable, be they negative or positive ones, to no comments at all.

Delegates were asked to give input on the workshop format that they would like to see. The main source of feedback for these workshops will come from delegates completing and returning the questionnaire that will be distributed with these proceedings.

It was suggested that "hot links" to various other sites be included within the OPTAS B web. These would include links to sites such as the European Commission, EUROCONTROL, AOPG (Aerodromes Operations Group)/ICAO and possibly the FAA web site. Finally it was announced that the first call for projects under framework 5 is expected to be on the 1st March 1999.

2.4.17. Workshop 2 - Questionnaire Response and Results

Thirty six questionnaires were distributed to the attendees of workshop 2 and from this there were seven responses. Questions 1-a and 1-b refer to the topics in workshop 2 as listed in 3.2.

Question 1-a: "Were these topics of interest to you and your work?" - the table below summarises the responses to this question.

Topic	Yes	No	No Answer
DEFAMM - Demonstration Facilities for Airport Movement Management	7		
FAA International Perspective	6	1	
ICAO/RTCA A-SMGCS Activities	7		
Oslo Airport A-SMGCS	7		
Airport Landside Simulation	4	3	
OPTAS A - Air and Landside Airport Modelling	5	2	
ATHOS - Airport Tower Harmonised Controller System	5	2	
MANTEA - Management of Surface Traffic in European Airports	6	1	
ARAMIS - Advanced Runway Arrivals Management to Improve Airport Safety and Efficiency	6	1	
DAVINCI - Departure and Arrival Integrated Management System for Cooperation Improvement of Airport Traffic Flow	6	1	
SAMS - SMGCS Airport Movement Simulator	5	2	
ATOPS - A-SMGCS Testing of Operational Procedures by Simulation	5	2	
AIRPORT-G	6	1	
SEEDS	6	1	

Table 2.5: Summary of Answers to Question 1-a

There was also a provision for comments and the following comments were made:

"Each project should aim to give tangible results for main future investors in A-SMGCS, as well as for airports as for ATC separately, not only from an airline point of view:
- capacity benefits, by poor and good weather conditions, separately;
- safety benefits,   "   "   "   "   "
- availability of a user-friendly tool that can be bought by airport and/or ATC.
  Airports are reluctant to invest in that field as long as there is no real cost-benefit analysis supporting it.
  An A-SMGCS cannot provoke traffic restrictions, due to less flexibility, as indirect effect of safety increase."
          Mr M Noel, Belgium

"The topics mostly described specific sphere of A-SMGCS and were very interesting."
Mr M Tykal, Czech Republic

"It was useful to hear about the progress being made on the various European Commission funded projects and to see how they fit together. The demonstration of SEEDS was very interesting."
Mr N May, NATS, United Kingdom

"Subjects treated were in general very interesting. Airport Landside domain is also interesting, but my work is not in this field."
Mr R Melcon, ISDEFE

Question 1-b: "Do you feel that these topics are key issues within the European airport community?". Table 2.6 summarises the responses to this question.

Topic	Yes	No	No Answer
DEFAMM - Demonstration Facilities for Airport Movement Management	6		1
FAA International Perspective	5	2	
ICAO/RTCA A-SMGCS Activities	6	1	
Oslo Airport A-SMGCS	7		
Airport Landside Simulation	7		
OPTAS A - Air and Landside Airport Modelling	6	1	
ATHOS - Airport Tower Harmonised Controller System	7		
MANTEA - Management of Surface Traffic in European Airports	6		1
ARAMIS - Advanced Runway Arrivals Management to Improve Airport Safety and Efficiency	6		1
DAVINCI - Departure and Arrival Integrated Management System for Cooperation Improvement of Airport Traffic Flow	6	1	
SAMS - SMGCS Airport Movement Simulator	6	1	
ATOPS - A-SMGCS Testing of Operational Procedures by Simulation	7		
AIRPORT-G	6	1	
SEEDS	7		

Table 2.6: Summary of Answers to Question1-b

The following comments were also made:

"ICAO/A-SMGCS Study Group results are expected asap to have validation of each system recognised as of interest for airport community."
                    Mr M Noel, Belgium

"Some present Tower and Ground working positions however in any case future working positions will be computer positions. The projects Athos and Menthea do not solve working positions generally but only in relation to A-SMGCS. I think that is necessary to solve TOWER and GROUND position completely with operation of lighting system, Meteo data, LVP data(monitor), FDP, Information data etc."
                        Mr M Tykal, Czech Republic

"By themselves, these topics are not going to address the key issues in Europe. However, the findings of the projects, when combined, will take us forward. There is still along way to go."
                        Mr N May, NATS, United Kingdom

"In general, all topics about the increase of safety, capacity and efficiency in airports are key issues."
                        Mr R Melcon, ISDEFE

"Re Airport Landside Simulation: The comparative analysis of the models is. There are many toolkits in the general simulation area. I note that my point about the dangers of ignoring the effects of autocorrelation was edited out of the note on the proceedings. This is one problem of having a salesman doing a presentation."

[NOTE: the failure to include this point was in fact an innocent omission on the part of the editors, for which we apologise. The proceedings were compiled and edited by the OPTAS B project team and, although every effort was made to ensure comprehensiveness, some contributions, particularly of a technical nature, can be missed]

"Re OPTAS A - Air and Landside Airport Modelling: I have strong doubts about the rationale behind this - especially the choice of a systems dynamics representation. As an engineer I would like to start from first principles and demonstrate the use of Systems Dynamics in a number of simple situations , for example check-in desks. As a one time Fellow of the UK SRC Simulation Centre I am not sure that other analytic tools are not preferable - I am very suspicious (and ignorant of a successful similar application of Systems Dynamics).

Re ATHOS - Airport Tower Harmonised Controller System: An exciting development but why should the European Airport Community believe the issues to be key when the focus is toward the manufacturing industry. Cost Benefit analysis ought to lead - not be added as a post-hoc justification.

SEEDS was an exciting demonstrator of building a model with a state-of-the art toolkit. It is always difficult to give an unqualified endorsement but this is one piece of software which raises many questions. I would love to be in a position to audit it more thoroughly."
        Mr S Mathewson, ACI-EUROPE

Question 1-c: "Do you feel that the OPTAS B workshop 2 was well run and organised?" - To this question all who responded answered yes.

Question 1-d: "Do you have any other comments about workshop 2" - To this question the following comment was made:

"I would thank you for the organisation of the Optas B Workshop 2 in Rome.   I very much enjoyed the presentations."
                        Mr J Pires, Portugal

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"It is better to distribute the presentation papers before the presentation, mainly for personal comments and for next discussion."
>Mr M Tykal, Czech Republic

"It was nice to have a meeting somewhere other than Brussels."
>Mr N May, NATS, United Kingdom

"I have only one comment to do. This is concerning the great number of presentations made during the workshop. Perhaps, it is more interesting to select fewer projects to be presented in order to maintain the concentration of people attending."
>Mr R Melcon, ISDEFE

Question 2-a: "Are there any topics you would like to see presented and discussed at workshop 3 or any of the other future workshops?" - The following topics were suggested and comments made:
"Some possible topics would be:
- 100% screening of the hold baggage;
- Noise monitoring at airport surrounding."
>Mr J Pires, Portugal

"YES: same as OPTAS-B Workshop 1 comments;
>1- Improved airport procedures;
>2- Wake Vortex studies and Wake Vortex separations;
>3- Environmental issues awareness;
>4- Capacity enhancement initiatives;
>5- Sequencing tools: AMAN & DEMAN, Runway management;
>6- Safety net tools for runway and surface operations at airports;
>7- Airport design optimisation (air-side);
>8- Navigation aids for surface operations at airports;
>9- Collaborative planning and collaborative decision making (CDM) at
>airports;
>10- Meteorological issues at airports (air & land side);
>11- Environmental constraints at airports (air & land side);
>12- Aircraft noise certification issues Vs airport needs (linked to neighbouring
>populations)."
>Mr E Miart, EUROCONTROL

"1) Eurocontrol's Gate to Gate strategy and how this is being supported by R&D and the Airports Operations Domain.
 2) Wake Vortex research.
 Environmental aspects - noise and emissions."
>Mr N May, NATS, United Kingdom

"Perhaps, the perspective of pilots and controllers concerning airport operations is less covered than necessary. Projects related with these topics are also very interesting (on-board guidance and situation awareness, on-board data display, etc.)"
>Mr R Melcon, ISDEFE

"In general I was very impressed with the technology but with the exception of the relationships between ICAO and this Group, I felt that the ATM users were not getting the benefit.

I was pleased that Eric Miart from Eurocontrol was a visitor, but I am left with the feeling that there must be more liaison between Airports and this work. Perhaps the Eurocontrol Airport Operations Team (AOT), as representative of the airport interests, should be more involved with a view to exposing the work to the ATM industry and becoming sensitive to the value that the industry might place on some of the capacity/efficiency advantages implicit in the technology.

In particular the route planner from SEEDS and perhaps some of the Athos/Mantea/Aramis work is packaged to a level where it could be made available as an advisor to the Ground Movement Planner.

SEEDS itself could be quite impressive - but we didn't go into the detail"
            Mr S Mathewson, ACI-EUROPE

Question 2-b: "Do you have any other comments or suggestions regarding the format of future workshops?" - The following comments were made:

"Mixture of presentations, discussion and demonstrations.
Combine with a visit to a (busy) airport."
            Mr N May, NATS, United Kingdom

"Yes. I think it would be very interesting to include demonstrations and simulation exercises of those projects which develop simulators or demonstrators (like SEEDS). Not only slides."
            Mr R Melcon

"I would like to suggest some form of workshops with a view to improving the dialogue outlined above. Stephane Paul was a good example where the discussion on technology dominated to the exclusion of value.

Perhaps take a number of subjects, spilt into small groups, brainstorm and present to the whole body in a more rounded way.

I would like to have more application discussions."
            Mr S Mathewson, ACI-EUROPE

Question 3: "Do you feel that the OPTAS B workshops are of value to the airport industry?" - Again to this question all who responded answered yes and the following comments were made:

"Each discussions of new system as A-SMGCS is great opportunity to reach deep knowledge of this system. I am not sure , that airport managers have any information about the opportunity to reach information of A-SMGCS"
            Mr M Tykal, Czech Republic

"The workshop is clearly helpful. The inclusion of SEEDS, a non-DG VII interest, was exactly right (and there is similar work being done elsewhere in the Commission in the context of Wake Vortex Standardisation, for example). Rather than represent work which has already been exposed, Mr Bernabei is to be congratulated on bringing in work of general interest from outside his immediate area of responsibility and I hope that this action will be followed in future workshops."
            Mr S Mathewson, ACI-EUROPE

Internet Open Forum

- Thierry [Jourdan] and myself are from ISR, not Alcatel ISR

- Concerning the Athos project, it was NOT found during this project that under simulation conditions controllers could handle up to 250% more traffic. This information originated from ADP and motivated the type of demonstration that was handled in Athos.

- Concerning the question under ARAMIS, by Eric Miart, "ADB" is to be replaced by "ADP (Aeroports de Paris)".

I take this opportunity to thank you again for your invitation.

Stephane PAUL- ISR, France – email: Stephane.Paul@isr.thomson-csf.com

Summary: The questionnaire responses give the impression that the second workshop was received well. The majority of the delegates found the topics discussed of interest to them and their work and of importance to the airport community.

2.5.   WORKSHOP 3

The 3rd Workshop was held at the Park Hotel Flamenco and at the offices of LRI, Budapest, on the 16th and 17th September 1999. The first day consisted of two sessions, Initiatives to Improve Airside Efficiency and Initiatives to Improve Landside Operations, as follows:

➢ Workshop Introduction

➢ Session 1 - Initiatives to Improve Airside Efficiency

  ➢ Presentation 1– The Status of the Airport related Advanced Procedures

  ➢ Presentation 2 – Implementation of HALS/DTOP at Frankfurt Airport

  ➢ Presentation 3 – Operational Information Management

  ➢ Round table discussion (see Annex B)

➢ Session 2 - Initiatives to Improve Landside Operations

  ➢ Presentation 4 - The One-Stop Security Concept at Airports

  ➢ Presentation 5 - Air Transport for Persons with Reduced Mobility

  ➢ Presentation 6 - Simplifying Passengers Travel - The SPT Project

  ➢ Round table discussion (see Annex B)

The morning of the second day comprised a session on Capacity Enhancement Through Simulation, as follows

  ➢ Presentation 7- Analytical Models

  ➢ Presentation 8 - Simulation Models

  ➢ Presentation 9 - Simulation Activities at Madrid-Barajas

  ➢ Round table discussion (see Annex B)

This was followed by a presentation by the hosts, LRI, and a tour of the new facilities at Budapest Airport.

2.5.1. DAY 1, AM - Workshop Introduction

Mr János Fülöp Director ATS Division, LRI welcomed all the delegates to Budapest and showed a video titled "One Sky for Europe", which gave an overview of a project undertaken by LRI, to provide a shared military and civil airspace environment. The project made extensive use of real time simulations at the Eurocontrol Experimental Centre at Brétigny, France, for cross training of military controllers and the development of new rules and procedures. This was followed by a welcome from Cesare Bernabei, who thanked LRI for their hospitality and emphasised the importance of the extension into Eastern Europe and drew attention to Mr Fülöp's point about capacity problems. He stated that the timing of the workshop was good, as he would like to provide feedback to the AOT, the following week.

The OPTAS B project co-ordinator, Felix Dux, gave a brief presentation to remind delegates of the objectives and details of the OPTAS B project.

The Workshop consisted of three sessions as follows:

<u>Day 1</u>:

➢ **Session 1: Initiatives to Improve Airside Efficiency**

➢ **Session 2: Initiative to Improve Landside Operations**

<u>Day 2</u>:

➢ **Session 3: Capacity Enhancement Through Simulation**

2.5.2. Session 1 - Initiatives to Improve Airside Efficiency, Day 1 AM

2.5.2.1.   <u>Presentation 1– The Status of the Airport related Advanced Procedures - Anders Hallgren, Eurocontrol.</u>

Mr Hallgren gave the background to the development of the ATM procedures.   Details were given of how the procedures are derived, prior to proposal to ICAO.   This included establishment of the operational requirements, research into existing ICAO processes and validation using simulation and safety cases.

The details and status of the seven most mature airport related procedures were given, namely:

1. Landing clearance based on anticipated separation

2. Reduced runway separation on the same runway

3. Simultaneous intersecting runway operations

4. Intersection take-off

5. Multiple line-ups on the same runway

6. Visual approaches

7. Visual departures

2.5.2.2.   <u>Presentation 2 – Implementation of HALS/DTOP at Frankfurt Airport – Michael Huhnold, Frankfurt Airport.</u>

Details of the HALS/DTOP (High Approach Landing System/Dual Threshold Operation) project carried out at Frankfurt airport were given which aims to increase the capacity of the airport, by optimising the use of its parallel runways.   The project is based on displacing the threshold on one of the existing runways, to reduce the aircraft separation by minimising the wake vortex effects.   The project has involved Frankfurt Main AG, Deutsche Flugsicherung, Lufthansa and the simulators for pilot testing were provided by Vereiningung Cockpit (VC). The presentation is available on the OPTAS website.

2.5.2.3.   Presentation 3 – Operational Information Management - Giorgio Medici, SEA.

Mr Medici emphasised the problems between the different sectors of the airport, and highlighted the need for harmonisation and a common information system to serve all parties.

2.5.3. Session 2 - Initiatives to Improve Landside Operations, Day 1 PM

2.5.3.1.   Presentation 4 - The One-Stop Security Concept at Airports – Frank Durinckx, ECAC

The "One Stop Security Concept" is based on a single check in and screening of baggage, within a specified area. This would require a bilateral agreement between states, currently there is only one such agreement in place between Belgium and Genva. To expand this further there must be a definition of screening standards and equipment throughout the member states.

2.5.3.2.   Presentation 5 - Air Transport for Persons with Reduced Mobility - Yves Toffin, Inspection Generale de l'Aviation Civile, France.

Yves Toffin presented the problems for Persons with Reduced Mobility (PRM) using air travel within Europe. He highlighted that this is a large potential market which includes people with children, pregnant women, etc. and not just the disabled. The areas to be tackled include accessibility of airports, technical rules for aircraft and the current situation at European airports.

2.5.3.3.   Presentation 6 - Simplifying Passengers Travel - The SPT Project – Bob Vis, SITA.

The SPT programme is the investigation of the use of technology to increase the efficiency of passengers through airports. It was suggested that passengers, equipped with a multi-functional smart card including a biometric identity (ID), could provide information in a "one-stop" check process which, together with other information generated from the journey and shared between all involved parties, would facilitate subsequent processing, and allow controls to be effected on a risk assessment basis.

2.5.4. Session 3 – Capacity Enhancement Through Simulation, Day 2 AM

Welcome from Acting Director, introduces general director Peter Kordes

Greeting from Cesare Bernabei

Welcome from Emmanuel Fafournoux, Chairman Session 3, he stated that ATM has provided ATC centre here, will be operational by 17 September. OPTAS A results will be available on the Web site.

Small introduction from Paul Adamson, Eurocontrol UPS unit. Distributing a paper on use of modelling/simulation tools.

2.5.4.1.   <u>Presentation 7- Analytical Models – Christian Bousmanne, IATA.</u>

This presentation was given in conjunction with the following presentation on Simulation Models. It concentrated on the runway capacity modelling tool currently being developed by Airport Capacity Modelling Task Force (ACMTF).

2.5.4.2.   <u>Presentation 8 - Simulation Models – Peter Crick, Eurocontrol</u>

The presentation highlighted the information that could be gained by using simulations to look at airports. It concentrated on simulations available to Eurocontrol of airport capacity and environmental issues, as well as possible future improvements.

2.5.4.3.   <u>Presentation 9 - Simulation Activities at Madrid-Barajas - Juan Gallego, AENA.</u>

Mr Gallego presented a simulation of passenger flow through Madrid airport. It illustrated the necessity for simulation the terminals prior to large investment in the light of predicted increase in passengers. The presentation included a demonstration of one of the models used by Madrid, which simulated the various points of processing passengers.

2.5.5. Close of Workshop

Cesare Bernabei, European Commission: Although we have raised more questions than we have solved problems, I would congratulate everyone on the success of this Workshop.   The papers presented were very stimulating and triggered quite lively discussions.

It seems to me that this formula has been well received and that it gave everyone the opportunity to express many important issues. I will commit myself to pass your messages to the policy makers, both inside the European Commission and outside, at the AOT in Eurocontrol and at the AOPG, of ICAO.

The next Workshop will take place around February/March : please remember that we need your input to establish the issues we plan to discuss, therefore do not forget to send your comments and your suggestions.

Finally I would like to thank all of you for your active participation, RED Scientific staff for the excellent organisation of this event. A special thank you to Zoltan Gati of LRI for his assistance and his warm welcome in Budapest.

2.5.6. Workshop 3 - Questionnaire 3 Response and Results

Thirty eight questionnaires were distributed to the attendees of workshop 3 and from this there were eleven responses. Questions 1-a and 1-b refer to the topics in workshop 3.

Question 1-a: "Were these topics of interest to you and your work?" The responses to this question are summarised in Table 5 below.

Topic	Yes	No	No Answer
The Status of the Airport related Advanced Procedures	11		

Implementation of HALS/DTOP at Frankfurt Airport	11		
Operational Information Management	11		
The One-Stop Security Concept at Airports	9	2	
Air Transport for Persons with Reduced Mobility	6	4	1
Simplifying Passengers' Travel: The SPT Project	9	2	
Analytical Models	10	1	
Simulation Tools	11		
Simulation Activities at Madrid Barajas	7	4	

Table 2.7: Summary of Answers to Question 1-a

There was also a provision for comments and the following comments were made:

"Due to ONERA mission, aircraft oriented, I'm not concerned by the landside aspect.. So far. Nevertheless, its true that we need global solution assessment with respect to airport capacity/safety."
> Bruno Lamiscarre, ONERA, France

"Reduced Mobility was a repeat of 1st Workshop Presentation and Madrid simulation added no value, very low interest. "
> Eric Miart, Eurocontrol, Belgium

"SPT is a very important concept. It is vital that the common user approach is pursued."
> Frank Cruise, AER RIANTA, Ireland

"Procedures- Some mature APATSI procedures as SIRO's (Simultaneous Intersecting Runway Operations) or Land Aftens? will never be implemented at Brussels, before approval by ICAO. ECAC technical work has now to be validated (operationally), promoted on EU level and supported for ICAO approval."

"HALS/DTOP- We could implement such procedures at Brussels on a RWY 25l lengthened, after validation of this concept on ICAO level."
"One Stop/PRM – A standardisation of the requirements, based on the results, to be reached is needed. The recommended concept should be promoted at ECAC and EU level. Harmonisation of funding s also required to avoid competition between airports and airlines."
> Michel Noel, BIAR, Brussels

"Being part of an ATC provider, only airside issues are of interest to me. However, I'm sure the other elements will be of interest to other participants."
> Neil May, NATS, United Kingdom

"Although most of the topics were of interest to me, only a few really triggered me. I missed the foundation or lets say business case of the present projects. Also the strategy on how to deal with future requirements was missing. Hopefully next time the visions and strategies can be emphasised in the presentations. The presentations on day 2 were chaotic due to technical problems."
         Robert Verbeek, ATM, The Netherlands

"Presentations given on initiatives to improve airside efficiency and landside operations have been of great interest for me, since they are closely related to my work in ECAC working group on facilitation of air transport.
As for the topics dealt with on the 2nd day, if I am not working on that kind of question I have appreciated the opportunity to gain knowledge of the last developments in the field of simulation. It is of the highest importance to increase airports capacity in the years to come. In my opinion, it becomes more and more difficult to take into account the interest of passengers (commercial aspects). I wonder if representation of users and ? Have their say when simulation activities are initiated at airports."
         Yves Toffin, Inspecteur General de l'Aviation Civile, France

Question 1-b: "Do you feel that these topics are key issues within the European airport community?" Table 2.8 summarises the responses to this question.

Topic	Yes	No	No Answer
The Status of the Airport related Advanced Procedures	11		
Implementation of HALS/DTOP at Frankfurt Airport	10		1
Operational Information Management	10		1
The One-Stop Security Concept at Airports	10	1	
Air Transport for Persons with Reduced Mobility	7	4	
Simplifying Passengers' Travel: The SPT Project	11		
Analytical Models	10	1	
Simulation Tools	10	1	
Simulation Activities at Madrid Barajas	11		

Table 2.8: Summary of Answers to Question 1-b

The following comments were also made:

"There is a difference between the topics. So it is important to validate the effort of each issue."
        Martin Wiesner, DLR

"In my perspective key-issues should be of generic interest and providing solutions/answers to fundamental problems. Therefore HALS/DTOP is a key issue as it resolves a typical problem encountered in more than one location. However, I would normally not address a technical solution as a key issue."
        Robert Verbeek, ATM, The Netherlands

"It is crucial to maintain a high quality of services at European Airports in a situation of constantly increasing traffic. All the topics are key issues as far as they are aimed at preventing unnecessary delays to aircraft, passengers and cargo."
        Yves Toffin, Inspecteur General de l'Aviation Civile, France

Question 1-c: "Do you feel that the OPTAS B workshop 3 was well run and organised?" All but one of those who responded answered yes.

Question 1-d: "Do you have any other comments about workshop 3?" The following comments were made:

"Very well organised. Thank you very much I particularly appreciate WEB information before and after meeting."
        Bruno Lamiscarre, ONERA, France

"Meeting Rooms were inadapted, especially day 2. Moderation was inadapted."
        Eric Miart, Eurocontrol, Belgium

"Thanks to give us the opportunity to explain my project."
        Juan Jose Gallego, Madrid Airport, Spain

"It would be nice to get an address list of all members of the OPTAS B Workshop"
        Martin Wiesner, DLR

"Budapest was an excellent choice! Difficult to see screens in both conference rooms."
        Neil May, NATS, United Kingdom

"The tour of Budapest Airport and LRI was very nice. "
        Robert Verbeek, ATM, The Netherlands

Question 2-a: "Are there any topics you would like to see presented and discussed at workshop 4 or any of the other future workshops?" The following topics were suggested and comments made:
- Identification of bottlenecks in airport operations particularly airside - aprons, taxiways, runways.
- Low visibility operations. New procedures, more information on SAMS and ATOPS.
- Validation of results.
- Practical measures to reduce or remove bottlenecks.
- Results of 4th Framework programme projects such as TAPE, MANTEA and DEFAMM.
        Alan Gilbert, EUROCAE WG-41, Norway

- Information systems (global modelling (OMT) databases technologies, security/integrity issues)
- New sensors and related signal processing in order to increase efficiency with bad weather conditions (microwaves, optics, magnetics…) Hardware and simulation issues.
- A "New Technologies for Airport Management" session with the following possible topics:
- Simulation for solution assessment: Technology issues, object oriented simulation, distributive simulation). Improved models, environmental (noise, emissions, specs transport), sensors, aircrafts…
      Bruno Lamiscarre, ONERA, France

- Environmental issues awareness
- Wake Vortex studies and Wake vortex separations.
- Wake Vortex studies and Wake vortex separations.
- Collaboration Decision Making (CDM)
- Sequencing tools, AMAN, DMAN and Runway Management
- Safety Net Tools for runway and analyse operations at airports.
      Eric Miart, Eurocontrol, Belgium

- Consideration of very simple first order analytical models for runway capacity.
- Consideration of other factors that affect airport capacity e.g. community acceptance, infrastructure problems.
      Frank Cruise, AER RIANTA, Ireland

- AMAN/DMAN activities
      Martin Wiesner, DLR

- A SMGCS especially practical experience
- Roles of the several European Commission, ECAC boards and groups
- Operational experience with new procedures (e.g. HALS/DTOP)
- Assessment of statistical data
      Michael Huhnold, Frankfurt Airport, Germany

- Update on 5th framework projects
      Neil May, NATS, United Kingdom

- Strategy how to deal fundamentally with the requirement
- Overview of the projects/solutions which countries have planned in the near future to cope with the capacity problem (short fly over topics)
      Robert Verbeek, ATM, The Netherlands

Question 2-b: "Do you have any other comments or suggestions regarding the format of future workshops?" The following comments were made:

"Depending to the agenda, it could be possible for me to participate in a workshop longer than this one (3 days for example)"
      Bruno Lamiscarre, ONERA, France

"Out of 12 points suggested at workshop 1, only 1 has been addressed. I suggest you try to cover the remaining 11 points."
      Eric Miart, Eurocontrol, Belgium

"OK"
> Michel Noel, BIAR, Brussels

"Mixture of presentations and discussion should be continued - it worked well"
> Neil May, NATS, United Kingdom

"The triggering statements of Cesare Bernabei help to start the discussions. Maybe each presentation should end with 2 or 3 discussible statements and a 15 minute discussion should follow. The interaction and discussion of the different views really help to address the underlying problems."
> Robert Verbeek, ATM, The Netherlands

"The association of presentations by selected speakers and round table discussion seems a recipe for success."
> Yves Toffin, Inspecteur General de l'Aviation Civile, France

Question 3: "Do you feel that the OPTAS B workshops are of value to the airport industry?" Again to this question all who responded answered yes and the following comments were made:

"Yes in general. However, workshop 3 was weak."
> Eric Miart, Eurocontrol, Belgium

"Especially main issues like HALS/DTOP"
> Martin Wiesner, DLR

"Unique forum for discussing with all involved parties on an informal basis."
> Michael Huhnold, Frankfurt Airport, Germany

"A focus on operational results at short end medium term should be increased. Evaluation of the results should be done with all the partners at the end of each programme."
> Michel Noel, BIAR, Brussels

"An opportunity to bring together key players to discuss important issues. I hope that these fora will continue after OPTAS B has finished."
> Neil May, NATS, United Kingdom

"By bringing the different countries together and discuss their views/solutions/ requirements really help to address the fundamental problems. The European capacity problem can not be solved by each country alone. The complex issue should be mutually addressed and solved. These workshops are a starter for this. To my opinion a similar approach is needed on the air-side too."
> Robert Verbeek, ATM, The Netherlands

"It is difficult to answer this question, I don't know if the OPTAS B Website has got a great number of uses in the European Airport community."
> Yves Toffin, Inspecteur General de l'Aviation Civile, France

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Summary: The questionnaire responses give the impression that the third workshop was well received. The majority of the delegates found the topics discussed of interest to them and their work, and of importance to the airport community.

Internet Forum

A correction was received from Neil May of NATS to the description in the WS3 briefing paper of the HERMES (Heuristic Runway Movement Event Simulation) model. The full text of the email is included in Annex B and the relevant amendments have been incorporated into the text of Section 4.5, where this paper is reproduced.

2.6.   <u>WORKSHOP 4</u>

The 4th Workshop was held at the Centre A. Borschette, Brussels, on the 15th and 16th March 2000. The first day consisted of two sessions, Integrating Airports in a Single Sky and Reviews of Research Into Airport Processes, with presentations as follows:

➢ Workshop Introduction

➢ Session 1 – Integrating Airports in a Single Sky

  ➢ Presentation 1 – Integrating Airports into the Single European Sky: the Central Flow Management Unit (CFMU) view

  ➢ Presentation 2 – System Information Approach for Managing Airport Complexity

  ➢ Presentation 3 – Collaborative Decision Making (CDM)

  ➢ Round table discussion (see Annex B)

➢ Session 2 - Reviews of Research Into Airport Processes

  ➢ Presentation 1 – Departure Management at Major European Airports (DMAN)

  ➢ Presentation 2 – Surface Movement Systems

  ➢ Presentation 3 – Airports of the Future

  ➢ Round table discussion (see Annex B)

These were followed by a Wrap-Up of the project as a whole. The morning of the second day consisted of presentations from a number of high-level decision makers from a range of organisations on their vision of How Research can Support the Role of Airports in a Single European Sky.

2.6.1. DAY 1, AM - Workshop Introduction

Cesare Bernabei welcomed all the delegates to Brussels and gave an overview of the structure of the workshop and what he aimed to achieve. This was followed by the OPTAS B project co-ordinator, Felix Dux, who gave a brief presentation to remind delegates of the objectives and details of the OPTAS B project. Slides for this presentation can be found in "OPTAS_B.ppt".

The main objective of the OPTAS B project is to achieve a comprehensive overview of the current state-of-the-art of research into airport capacity. This will be done by collating and reviewing studies from the European Commission, International, National and Independent (commercial or academic) organisations.

The approach has been divided into two sections, research and data collection, and dissemination and delegate feedback. The research and data collection will result in a consolidation document briefly describing each study found and focusing on the topics chosen for discussion at each workshop. There will also be a bibliography database containing summary information on each study. The primary vehicle for dissemination and

delegate feedback is a sequence of four workshops that are being held over two years. These workshops are supported by the OPTAS B web site, which has all the latest reports and version of the database available for download, and an open forum to allow delegate feedback. Due to the apparent lack of use of the open forum facility on the web site since the first workshop, questionnaires are also being distributed to each delegate to elicit extra feedback. The OPTAS B web site has been up and running since before the first workshop which was held in June 1998.

It was emphasised that as 7th April 2000 was the final date for feedback on the project and all expense claims should be received by 5th April 2000 to ensure payment.

2.6.2. Session 1 – Integrating Airports in a Single Sky, Day 1 AM

2.6.2.1.   Presentation 1 – Integrating Airports into the Single European Sky: the CFMU view – Alain Fournié, Eurocontrol.

Mr Fournié presented an overview of how the Central Flow Management Unit would assist in the integration of airports into ATM. The role of the Central Flow Management Unit is to manage the imbalance between the traffic demand and the available capacity in normal or exceptional situations. Flow management has a dual impact on airports, management of the local ATC capacity and handling of Calculated Take-Off Time for the flights subject to ATFM measures. Several limitations in the present process have been identified for both issues. They have been integrated by the CFMU into its 5 years development plan that was agreed by the European ATFM Group and revised annually.   Its main goals are to improve the information exchange between the airports and the other stakeholders (accuracy, consistency, availability) and to define the relevant procedures (Collaborative decision making). The presentation indicated the actions as already planned by the CFMU and the longer term issues.

2.6.2.2.   Presentation 2 – System Information Approach for Managing Airport Complexity – Bruno Lamiscarre, ONERA.

Mr Lamiscarre presented examples of airport information system modelling including the AdF (Airports of the Future) project. This is a multidisciplinary project conducted at ONERA, aiming at proposing and validating solutions to assist controllers and pilots to improve safety and maintain an average level of aircraft movements, whatever the weather conditions. Technical objectives are to improve existing/emerging technologies, including navigation, A-SMGCS, management and security of airport information flows.

The problems addressed in designing the CMSI were stated, and the expected extension and benefits of an Object Oriented Modelisation and Simulation (OOM&S) and High Level Architecture (HLA) based technologies described, to face the requirements of the European single sky.

2.6.2.3.   Presentation 3 – Collaborative Decision Making (CDM) – Peter Martin, Eurocontrol.

Mr Martin presented an overview of Collaborative Decision Making (CDM) and its aim to improve flight operations through involvement of the aircraft operators and operations in the process of Air Traffic Management (ATM). It covered applications aiming to take into account the internal priorities of the Aircraft Operators or the Airport, before and during the

flight, and development of Information Management systems and procedures in order to make full use of available data.

It demonstrated that it can be applied to the airport domain to improve situation awareness through the sharing of information locally and regionally to focus the application of modern technology.

2.6.3. Session 2 - Reviews of Research Into Airport Processes

2.6.3.1.   Presentation 1 – Departure Management at Major European Airports (DMAN) – Volker Huck, Eurocontrol

Eurocontrol DMAN project, support to Air Traffic Services (ATS) – PCS arrival management.

Mr Martin presented an overview of the Eurocontrol Departure Management (DMAN) project. He stated that DMAN was a computer-based tool for assisting air traffic controllers at airports with the management of departing flights. It is currently at the stage where an operational concept and statement of requirements have been developed by Eurocontrol and its contractors. The function of DMAN is to plan take-off times and consequent start-up times, and to make these available to ATC, aircraft operating companies and airport authorities.

The primary objective of the DMAN project is to maximise runway throughput. The possibility of doing this arises from the fact that, given a set of departing flights, some orders of departure will require less runway time than others. This in turn is because the minimum time interval between two successive departures depends on specific details of the flights in question, including the wake turbulence categories of the two aircraft and whether or not they will follow the same route through the TMA.

DMAN started in 1998, it is currently in its 2nd phase and will report in July 00, the results of which will be made available.

2.6.3.2.   Presentation 2 – Surface Movement Systems – Paul Fleming, AOPG/PT2 (AOPG Project Team 2)

Mr Fleming gave an update on the current work and progress of the PT2, a project team of the Aerodromes Operations Group of ICAO. Its main task is to produce a European manual for A-SMGCS [2], 1st draft in May, and operational procedures for A-SMGCS. The manual consists of two volumes, the first covers operational requirements and guidance material from the last 3 years. The second contains implementation requirements, roles and responsibilities and performance requirements, and is currently being written. Both volumes will be available on the OPTAS B web-site.

The implementation and requirement procedures are restricted to those with tangible benefits and can be implemented, these include safety issues. A proposed system has to be proved to be generically safe to ICAO, and another safety assessment has to be performed to prove it is safe at an individual airport. The procedures are based around runway utilisation, concentrating on surveillance and linking it with the guidance system.

The roles and responsibilities should be considered as A-SMGCS becomes more complex. If the controller/pilot rely on a system it has to be trusted, as the level of implementation increases the integrity becomes paramount. The preference is for the performance requirements to be quantifiable, it is often easier to provide objective based requirements

which I prefer. We will try to achieve both. The current procedures require no change to guidance and control. Research is important to provide the figures for the procedures, through simulations, etc.

Some ideas from the manual, validation of performance – these should be realistic, for example a position accuracy of ±25 metres could be adequate, 3 metres could be easy to achieve but unnecessary, allowing the system designer to use the technology they want. There is no such thing as an operational trial, when conducting trials it has to be safe for the others using the same airspace. In Bruno Lamiscarre's literature is an infra-red picture, this is not good enough the pilot cannot see the lines, etc.

Response times are quoted in seconds, when the operations are combined they could add up to minutes. In some systems the time is increased because of the technology, and items being switched on and off – Is this an advance? We don't have any communication requirements, we need to how data-links work and the times involved.

In summary, the manual will evolve as systems come on line and procedures are developed. Research is required to support and complete the manual, we have to keep going backwards and forwards to check the validity of what has been written. Money is required, we don't have any money we are looking for handouts in terms of funding and information. Personally I see a lot of large consortiums involved in research, it is the same people every time and the diversity and fresh thinking has been lost, perhaps involve universities and a wider spread of airports. Use a variety of pilots and controllers, the inexperienced should also be catered for, in addition choose individuals with limited English language skills, test the limits of the systems. But essentially don't stretch the safety.

2.6.3.3. Presentation 3 – Airports of the Future – Laurence Matthews, BAA

Mr Matthews presented an overview of BAA's programme titled 'Airports of the Future', which looks at the likely impacts of technological, commercial, social and political trends on the future design and operation of airports.

Although much of the emphasis of this work has been on the terminal building itself, many of the issues impact directly on the operation of aircraft on stands and on manoeuvring areas. Furthermore many issues, which arise when we take a wider perspective in looking at the changing world, will affect many areas simultaneously - so that looking at one aspect of airport operations in isolation can be misleading.

The presentation will give some historical examples of such linkages, and outline the main findings of the work, areas of research active within BAA, and areas where further work would be useful.

2.6.4. Session 3: How Research Can Support the Role of Airports in a Single European Sky

2.6.4.1. Welcome and High-Level Summary – Cesare Bernabei, European Commission.

Welcome to the high level speakers. Apologies on behalf of Piero D'Aloia, and thank you to Thierry Tostain, Secretary to ICAO Europe, for stepping in. We have discussed the difficulties in separating policy from technical matters, but we need to set priorities.

OPTAS B objective was to provide an overview of the current state of airport research. The 1st workshop in June 1998, and stakeholders were asked what were the major items to

tackle, this was the start of the single sky initiative which occurred 18 months later. Also covered were the issues regarding people with reduced mobility (PRM) which represent 25% of the population, future business needs, gate-to-gate (GTG), and environmental issues.

The 2nd Workshop consisted of a briefing of a large number of projects, most of which were sponsored by the European Commission. This exhausted the audience, but it showed the delegates the extent of the work being carried out and where items overlapped. The 3rd Workshop had three sessions each having three presentations and followed by round table discussion. This proved to be a successful format, the open forum being the most constructive confronting the issues.

The problems need to be defined and measured, this is a priority. We need tools to measure the capacity of the airspace and airports both areas have to be developed together. Removal of political barriers with CDM at all levels, all stakeholders contributing. A more top down approach, with the European Commission and Eurocontrol taking responsibility. For capacity planning, integration of arrival, departure and ground movement planning tools; harmonisation and upgrade to latest (best) algorithms; and greater flexibility of CFMU functionality. Regarding safety, there needs to be a standard approach to safety, with safety assurance procedures and a risk based approach in implementing them. The integrity of models/systems must be determined. Finally, a separation of Eurocontrol service provision and the regulatory function.

Regarding A-SMGCS, it should be seen as an enabling system for surface movement solutions, with a common and flexible implementation methodology and the objective to increase airport capacity. A tangible cost benefit analysis needs to be carried out, with AOPG PT/2 involved in the development of requirements. Modelling and simulations should be flexible and simple, covering the global picture of both the land and air sides. A standard airspace capacity model is also required, but in all cases the demand on software engineering should be considered.

Regarding the role and scope of Eurocontrol, it was recognised that it is working as best possible within its present constraints. Resources must be allocated to tackle the priority issues, with more collaboration and financial support between the European Commission and Eurocontrol, therefore reducing the red tape.

Other issues highlighted were the environment, inter-modality, a road map of the where we are to go, improve the barriers between R&D and implementation, recognise the role of smaller airports but overall the passenger quality of service should not be forgotten. The journey should be considered as a whole, we can increase capacity, the number of slots in an airport, but what is the price for this.

Please use the websites for feedback, the OPTAS B web-site will be kept for the thematic network.

2.6.4.2.　Michel Ayral – Director Aviation Policy, European Commission

Within the European Commission the R&D and policy units have been integrated into the same unit. The European Commission want to indicate that research must contribute to future policy actions, and the air transport research must contribute to a single European sky. It is a major European Commission objective management of air traffic must be consistent with organisation of the European market as a whole. In terms of Safety, want to form a single authority, able to provide and deliver the procedures and certificates. We have

to account for the existence of Eurocontrol and reorganise it to cover the internal market. Research must contribute scenarios, data and technical information.

The difficulty in the air transport field is that everything is linked, for example, we need tools for consistent management of airports with air traffic. The relationship between the air traffic slots and the airport slots must be addressed. The European Commission will shortly make a proposal to reform this, but it is a complex issue.

We have to approach airports in an integrated way, as a network and as part or the overall transport system, this way we give priority to inter-modality projects, which the European Commission wishes to promote in all means of transport.

In conclusion, this project must be considered as part of the Single Sky project to see what contribution can be made to efficiency of air traffic management. The AECMA group, which is classed as a high level group, looking at how to integrate research into ATM in order to have a more consistent approach to benefit industry.

2.6.4.3.   George Paulson, Director Eurocontrol

Need to address the quality of service, in 1998, 3.7% of delays could be attributed to ATC, 5.9% to other airport activities and 1.1% to the weather, i.e. 10% were down to the airport and lack of efficiency. 85% of these delays were due to 18 airports which shows that they are concentrated and severe. At 30 airports the demand to capacity ratio was critical.

There are 2 aspects to single sky integration, airport issues themselves and integration into ATM. Gate-to-gate has to be seen as a systems approach, within Eurocontrol there needs to be a focus on airport operations teams working in the short to medium term and being cost focused. There are 5 priority issues;

➢ Infrastructure: Rapid exit taxi, runway and apron configuration and stands, relatively small changes can have a large input. Effective modelling tools are paramount here, with far more work needed.

➢ Technology: Improving ATC facilities, simple things like labelling ground movement radar. Support to A-SMGCS, traffic management tools, integrating AMAN and DMAN into SMAN (Surface MANager), integrating tools within the terminal area, this will become enlarged and more automated (ARETA), and the safety aspects of the runway incursions.

➢ Procedures: Improve approach procedures in the terminal area, flight management systems, could bring advantages to traffic flow and the environment, parallel operations, complicated processes the risk and safety cases must be made clearly.

➢ Information Management: SWIM (System Wide Information Management) at a strategic level, need close collaboration of planning, at a tactical level CDM with a common database and integration of data, including for example ETFMS (Enhanced situation display facility).

➢ Human Factors: It is key that it relies on people, so best practise for ATC is vitally important. Since I did modelling in the 90's there has been no change in technology or the infrastructure, it has just relied on people and best practice to provide the increase in movements. AMAN & DMAN should be an aid and not encumbering.

My underlying theme is that we should work together, collaboration is very important.

2.6.4.4. Thierry Tostain, ICAO - Europe and North Atlantic Office

Three points:

➤ Co-ordination of work between Eurocontrol and other agencies, there is a need for common priorities and visibility. We cover a large region, individual states have different priorities, but it is vital for success that there is collaboration and co-ordination between the states.

➤ Safety needs more attention, as we increase capacity we are getting nearer to the safety margins, ICAO is preparing a new provision on this matter.

➤ Early result of R&D through appropriate provision, for the best use of resources in Europe.

2.6.4.5. Alejandro Egido, ACI

ACI represents over 200 airport operators in Europe, with 450 airports in 48 countries. In 1998, these airports handled 907 million passengers, 12.3 million tonnes of cargo, 16.4 million movements and employing over 1.1 million people.

We think of airports as nodes in an ATM network, ACI want to show our commitment to the ATM2000+ strategy [3] and state that we share IACA views on land side relevance. We aim to maximise the predictability of air traffic operations, improve efficiency by the allocation of resources, monitor environmental impacts, improving awareness within the airport community and align our GTG objectives with those of the European Commission.

Causes of delays in 1998, 50% can be attributed to airports. Airports have always tried to balance capacity with demand, we think around 50% of these delays can be attributed to inefficient use of the current capacity. ACI are concerned about the accuracy of the data available, these indicators are key to efficient management therefore, more research is required but in partnership with the airports.

One or our priorities is CDM, although we feel that airports are not treated as equally as the other partners, it is essential they play an active role. We would like to identify the scope and terms of reference for an ATM network manager, to co-ordinate scheduling, capacity management and capture the operational drivers within the airport. We want to build awareness of using best practice in solving problems, whilst promoting research locally.

To sum up we need to promote awareness of the airport databases supported by knowledge management techniques, and seek wider airport models to analyse the trade-offs between operational practice and, economic and environmental impact.

2.6.4.6. Phil Hogge, Director IATA

IATA strongly support the Commission's single sky initiative, but it should be remembered that the single sky for the 15 EU states should fit within the sky of the 38 ECAC states and into the ICAO 185 member states. The tight scheduling slots associated with international traffic give waves of traffic. We also see airports as nodes in a tight network, effects at one airport have a knock on effect at another airport in the network. I am also vice chairman of the Performance Review Commission, we are developing performance measures to monitor

and provide data to improve performance across the system including airports. A number of airlines use the automatically reported data provided by Out-Off-On-In data which could be combined with the CFMU work on ETFMS, this could give punctuality data. There is a need for more on-route capacity but this could expose airports further.

I have an interest in CDM at strategic and tactical levels. There is information available sitting in airport, airline, ATC and CFMU systems if this is accessed in real time it can assist operational decisions. CFMU will have play a significant part in this. Airport capacity is complex with airport being unique, until recently there are no consistent measures of capacity across Europe making it difficult to compare like with like. Its essential there is a consistent capacity assessment model, that can show unconstrained, sustained and declared capacity to calculate how much the target has been missed, which would give the business case for asking for improvements.

Common safety analysis is required for runway incursion, simultaneous operations on intersecting runways. This is done by the FAA and several countries in Europe, it has to be consistent so we can learn off each other.   Multinational TMA, we should not sit in our national boxes and ignore the opportunities of combining ATC for example, using Benelux to cover Amsterdam, Brussels and Luxembourg. Can we start small and grow big, AMAN, DMAN and SMAN linking the operations 200 miles from the airport, metering aircraft in and out of runways.

Modelling initiative to assist the interaction between the various elements. Wake Vortex – work is done on detection and avoidance, is there more that can be done, a small change will dramatically effect the throughput of runways.

2.6.4.7.   Uwe Völckers, Director DLR, Braunschweig

With a general view from the perspective of research organisations. Capacity is a critical issue, airports are the key elements, the sites and sources of traffic can be compared to a complex organism, like a human, the organs need to collaborate together. Despite all the work that has been done, we do not fully understand all the internal processes of an airport or the role of airports within the air traffic system.

To do the work we need consistent, comprehensive, transparent broader models of capacity as well as consistent detailed models. We need to investigate and analyse, it is unclear where the bottlenecks are and their causes, once they are identified then the action needed can be prioritised, and established whether they are technical or procedural. This can then provide the solid information required by the decision makers.

The research carried out by the states and academia should have an objective, unbiased view and can integrate the views of the stakeholders. Projects have demonstrated what can be done, we need to harmonise solutions under the 4th Framework umbrella and the EU should bring together, endorse and foster combined activity. My plea is that there is a wide scope of work available, but it needs integrating.

Close of Workshop

2.6.5. Workshop 4 - Questionnaire 4 Response and Results

Forty questionnaires (26 delegates, & 14 speakers) were distributed to the attendees of workshop 4 and from this there were eight responses. Questions 1-a and 1-b refer to the topics in Workshop 4.

Question 1-a: "Were these topics of interest to you and your work?" The responses to this question are summarised in Table 2.9 below.

Topic	Yes	No	No Answer
Integrating Airports into the Single European Sky: the CFMU view	8		
Modelling of Airport Information Systems	5	3	
Collaborative Decision Making (CDM)	8		
Departure Management at major European Airports (DMAN)	8		
Surface Movement Systems	8		
Airports of the Future	7		
Project overview and conclusions	8		
How research can support the Role of Airports in a Single European Sky	8		

Table 2.9: Summary of Answers to Question 1-a

There was also a provision for comments and the following comments were made:

"There was a high level in the contents and quality of the presentations. Good representations of the different stakeholders were present at the workshop. That allowed an enlightening debate, which I hope will steer action plans for the near future."
    Alejandro Egido, ACI-Europe, Palma de Mallorca Airport.

"Perhaps a little too academic in some of the papers, but generally very interesting, especially airports of the future."
    Frank Cruise, AER RIANTA, Ireland

"We are especially involved in:
➢ Modelling of Airport Information Systems.
➢ CDM, taking part in the A-CDM-D project
➢ Surface Movement Systems
BIAC is also particularly interested in AMAN/DMAN projects and Airport Future Developments"
    Michel Noel, BIAC, Belgium

"'Airports of the Future' was very exciting. A new view to access the problem. Opened the mind."
    Peter Mosch, Frankfurt Airport, Germany

"To my opinion, this last conclusive workshop discussed the primary key issues regarding the enhancement of airport's capacity in respect of the whold 'gate-to-gate' ATM system.

The more or less political conclusions which were drawn at the end of the first day and the wrap-up session the day after, are vital for efficient and successful implementation of all the solutions discussed in earlier OPTAS-B workshops
Therefore, I found this last workshop very interesting and a good basis for the next on-coming 'Network' programme within the 5th framework programme."
        Robert Jan Verbeek, ATM, The Netherlands

Question 1-b: "Do you feel that these topics are key issues within the European airport community?" Table 2.10 summarises the responses to this question.

Topic	Yes	No	No Answer
Integrating Airports into the Single European Sky: the CFMU view	7	1	
Modelling of Airport Information Systems	6	2	
Collaborative Decision Making (CDM)	8		
Departure Management at major European Airports (DMAN)	6	2	
Surface Movement Systems	8		
Airports of the Future	5	3	
Project overview and conclusions	6	2	
How research can support the Role of Airports in a Single European Sky	8		

Table 2.10: Summary of Answers to Question 1-b

The following comments were also made:

"A good mixture of on going practices, modelling activities and futuristic forecasts was presented. I think it is a good approach to analyse where we come from, where we are and how to get to the future."
        Alejandro Egido, ACI-Europe, Palma de Mallorca Airport.

"Yes or No is a drastic choice. Everything is interesting, when I say No is where it is not of direct interest to my present job."
        Christian Gonnord, Aéroports de Paris, France.

"Unfortunately, the IATA position was a little superficial, to my mind. More attention to schedule management and ?? would have been helpful."
        Frank Cruise, AER RIANTA, Ireland

"'Airports of the Future' should be more integrated in research. Important to look for solutions which cover the whole chain of travel and take service levels into consideration during all legs during travel also in the terminal buildings."

Peter Mosch, Frankfurt Airport, Germany

"I refer to my statement at 1-a; yes all topics, and especially the conclusions drawn from them, should be key issues within the airport community."
Robert Jan Verbeek, ATM, The Netherlands

Question 1-c: "Do you feel that the OPTAS B workshop 4 was well run and organised?" All of those who responded answered yes.

Question 1-d: "Do you have any other comments about workshop 4?" The following comments were made:

"The workshop is over, What about the day after? How are the workshop conclusions going to be translated into action plans? Those are the major concerns I can think of at the moment."
Alejandro Egido, ACI-Europe, Palma de Mallorca Airport.

"Q1 (CFMU): To integrate the airport into the ATM network is of prime interest, but I'm not sure that the CFMU view is the main issue.
Q3 (CDM): The rationale must be 'How to insure that scheduled flights can take-off in time, without any ATC constraint?' The CFMU view and the D-MAN concept is exactly the opposite their problem being 'How to plan departure time in respect to airspace constraints?
Q 5&6: These issues were more workshop opportunities."
Christian Gonnord, Aéroports de Paris, France.

"Probably the best in line with my activities/work from the four."
Eric Miart, Eurocontrol, Belgium

"Arrangements very satisfactory."
Frank Cruise, AER RIANTA, Ireland

"Of great interest, as we feel that a political pressure of DGVII could be worth, enforcing collaboration and co-ordination between all partners and programs"
Michel Noel, BIAC, Belgium

"Round table which included every participant was very good."
Peter Mosch, Frankfurt Airport, Germany

"Well done and organised! Especially the wrap-up on the second day together with the 'high-level' decision makers was an excellent item. I'm sure that the conclusions from this workshop 4, as presented by Mr. Bernabei will help the European Community in their high level elaborations."
Robert Jan Verbeek, ATM, The Netherlands

Question 2-a: "Are there any other topics you would have liked to have seen presented and discussed at the OPTAS B workshops?" The following topics were suggested and comments made:

"I am not quite sure about the importance of planning in airport operation activities having been stressed enough. A stronger representation of co-ordinators could be extremely helpful under my point of view."

Alejandro Egido, ACI-Europe, Palma de Mallorca Airport.

"I think there is an interesting topic in the field of simulation, a kind of synthesis, what tools are existing, are they object oriented, what are the metrics (performance, safety, environment,..)."
Bruno Lamiscarre, ONERA, France.

"Yes, see my two former replies to you questionnaire, same topics minus those who were addressed at WS-4."
Eric Miart, Eurocontrol, Belgium

"Demand management and also some practical examples of capacity calculation and delay effect calculation."
Frank Cruise, AER RIANTA, Ireland

➤ "Operational R&D (follow-up) on:
  ➤ Optimisation processes (gate-to-gate): landside/airside
  ➤ Capacity constraints
  ➤ Environmental constraints
➤ How much to match economic constraints with safety and operation requirements."
➤   Michel Noel, BIAC, Belgium

"No, I think extra presentations and/or discussions on other ongoing programmes wouldn't have changed to final conclusions."
Robert Jan Verbeek, ATM, The Netherlands

Question 2-b: "Do you have any other comments or suggestions regarding the format of future workshops?" The following comments were made:

"I think there is an interesting topic in the field of simulation, a kind of synthesis, what tools are existing, are they object oriented, what are the metrics (performance, safety, environment,..)."
Bruno Lamiscarre, ONERA, France.

"Two days, same density and same participation/invitees as last one workshop is the right format!"
Eric Miart, Eurocontrol, Belgium

"Much more involvement by airports, i.e. more balance in representation."
Frank Cruise, AER RIANTA, Ireland

"I have 2 remarks on the format:
1.   the timeframe between the workshops held, is far too long. It doesn't help to really come to the core of the problem/discussion.
2.   Only presentations makes the attendees a passive audience. The opinion tour, like the one which was held at the end of the first day, should be done more often in each workshop. Especially then, the attendees have to show that they have been active listeners and a discussion can follow."
Robert Jan Verbeek, ATM, The Netherlands

Question 3: "Do you feel that the OPTAS B workshops are of value to the airport community?" Again to this question all who responded answered yes and the following comments were made:

"As I said before, I hope the conclusions are able to trigger action plans, with well defined targets and a roadmap to reach them."
        Alejandro Egido, ACI-Europe, Palma de Mallorca Airport.

"What I have particularly appreciated: Open meetings, friendliness, Web-site, synthesis attempts."
        Bruno Lamiscarre, ONERA, France.

"The main value of OPTAS workshops is with exchange of information, views, etc."
        Eric Miart, Eurocontrol, Belgium

"First real attempt to get to grips with this difficult issue."
        Frank Cruise, AER RIANTA, Ireland

"Partly. It is at least a good platform to exchange knowledge about ongoing projects."
        Peter Mosch, Frankfurt Airport, Germany

"Discussing and combining the views of the national (expert) delegates on the OPTAS-B issues is definitely the first step to supra-national 'collaborative decision making'. It fits to the current approach of the European Commission as in today's 'High Level Group.'"
        Robert Jan Verbeek, ATM, The Netherlands

Summary: The questionnaire responses give the impression that the fourth workshop was well received. The majority of the delegates found the topics discussed of interest to them and their work, and of importance to the airport community.

3.   CONSOLIDATION OF AIRPORT STUDIES MATERIAL

3.1.   Introduction

The objective of WP 2 was to gather and collate references to airport research projects and other relevant study material, which could serve as a basis for the synthesis activities reported in Section 4 below. These references were compiled into a database, which constitutes the main deliverable for the WP and which is now available for download from the OPTAS B Website (www.red-scientific.co.uk/optas_b.htm).

This section has been adapted from the WP 2 report originally prepared by Airsys ATM, the WP leader, in accordance with the original project plan. It briefly documents the approach adopted for selecting relevant study material and for the design and implementation of the database.

3.2.   Information Gathering

Each partner in the project consortium shared responsibility for obtaining study material from relevant organisations and from sources such as ARDEP [4]. Documents were collected in paper format and, where possible, in electronic format. Member states and Workshop delegates were also invited to provide information on research activities within their states and nominating organisations. In practice, however, the response from both the states and the Workshop delegates was generally disappointing and most of the material was obtained via literature searches conducted by the study team.

To determine which studies were relevant for inclusion, 2 sets of criteria were applied in succession, which effectively acted as *filters*. Studies which met the criteria for filter 1 were assessed against the criteria for filter 2 and were accepted if they met both sets of criteria. The filter criteria were as follows:

➢ Filter 1: Studies and reports were required meet the following criteria:

    ➢ They should not be more than 5 years old (at the start of the OPTAS B project);

    ➢ They should deal with airport issues;

    ➢ They should concern initiatives likely to be implemented within the next 10 years.

    ➢ The studies should be sourced from the following organisations:

        ♦ Nation states, both within and outside Europe.

        ♦ Aviation organisations.

        ♦ Eurocontrol and the European Commission.

➢ <u>Filter 2:</u> Studies should be related to one or more of the following list of domains or subject areas:

Domain	environment	airside	infrastructure	Landside	other
Subject area		➢ Airspace Management ➢ Runway Management ➢ Ground Handling ➢ Slot Management ➢ Taxiway/Apron/ Stand Management	➢ Intermodality	➢ Passenger Handling ➢ Baggage Handling ➢ Cargo Handling	➢ Other

Table 3.1 Filter 2 Domains and subject areas

Subsequently, the studies that had been collated were subjected to an analysis which resulted in a parallel classification using the following "themes":

➢ ATM

➢ Capacity Data

➢ Data Collection

➢ Environmental and Social Impact

➢ Human Factors

➢ Information Management

➢ Infrastructure

➢ Operational Procedures

➢ Passenger Handling (including PRMs)

➢ R&D Policy

➢ Safety/Security

➢ Simulation and Modelling

➢ Surface Movement

3.3. Studies Database

The references gathered in the way described above have been compiled into a database, which is intended to act as a research resource and is available for download from the

project Website. The database was implemented using MS Access. An initial version was placed on the OPTAS B Web site in August 1998. A revised version was placed on the Web site in May 1999.

The database has been designed so as to allow users to frame questions such as:

➢ "What projects are concerned with airport capacity, and what were their conclusions?"

➢ "Who led these studies?"

➢ "Where can I find documentation about a specific topic?"

In terms of an "entity-relationship" model, the above requirements imply that the database would need to know about entity types such as:

➢ project: e.g. OPTAS A (study),

➢ theme: e.g. airport simulation tools, traffic management airside,

➢ programme: e.g. 4th framework programme,

➢ geographic area: e.g. Europe, Brussels airport, CDG, Frankfurt airport

➢ organisation: e.g. European Commission, EUROCONTROL, RED, FAG, Airsys ATM

It should also be able to represent relationships such as**:**
➢ between organisation and study: "sponsors", "funds", "leads", "participates in"
➢ between contact and organisation: "represents"
➢ between study and theme: "addresses"
➢ between contact and study: "can provide information about"
➢ between organisation and programme: "sponsors"
➢ between project and programme: "part of"
➢ between project and geographic area: "addresses"
➢ between programme and geographic area: "addresses"

This entity-relationship model lends itself to implementation with a relational database management system, such as Microsoft Access, in which all of the entities and relationships are modelled using tables. Given its wide availability, Access was therefore chosen for the database.

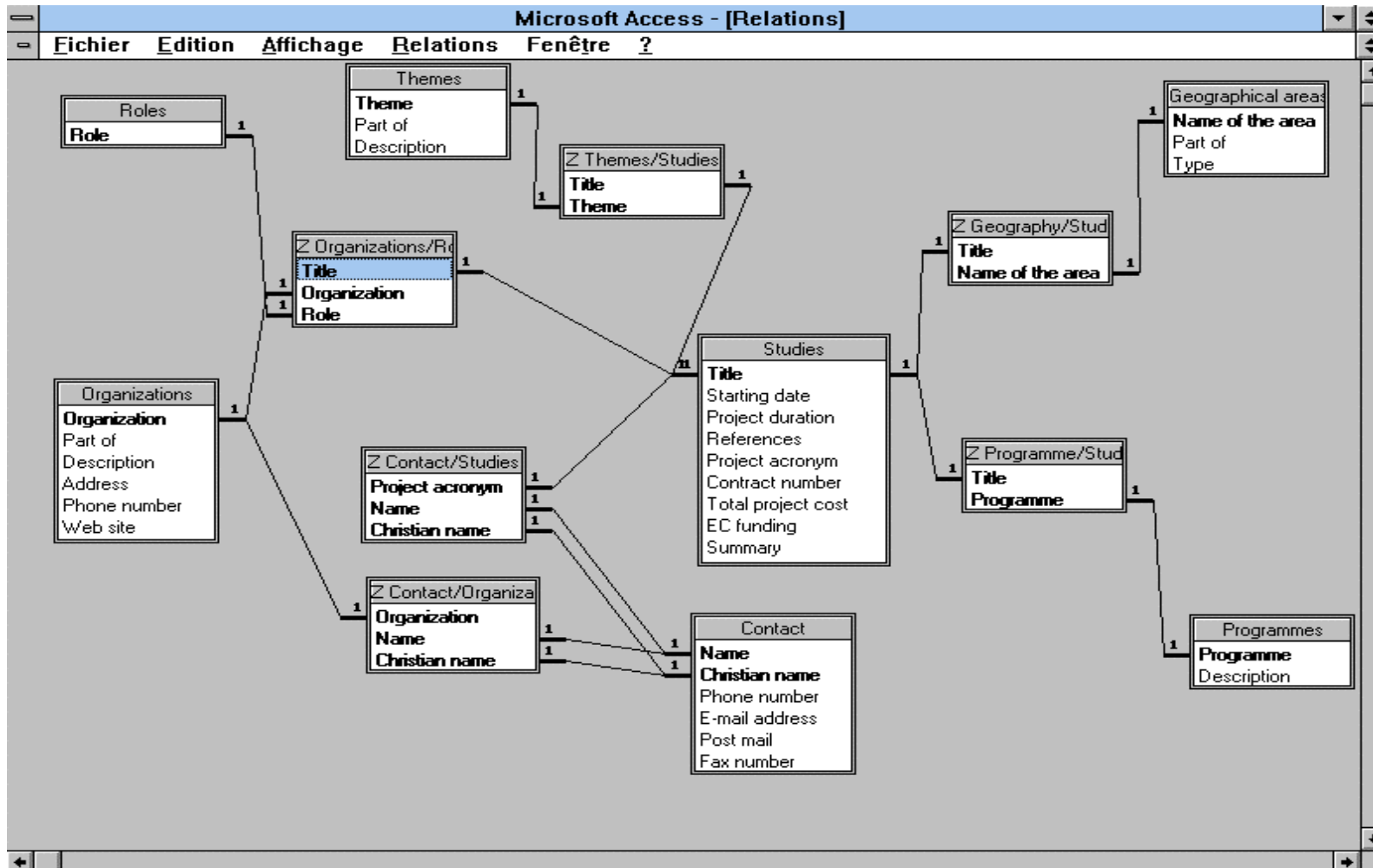Figure 3-1 illustrates the tables and relationships constituting the database.

Figure 3-1: Relations between tables of the database

3.4.   Reading Form

The user interface to the database provides a *reading form* which allows users to view detailed information on individual studies and to add new studies. This form includes the following fields:

➢ about the study itself:

  ♦ title, project acronym, starting date, project duration, contract number, total project cost, source of funding

  ♦ reference documents

  ♦ name of the programme of which the study is a part (if applicable)

  ♦ summary

  ♦ themes

  ♦ geographic areas (country, airport, town...) if any

➢ about the organisations involved in the study:

  ♦ role in the study (sponsor, leader, partner)

  ♦ contact names and co-ordinates

3.5.   Searching Facilities

The revised version of the database, which was made available in May 2000, provides 2 additional searching facilities:

(i)   a facility to search for records associated with a particular theme,

(ii)   a facility to search on occurrences of user specified keywords within the title and summary text fields of the database.

The provision of the keyword search facility was complicated by the fact that Access does not normally permit queries to be performed on the values of "memo"-type fields (i.e. fields containing large amounts of text). To get around this problem it was necessary to implement some additional software to perform post-processing on the database after data entry.

4.   REVIEWS AND ASSESSMENTS OF AIRPORT STUDIES

4.1.   Introduction

The work conducted under WP3, synthesis, was directed towards providing briefing documentation in advance of Workshops 3 and 4, giving an overview of the state of research in the areas being covered by the Workshop sessions, as a further basis for discussion.

The briefing documents were therefore intended primarily as a source of background information, which would help to foster debate within the Workshops. Of necessity they are brief and do not claim to be either complete or comprehensive. In addition some of the statements they contain may be contentious, rather than representing the kind of consensus view which was one of the objectives of the Workshop discussions.

A range of topics were covered by these documents. In this section these topics have been grouped under the following headings:

➢ **Airside Initiatives - Management of the Network**. This covers those initiatives which consider airports within the context of the European airspace as a whole, such as CDM, or which concern the interface between the airport and the wider airspace, such as planning tools for arrival and departure management. The concept of the Single European Sky is clearly relevant here, and a discussion is therefore included of the European Commission's recent communication on this subject [5].

➢ **Airside Initiatives - New Systems and Procedures**. This covers research into new procedures and technologies for runway operations and surface movement.

➢ **Landside Initiatives**. This covers research into operations within the terminal area.

  ➢ Security Initiatives

  ➢ INSPASS/CANPASS

  ➢ Initiatives to Improve Passenger Handling Procedures - Airport Automation

  ➢ Initiatives to Improve Processing of Passengers with Reduced Mobility (PRM)

➢ **Capacity Enhancement Through Simulation**. This gives an overview of the current use of fast-time simulation and analytical models to support decision making in airport operations.

4.2.   Airside Initiatives – Management of the Network

4.2.1. Introduction

Many airside capacity constraints are related to congestion in the European airspace as a whole. Initiatives in this area seek to improve the regulation of the flow of aircraft into and out of airports within this context. This subsection focuses on three major initiatives in this area:

➢ Air Traffic Flow Management (ATFM), including in particular the role of the Central Flow Management Unit (CFMU)

➢ Collaborative Decision Making (CDM)

➢ Arrival and Departure Systems

Additionally, a discussion is included of some of the potential research implications of the Single European Sky concept [5].

4.2.2. Air Traffic Flow Management

4.2.2.1.   Introduction

ATFM currently exists to support ATC in preventing any system overloading and ensuring an optimum flow of air traffic to, from, through, or within defined areas during times when demand exceeds, or is expected to exceed, the available capacity of the ATC system.

4.2.2.2.   Overview

Flow management was introduced into the present ATM concepts as a protective measure using regulatory mechanisms to manage traffic. There will always need to be some means of comparing demand and capacity and managing any imbalance between the two, particularly with respect to airport capacity limits and changing meteorological conditions. There is however, a trend towards a more sophisticated, adaptive and dynamic process that can operate to finer capacity and time limits than the current system, with a progressive emphasis on the efficient and collaborative management of resources and capacities at airports and en-route so as to meet demand.

The options for ATFM are strongly influenced by option choices made in other areas. The principal option is for it to become a part of an integrated, layered planning process, supporting flights operating on predictive trajectories or in structured traffic flows, where the balance between capacity and demand is refined over time in co-operation with users and other service providers. The degree of integration to be applied between the various planning layers, between demand and capacity balancing, en-route ATM, and the airport slot allocation process, as well as the time horizons which should be used, will depend largely on the choices that are made in other concept areas.

At present, the balance between airport demand and available capacity is addressed in the airport scheduling process, and airspace capacity is related to demand through flow management. There is a range of options as to how integrated and comprehensive the process for reconciling demand and capacity at the strategic planning stage could be.

4.2.2.3.   The current European ATFM system: the CFMU

This section is based on a contribution from the Central Flow Management Unit.

4.2.2.3.1.   Flow management

The Role of Flow management (ATFM) is to manage the imbalance between the traffic demand and the available capacity in a normal situation. It also coordinates the actions of all partners in case of a crisis situation. The CFMU of Eurocontrol is responsible for ATFM in the ECAC area.

ATFM works on the flights before their departure. Based on the capacity provided by the different ATC units (en route sectors or aerodromes), ATFM acts by controlling access to the congested areas by organising the traffic flow, imposing appropriate ground delays by issuing take-off times to the concerned flights or by rerouting aircraft over less congested areas. The capacity value used for ATFM is the throughput of traffic (e.g. number of flights landing on an aerodrome or number of flights entering a sector during one hour).

The basic rule of ATFM is the first flight entering the regulated area gets the first available place.

4.2.2.3.2.   Impact of ATFM on airports

The impact of Flow management for aerodromes has 3 main issues:

➢ Protection of the aerodrome (Arrivals, departures, global)

➢ Bad weather or crisis situations (low visibility, de-icing, closures, etc.)

➢ Management of the CTOT (Calculated Take-Off Time).

The ATFM delays due to airport congestion, including bad weather, represented 16% of the total ATFM delays in 1999. This ratio is higher in winter and may reach 40%, mainly due to low visibility.

As ATFM provides take-off times for flights subject to flow measures, a procedure has been created to describe the role of the different stakeholders in the management of the slot. The CFMU provides a CTOT (Calculated Take-Off Time) 2 hours before the Off Block time provided by the aircraft operator. Revisions may be issued as necessary depending on the evolution of the ATFM situation.

The responsibility of the Aircraft operator is to manage the flight according to the provided CTOT (awareness, request for push-back).

The local ATC unit shall assist the flight in getting airborne at a time as close as possible to the CTOT. A tolerance window has been defined ECAC-wide to allow some flexibility. The value has been set to –5, +10 around the CTOT.

4.2.2.3.3.   Integrating airports

Several limitations in the relations between airports and ATFM can be identified:

➢ Airport restrictions may be different from the filed flight plan information (airport slots, schedules)

➢ Aerodrome data is not accurately known by the CFMU (Taxitime, runway in use, etc.) and the efficiency of the overall system is reduced.

➢ The actual take-off time may be outside the slot tolerance window. Statistics made on the compliance to the CTOT show that at some airports more than 30% of the flights are departing outside the slot tolerance. The impact is that the protection of the regulated areas is not as good as expected by the areas concerned and the capacity value may be lower than what could be expected.

➢ Aerodrome problems are ignored by the CFMU or are not well managed due to the lack of information (too many flights with similar CTOT, disruptions on the ground, arrival/departure management, etc.)

➢ The management of arrivals shall be enhanced in order to get the best from ATFM and the holding patterns.

➢ Consideration also shall be made on the Hubs and spoke, and their effect on ATFM delays.

The CFMU has a 5 year plan called the CFMU Development Plan which has been approved by the European ATFM Group and revised anually to take into account future evolutions. It has 6 major objectives, three of which concern airports:

➢ Achieving coherence between ATFM and runway slots

➢ Developing the tactical performance of ATFM to maximise the use of ATC capacity

➢ Developing more effective ATFM management of unusual situations

   At a lower level, the CFMU has defined the following objectives :

➢ Integrate procedures and systems with ATFM partners to optimise arrival sequencing, ground movement planning and departure management.

➢ Provide ATFM partners with an accurate view of the actual traffic in order to adapt to and utilise real ATC capacity.

➢ Achieve coherence between ATFM measures and airport runway slots (combination of the constraints, improvement of the mechanism, priorities).

➢ Increase data sharing with ATFM partners.

   Several developments are already planned for the near future:

➢ Freeze the CTOT before the push-back according to the aerodrome in order to prevent last minute changes to the CTOT (march 2000).

➢ Ability for the TWR to inform that a flight is ready to depart before the initial Off Block Time (REA (Ready) message) March 2000.

➢ The CFMU will receive updates on the real flight position after take-off (2002 for the core area) It will enable CFMU to take corrective actions on the management of regulated areas and will provide a better anticipation of the expected traffic.

➢ Such information will be redistributed to ATC systems. (2004)

➢ Exchange of information between the airport and the CFMU before the take-off in order for the CFMU to take into account the local situation. A message is being defined by the CFMU with the particiaption of the members states.

➢ Improvement in the management of bad weather situations and local disturbances such as de-icing.

➢ Short notice extension of a slot (under analysis).

Some other points shall also be considered:

➢ Harmonisation between airport slots and ATFM strategic planning including the impact of the Hubs and spoke.

➢ Improvement in the exchange of information between airports and ATFM.

➢ Improvements in the management of arrivals (role of stacks versus ATFM).

➢ More flexibility for aerodromes.

These actions are not easy to set-up. It requires exchange of information between the relevant parties (Airport, TWR, CFMU and Aircraft operators). The critical issue is the communication between a central system and the local user, in particular when there is a time pressure at aerodrome level.

The number of locations and the range of local equipments are also to be looked at. Even if the major airports are the most complex ones, the smaller airports shall also be in a position to act in the same way when they get a difficulty.

Collaborative Decision Making is certainly the concept to use, but automation of the processes and exchange of information between the CFMU and the airports are the major enablers to achieving it.

4.2.2.3.4.   Conclusion

Integrating the ground with the sky is a challenge for the next few years. The CFMU has a role to play in assisting ATC in the management of the balance between demand and capacity.

4.2.2.4.   Improved ATFM

This section is based on the EATCHIP Operational Concept Document [6] and may therefore end to represent the point of view expressed in that document.

A major objective of the concept is to develop the airspace capacity to such an extent that flow regulation would only be needed in exceptional circumstances. In this context, the emphasis of Flow & Capacity Management (F&CM) would move from adapting demand to a fixed capacity limit, to optimising the capacity of the system to meet the predicted demand.

An important consideration is the limitation imposed by airport capacity. While every effort will be made to optimise available airport capacity, the continuous growth in demand will continue to exert pressure on several airports. F&CM's prime objective would be to optimise the use of scarce airport resources by the tactical management of arrival and departure flows.

Another requirement for F&CM stems from autonomous aircraft operations and free routings, which implies a need to determine and manage the areas where such operations can be accommodated, or no longer sustained at specific times.

F&CM will deliver an increase of capacity during both normal and abnormal situations by:

➢ the use of advanced air situation displays and support tools to provide a real-time picture of the traffic situation in ECAC airspace;

➢ improved collaboration between the ATM system, Airports and the AOCs for flight planning. Airspace users will have a greater say in decisions on those occasions when compromises have to be found between delay, re-routing, or trajectory limitations and costs. This will improve the opportunities to optimise trajectories, help minimise delays and the occasions when additional route mileage has to be flown, enhance fuel loading assessments, and offer more flexible and responsive solutions to the needs of flight operations;

➢ the capability to maximise the use of the available capacity and achieve a closer alignment between the aircraft operators short-term changes and ATM by the tactical choice of alternative routes (together with indications of the penalties associated with each) in order to reduce delays, to avoid congestion points, to reduce the need for strategic routing schemes and the number of instances of significant system overload;

➢ the development of more effective measures for dealing with unusual situations, such as significant outages in the ATM system.

4.2.2.4.1.   Managing the Service Quality Plan

As part of the required quality of service, flight punctuality and flexibility will be optimised through the use of scheduling and planning functions. The main principles include co-ordinated timetables, optimised arrival times and minimal in-flight delays. Declared airport capacity will be a major factor in deciding these. In addition, standard contingency plans will be developed at the scheduling and planning stage to ensure that localised airport-related capacity reductions (for meteorological or other reasons) will not cause ripple effects elsewhere in the ECAC region.

F&CM will incorporate a layered planning system, with each layer operating as a filter for the next, in order to optimise the resources needed for a particular day's operations.

The process will involve:

➢ Strategic Flow Scheduling;

➢ Optimal Flow Regulation;

➢ Tactical Flow Planning.

The requirement for flight plans or other media to provide notification of intentions will remain, but in the tactical planning phase these will contain more extensive details of the intended trajectory to be flown by the aircraft.

The process will involve close co-operation between the parties involved: the F&CM body, the aircraft operators and their AOC, the airport operators and the ATC service providers. The degree of information integration will be a determinant in the roles and flexibility given to individuals.
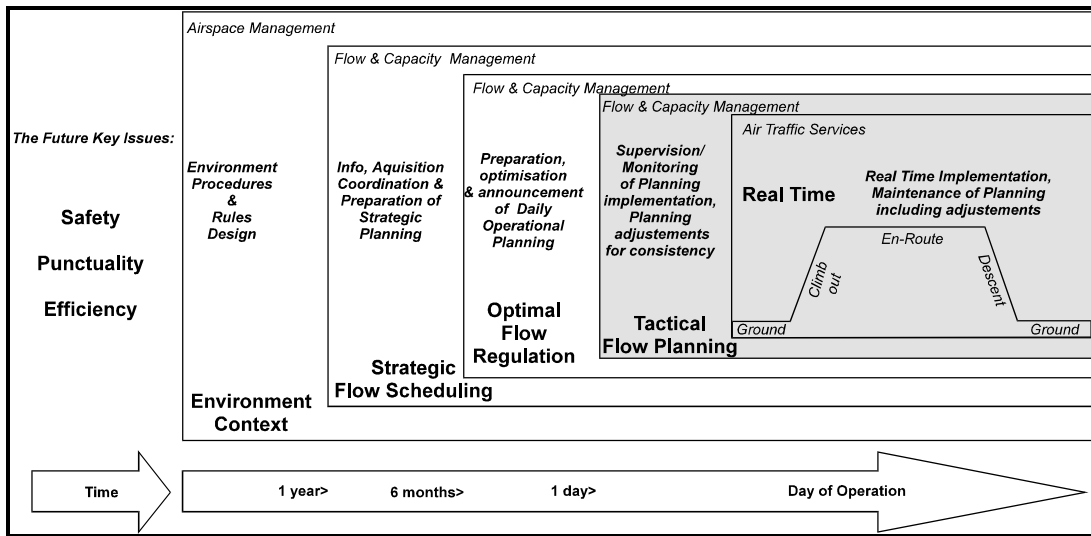
Figure 4-1: F&CM Key Issues

4.2.2.4.2.   Strategic Flow Scheduling

The need for strategic flow scheduling emanates from the need for the airlines to publish their summer and winter timetables well before the beginning of each season. This is the stage at which individual airlines position themselves in the travel business market, and adjust their route network requirements to the demands of the travel industry. One of the drivers for the publication of the timetables is the need of the travel industry to define their holiday packages, buy capacity on flights to selected destinations (on charter as well as scheduled flights), and to start taking early bookings. Based on declared airport capacity and statistical information concerning weather conditions at airports, traffic flows will be optimised to provide acceptable scheduling (i.e. a timetable) and facilitate the agreement of service quality plans with the users.

The optimal airspace configuration will be defined from the consolidated picture of the forecast ECAC traffic flows. This will enable the preparation of strategic measures to create the corresponding capacity.

The output of the process will be a set of Daily Operations Plans (DOP)s that will balance the expected demand and forecast available capacity.

4.2.2.4.3.   Optimal Flow Regulation

There will still be changes to timetables following the strategic planning phase, and aircraft operators will plan flights that have not already been captured. The role of Optimal Flow Regulation will be to refine the details of the original plan over time and to prepare and promulgate an optimised and detailed operational plan one day in advance of the implementation date (e.g. airspace configuration(s), forecast flight operations and types). Optimisation planning will require detailed analysis of the expected traffic levels and available capacity using advanced simulation tools, and will determine the airspace and systemisation configurations to be used.

4.2.2.4.4.   Tactical Flow Planning

The role of Tactical Flow Planning will be to implement and supervise the DOP, and to apply any refinements needed in the light of real-time events. The intention will be to ensure as little disruption to the daily airspace plan as possible, and any real-time corrective measures will follow this aim. The need to adapt the original plan may result from significant weather phenomena, industrial action, or unexpected ground or space infrastructure outages and predicted limitations.

Tactical Flow Planning will act in a supervisory role, and make full use of all available information facilities to monitor and anticipate adjustments to the plan in terms of the most efficient configuration of resources. If delays are unavoidable, an equitable re-partition will be negotiated with the airspace users affected. When necessary, a ground holding strategy will be applied to avoid costly airborne delays.

ATC units will co-operate with F&CM and the other parties involved in order to implement and maintain the DOP.

4.2.3. Collaborative Decision Making

Parts of this section are based on the A-CDM-D Interim Business Plan [7] and therefore tend to represent the point of view adopted by that document.

4.2.3.1.   Introduction

The principle of CDM is to ensure that all of the participants in aviation operations have equal access to information which is relevant to their activities. Thus, any existing information which is available to a particular participant will also be distributed to the other participants who have an interest in it and will be able to use it, either to assist their own operations or in a more co-operative way. This is intended to create a situational awareness which is shared by all actors and will therefore allow the right decision to be taken by the right person at the right moment.

Currently constraints on aircraft operations are enacted without regard for the relative priorities which airlines may be placing on individual flights, based on factors such as crew criticality, passenger connectivity, critical turnaround time, gate availability, on-time performance, fuel status and runway preference. Airlines, however, always seek to maintain the integrity and stability of their schedules (with multiple flights feeding one large connecting flight or vice-versa) in the face of aircraft and airspace uncertainties.

The strategic goal of CDM is thus improved traffic management through the increased involvement of Aircraft and Airport Operators. This covers applications aiming to take into account the internal priorities of the Aircraft Operators or the Airport, before and during the flight, and development of Information Management systems and procedures in order to make full use of available data.

4.2.3.2.   CDM in the US [8, 9]

CDM has recently been implemented in the USA in a co-operative venture involving the Air Traffic participants and the FAA. One benefit of this implementation, which has already become apparent, is that Airlines are now able to make better informed decisions about arrival capacities at airports during bad weather.

The basic premise of the US program is that the job of ATC -and in particular the Air Traffic Control System Control Centre (ATCSCC) - is to identify constraints that produce capacity and demand problems relative to airport capacity (e.g., runway closures, weather fronts... through the GDP-E programme) and publish those constraints to the users. The users will at the same time keep ATC-TFM informed of current operational demand and intentions, provide airline business need plans and then plan around the published constraints to meet their own needs within a base line solution to the problem created by the constraint (e.g., cancellations / substitutions in response to a ground delay program).

In other words, ATCSCC will be the arbiter of limited airport arrival resources but will leave economic decision making up to the System Operators. One can clearly see the consistency of this paradigm with that of Free Flight which ultimately envisions the Service Provider intervening only in those instances where safety would otherwise be compromised.

US CDM focuses on tools and procedures that need to be in place to enable the ATCSCC and the National Airspace System (NAS) users to respond more easily to changing conditions. When bad weather strikes the nation's airports, the capacity to accept arriving aircraft is reduced. CDM initially analysed situations that usually lead to some kind of ground delay program, or ground hold strategy due to the reduction of airport arrival capacity.

The US CDM effort to implement new procedures and collaboration is currently well underway. The airlines and FAA now have a working "Intranet" (CDMnet) allowing data to be exchanged between the FAA and the carriers. Currently the data being exchanged is mainly the data needed for the ground delay part of CDM, although more data additions and associated functions are in the exploratory phase.

4.2.3.3. CDM in Europe

The current European CFMU system provides a similar functionality to the US CDM GDP-E programme. The most notable difference concerns the way the US system permits a greater flexibility over prioritisation of flights, which is largely precluded by the current equity rules applied in the European case.

A number of European actors have already carried out application and technical studies on CDM. For example DERA (Faster, A-CDM-D project [7,8,9]), Aérospatiale Espace et Défense (Faster), EUROCONTROL (Faster, A-CDM-D), Lufthansa (Jane, LDSS), DFS (Jane, LDSS), Frankfurt Airport (LDSS), AENA (some collaborative data for the AATMS study) and Airsys ATM (A-CDM-D) [9, 12].

In parallel, Europe is now moving from a flow management mainly based on regulating mechanisms as at present, to the essential function of collaborative management of capacities, both en-route and at airports, to best serve the traffic demand. It is recognised that this will still entail flow regulation. The developments will build on the implementation of the CFMU, and further enhance its functions and services to maximise the performance of the European ATFM system. This will include developing the tactical element of ATFM to maximise the use of the available capacity, and achieving a closer alignment between the preferences of the aircraft operators and ATM. Other improvements will focus on extending the choice of alternative routes offered through more flexible routing schemes, integrating ATFM measures and the allocation of airport runway slots to make more efficient use of airport capacity, and developing more effective measures for dealing with unusual situations.

Enhancements up until 2005 will concentrate on the continuing development of existing tools and procedures. Improved traffic management tools will allow ATFM to become more

responsive to short-term changes in airspace and provide better information about flight trajectories. Improvements in data networks, and the introduction of air-ground data links, will support more timely information exchanges and better collaboration between the aircraft operators, air crew, airports, the CFMU, and the rest of ATM. The ability of the CFMU to monitor the evolution of the traffic situation in Europe in real time through enhanced situation display facility (ETFMS) and updated flight information is considered to be an important enabler.

4.2.3.4. CDM and IT trends

The introduction of CDM is driven by the wide adoption of Internet technologies in the Air Transport world. Newly developed systems for Airlines and Airports are widely adopting the latest IT trends including Intranets and e-commerce solutions. The safety-critical mission of Air Traffic Services providers does not, however, permit the introduction of such new technologies at the same pace as for non-critical business operations.

For their IT procurement policies, Airlines and Airports must therefore manage both worlds: dealing with ATC means respecting existing systems interfaces and procedures, and on the other hand dealing with other companies or with their customers necessitates adopting new technologies (with low-cost hardware, Commercial off-the Shelf (COTS), increasing number of external interfaces and lower deployment costs). CDM is right in the middle of this dual constraint, and must be dimensioned to act as a mediator for heterogeneous systems and technologies. CDM combines the technical issues for the "legacy systems" and the technical issues for the "new concepts".

New concepts issues are comparable to those met with in e-commerce and financial applications where the flow of information has similar patterns. The business side of Airlines and Airports is becoming more and more inter-connected with the Operations side. For example, specific cost calculations and data mining functions are now more likely to complete the post-analysis functions previously implemented.

CDM is also by nature a distributed system at the boundaries of organisations, which raises issues linked to virtual enterprise integration and requires a reliable network infrastructure. This "mediator" role has a significant impact on the solutions which put into place at both the technical and the organisational level. CDM can be presented as a "system of systems" and one of the major issues is to find the overall architecture matching the constraints imposed by the legacy systems whilst exploiting the gains offered by the new concepts. CDM is also a system that must be flexible enough to be adapted to each context.

The conditions of operations of the system are also changing over time: the "content" of databases such as Aeronautical Data, Met Data, but also the Company fleet data, the ATSO equipment status will be managed on a 24 hours a day basis following the emerging "virtual data centre" concepts. CDM is also deployed in a very competitive context and some specific data protection mechanisms are required to allow individual participating entities to manage their own business directly.

System characteristics such as the reliability of the network infrastructure, quality of service, maximum transfer delay, availability, throughput / number of users have been assumed and will be re-assessed in the evaluation phase of A-CDM-D [15]. Thus the technical requirements necessary for a successful CDM implementation are not yet totally identified:

➢ the network infrastructure characteristics: availability, reliability, quality of service, maximum transfer delay, throughput, number of users,

➢ some security features to be completed (access protection, encryption, ...),

➢ generic hardware / software solutions (PC / windows).

The US CDM implementation is a good example of the balance that must be found between the constraints induced by legacy systems and the technologies available for new concepts. For example, the exchanges between the AOs and ATSOs are based on a specific message format not designed to limit software adaptation and deployment costs on the airline side.

4.2.3.5.   CDM and Airports

From the CDM point of view, airports can be classified in two ways:

➢ A classification which distinguishes between non-scheduled (i.e. non-constrained) airports and constrained (i.e. co-ordinated via scheduling) airports. This is necessary to distinguish slot dependencies. There are more than 60 co-ordinated airports including a significant number which are only constrained during peak seasons or hours. It corresponds roughly to the classification of major hubs, regional hubs, and other secondary and medium airports, excluding business airports (like "Le Bourget").

➢ A classification according to the levels of criticality of scarce resources (for example airport stands, gates, runway slots...) of relevance to the collaborative processes covered by CDM.

48 airports in Europe have more than 3 million passengers, of which 2 had more than 500,000 movements in 1997, 11 between 200,000 and 500,000 and 12 between 120,000 and 200,000.

The CDM implementation strategy for a given airport is variable because of the differences between airports identified above and because of differences in the speed at which airports are introducing the new technologies supporting CDM. The virtual enterprise integration is also to a large extent dependent on the local organisational breakdown and on previous initiatives to share information.

Some airports have already solved at a local level the organisational issues and have deployed a central database with the involvement of the different actors: they are now looking forward to solutions for the deployment of collaborative processes with local and remote actors. The next step is to harmonise the solutions so that airlines can uniformly manage their operations at different airports and to deal with Air Traffic Management issues at the European level.

Some airports are still in the process of getting a more integrated IT platform: they will benefit from the technical work handled by the CDM actors for the convergence of IT standards and components. The next phase is to prepare the selection and the adoption of the relevant technologies. Projects such as A-CDM-D [7], which targets the deployment of live demonstrators within operational entities, are a key phase for the validation of the CDM concepts in the real world.

CDM will also be a vector for the dissemination of new procedures where the collaboration between actors will be enhanced. The participating entities could be Stand and gate management, ground handling, apron control (control of aircraft on parking areas). It will eventually be possible to involve up to 17 participants, which is the average number of partners intervening during a turnaround.

4.2.3.6. System-Wide Information Management (SWIM)

Information Management will be a key issue in implementing the CDM concept. The European ATM programme Operational Concept Document (EATM OPD) describes the concept of System-Wide Information Management (SWIM) thus:

The decisions taken by controllers, pilots, dispatchers, flight planners, weather forecasters etc. represent information that is used by others as inputs to their own planning and decision making processes. In order for the ATM network to function properly, all of this information (decisions and inputs to decision-making) must be available when and where required. This entails more than just establishing a suitable CNS infrastructure or making systems inter-operable. Without advanced information management at the overall system level, the present lack of ATM integration will be perpetuated.

The aim of SWIM is to combine the forces of all suppliers of ATM information so as to assemble the best possible integrated picture of the past, present and (planned) future state of the ATM situation, as a basis for improved decision making by all ATM stakeholders during their strategic, pre-tactical and tactical planning processes, including real-time operations and post-flight activities.

Successfully managing the quality, integrity and accessibility of the complex, growing web of distributed, fast-changing, shared ATM information, is the main operational enabler for the target concept. SWIM, in turn, depends on a number of technical enablers, one of them being an adequate CNS infrastructure.

SWIM principles and mechanisms will need to deal with the following subjects:

➢ information ownership, licensing and pricing;

➢ information security management;

➢ ATM pool content management;

➢ information acquisition process;

➢ information dissemination process.

Effective SWIM will be essential for full use to be made of the CDM concept. Rather than each airline, each ATC unit and each airport authority gathering its own data from a number of different places, the available information needs to be harnessed in the most efficient way.

4.2.3.7. Other CDM Activities

Other projects that are currently underway also contribute in this respect. These include:

➢ the enhancement of the CFMU terminal with improved presentation of regulations and re-route possibilities;

➢ the European AIS Database (EAD) or equivalent, which will be a major source of information either by direct access or via a State system;

➢ the DFS STANLY project, producing a data warehousing and display system which combines surveillance tracks and flight plan information from a number of ATC centres.

➢ ETFMS Arrival and Departure Managers (AMAN and DMAN)

Within Europe a number of projects have investigated the requirements and opportunities for CDM. These include:

➢ FASTER – identified requirements for information exchange;

➢ CDM Applications project – identified opportunities for applications of CDM;

➢ the EUROCONTROL ad-hoc Working Group on CDM, which is now developing further the European CDM strategy [8];

➢ the CDM Website (www.euro-cdm.org) – illustrating the benefits of information exchange, and providing a focus for the development in Europe;

➢ the DFS Local Decision Support System (LDSS) project – using the STANLY data warehouse as the basis of a decision support system for all parties at Frankfurt airport;

➢ work by individual airports and airlines, and developments planned by the CFMU [18, 19, 20].

4.2.4. Arrival and Departure Systems

4.2.4.1. Introduction

The optimal sequencing of incoming and outgoing traffic is one of the most important tasks facing European air traffic organisations and airports as they seek to make the most efficient use of the congested runway systems and the airspace.

The following paragraphs will give a representative, but not exhaustive, overview of recent projects dealing with arrival and departure optimisation and management.

4.2.4.2. 4D-Planner

The 4D Planner, developed by DLR for DFS German ATS services, presents an innovative solution for making optimal use of existing airport capacity.

This new arrival system assists the air traffic controller in the precisely timed planning, guidance and monitoring of arriving aircraft. As the name suggests, it works in 4 dimensions so that, as well as considering spatial dispositions at any given time, it also takes account of planned and anticipated actions.

The 4D Planner performs the function of a computer aided arrival management system from the ground. It computes a plan based on all relevant and available data such as

➢ Flightplan data

➢ Radar data

➢ Weather data.

The continuing recalculation of planned and real data allows the system to give an updated picture of the traffic situation and to monitor actual aircraft guidance.

Air traffic controllers are able to control traffic in the approach area with high temporal precision, so that separation distances at the threshold can be optimised. The system essentially reduces the effect of interference on the separation accuracy caused by effects such as wind influence or inaccurate actions of participants of the control process. It ensures more precise timekeeping at metering fixes, merge points and the runway threshold.

The 4D Planner comprises 3 basic functions:

➢ **Arrival Planning**: determining a sequence for arriving traffic over the whole control area of the airport

➢ **Aircraft Guidance**: calculating precisely timed arrival trajectories from entry into the planning area up to the runway thresholds according to the constraints of the arrival planning of the site

➢ **Arrival Traffic Monitoring:** permanently monitoring the separations and 4-dimensional trajectories of all aircraft in the TMA

Precise Separations are achieved by proceeding as follows: when separating arriving traffic, air traffic controllers will use ICAO values with appropriate adjustments due to local regulations. By allocating altitudes, headings and speeds, they will determine the minimum distance of aircraft to preceding traffic. Separations must not be shortened without the pilot's approval and the aircraft being in sight at all times. This is an innovation over current practice where time accuracy is not taken into account for delivering an aircraft to the merge area or threshold. The 4D planner aims at the highest possible temporal accuracy in the delivery of aircraft. This reduces the inter-arrival error (standard deviation) by enabling closer separation keeping the planned landing times reliably to within a few seconds.

Landing Sequence is optimised by initially calculating the optimal conflict free sequence for all arrival traffic. The controller is free to intervene in this process at any time if, for example, it is necessary to change the planned times. Approaching aircraft entering the control sector are immediately arranged into the planned arrival sequence valid at that time. A runway allocation for the new aircraft is then assigned.

The best suitable place in the arrival sequence is found by calculating a target time for crossing the threshold. The general traffic optimisation is then carried out and the arrival at the merging point is calculated back from the threshold crossing time which has already been calculated. The best time for arriving at the metering fix is then calculated. The calculated times are used by the 4D trajectory calculation of the aircraft guidance function. They are checked again before the aircraft reaches the metering fix and will be adapted to the course of flight. The valid landing sequence is modified permanently in response to the actual traffic situation.

The Guidance Function of the 4D Planner checks all of the traffic for deviations to the planned flows, detects and solves the conflicts between planned trajectories and allows the controller to give advice or make changes in accordance with his strategy. Three functions enable these features:

➢ **Conformance Monitoring Function** compares the virtual approach situation of 4D Planner with real world flight movements. Actual positions of aircraft are compared with

4D points of the trajectory. If major deviations are detected, a new trajectory calculation is made.

➢ **Conflict Probe** checks every new trajectory to ensure that it does not cause a conflict with existing trajectories.

➢ **Trend Information** reveals the differences between planned and actually calculated times of arrival at the metering fix. The trend assists the planning controller in transferring the individual aircraft to the radar controller in a correct sequence.

The 4D Planner is currently under development at DLR where it is being tested in HMI surroundings and will be embedded in real life flight guidance systems for further testing with live operating systems. It is scheduled to be ready for operation in mid 2003.

4.2.4.3.   DARTS (Departure and Arrival Traffic Management System)

DARTS, another arrival and departure management system is currently under development at Zurich airport.

DARTS plans an optimal departure sequence and optimal take off times for all departures at Zurich Airport. Arrivals are considered and co-ordinated in their planning process in such a way that the optimal departure sequence as well as the optimal runway occupancy for all operations is generated.

In addition to the arrival data all available information including the parking position, the actual dispatch status, departure route, departure slots and different kinds of departure restrictions are taken into consideration. Provision of these data will be done by ATC as well as airport and airline information systems, so it can be guaranteed that the departure time can be realised.

DARTS is designed to be an assisting tool both for tower and apron controllers and is not to be seen as an automated system since it is understood in the system's philosophy that the controller's decision due to his final responsibility must always take precedence.

Planning results are displayed to the controller in a pre-processed form so that they can easily be converted into actions and necessary action can be taken in the right sequence and at the right time.

Planning processes are centralised in such a way that decision making is done for all working places and connected systems. Planning results are distributed to airlines, handling agents and the airport authority so that dispatching procedures of the aircraft can be handled in time. All changes that are entered at workstations will change the actual picture of the situation on site and lead to an updated planning situation. Since data updates are sent to all stations immediately, all participants can refine their planning immediately.

3 steps are defined for the realisation of DARTS:

➢ **Departure Management** – Planning of the optimal sequence by using solely ATC, airlines and airport data.

➢ **Departure Management considering planned arrivals** – Planning the departure sequence while taking arrivals into account. For this step an arrival planning system is needed in order to generate the planned arrival times in advance.

> **Co-operative arrival and departure management** – The optimal runway occupancy for arrivals and departures is planned in this phase. This will be realised by an overall plan for all movements.

4.2.4.4.   DARTS System Structure

> Client-Server architecture

> Central database

> Completely object-oriented programming

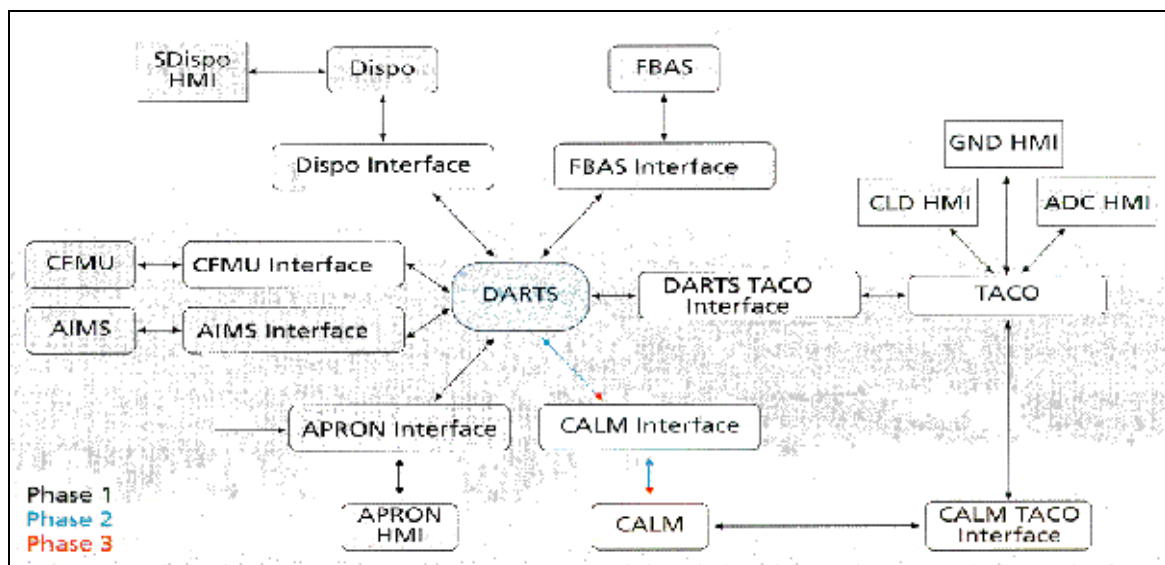> CORBA interfaces for resistance against hardware/software modifications

Figure 4-2 DARTS System Schematic Overview

4.2.4.5.   Future DARTS Waypoints

The philosophy of DARTS marks it as an open system that enables it to be integrated into an overall airport management system. Future extensions can therefore aim, for example, at the incorporation of a ground movement component. This functionality will link the present tasks and allow improved planning by monitoring surface movements and activities. DARTS then becomes an integrated element of an A-SMGCS.

It is also then a future element of an advanced gate-to-gate planning system.

4.2.4.6.   AMAN/DMAN

DMAN is a computer-based tool for assisting air traffic controllers at airports with the management of departing flights. The function of DMAN is to plan take-off times and consequent start-up times, and to make these available to ATC, aircraft operating companies and airport authorities. The primary objective of DMAN is to maximize runway throughput. The possibility of doing this arises from the fact that, given a set of departing flights, some orders of departure will require less runway time than others. This in turn is because the minimum time interval between two successive departures depends on specific

details of the flights in question, including the wake turbulence categories of the two aircraft and whether or not they will follow the same route through the TMA.

The DMAN project is one product of the 'Automated Support for ATC' programme (ASAP). ASAP is part the European Air Traffic Management Programme (EATMP), an overall effort to create one homogeneous ATM-system for the ECAC-area (European Civil Aviation Conference), covering all flight phases, i.e. from gate to gate. The EUROCONTROL Agency manages EATMP.

Other ASAP-projects, related to DMAN, are:

➢ Arrival Manager (AMAN)

➢ Surface Manager (SMAN)

It is envisaged that the DMAN tool will be used in co-operation with other ASAP functionality such as AMAN and SMAN to provide optimisation of runway capacity. This will provide a suite of tools for the controller and provide a basis for collaborative decision making and planning. It is understood that the Departure Manager will interact with other programmes and projects of the EATMP as well, e.g.:

➢ Initial Air Ground Data Link Applications

➢ Trajectory Prediction

As new runways are unlikely to be built at the location they are needed most, runway capacity is considered the hardest limitation of the air traffic system today and the foreseeable future. To help reduce this capacity constraint, DMAN will assist the controller to achieve an optimal departure sequence.

At first, a **feasibility study** was conducted to get an overview on the possibility of kicking off such a project in a European scale.

A **stakeholder requirements survey** has been conducted hereafter at 8 airports in order to search for the needs and ideas of European ATC providers.

After this there have been talks with 5 airport operators to reveal their work practice and expectations towards the system. The last step in this process was meeting 3 airlines and one handling agent to complete the view with their opinions.

The production of the **initial operational concept** document comprises the functionalities and working principles as well as the operational overview, output requirements and some other basic guidelines for the next steps of the project.

4.2.5. The Single European Sky

It is an accepted truism that the deregulation of commercial air transport in Europe has led to a massive increase in the number of air traffic movements. This is now leading to major congestion problems. The most recent report of the EUROCONTROL Performance Review Commission (PRC(Performance Review Commision)) [14], attributes 50% of the delays experienced during the calendar year 1998 either directly or indirectly to Air Traffic Management (ATM). It also finds, however, that 45% of these delays can be attributed to only 3% of ATC sectors.

This last finding supports the view that the congestion of European airspace is greatly exacerbated by fragmentation along national frontiers and between civil and military users, which leads to a sub-optimal allocation overall. The concept of the Single European Sky has evolved specifically to address this fragmentation. The concept has been most recently enunciated in a Communication from the European Commission [5].

In brief, this proposes that European airspace be managed collectively, regardless of borders, for both military and civil use. This implies a need for:

➢ A central organisation to take full responsibility for strategic and tactical management of European airspace, both military and civil, supported by new decision- and rule-making structures, with proper transparency and democratic control

➢ Common regulatory frameworks for safety and interoperability and, where appropriate, performance/service levels

➢ A separation, both at national and European level, between service providers, safety regulators and economic regulators

➢ High levels of interoperability between ATM systems across Europe

The Communication mentioned above makes a number of specific recommendations in support of these goals. These have implications for research activities within Europe. In particular, research will be needed to support the introduction of the next generation ATM system. This must include:

➢ Research into new tools and procedures, as well as specifications and certification procedures to guarantee the implementation of compatible systems across Europe

➢ In the short term, improved operational procedures, such as FMS approaches, improved surface management

➢ In the medium term, new controller tools, such as tools to support deconfliction 30 minutes ahead, direct routing, passing clearances by datalink

➢ In the long term, entirely new concepts such as ADS-B

The Single Sky concept will also necessitate higher standards of interoperability and standardisation, which would need to be supported by a new, common certification process for ATM systems.

Another research area is highlighted by the findings of the PRC mentioned above. There is currently a lack of sufficient and consistent data on performance indicators both with respect to safety and delays.

4.3.   Airside Initiatives – New Systems and Procedures

4.3.1. Introduction

The major airside capacity drivers within an airport are the runway system and the taxiway system/apron area. This subsection discusses two initiatives aimed at improving runway efficiency through the introduction of new procedures and the current state of research into A-SMGCS.

4.3.2. APATSI Mature Procedures for Airspace

In 1992 ECAC (the European Civil Aviation Conference) launched a program to improve the efficiency of air traffic operations in Europe. The APATSI project board was founded in order to define and implement the procedures and a manual was subsequently published in order to encourage the member states and their airports to evaluate and consider the implementation of the proposed procedures [28].

A mature procedure is defined to be a procedure that has been implemented in one or more European Member States and has been judged suitable for EU-wide use. This judgement will be based on the feasibility of applying the procedure at the relevant airports, taking into account the local operational arrangements, national regulations and so on.

A presentation on the details and status of the seven most mature airport related procedures was given at the 3rd Workshop by Mr Anders Hallgren of Eurocontrol.

1) Landing clearance based on anticipated separation

2) Reduced runway separation on the same runway

3) Simultaneous intersecting runway operations

4) Intersection take-off

5) Multiple line-ups on the same runway

6) Visual approaches

7) Visual departures

Each of the procedures, including the 7 listed above, is briefly described below:

4.3.2.1. Land After (Pilot Assessed)

This procedure allows better runway utilisation by allowing an aircraft to land while the preceding landing aircraft is still on the runway. The pilot has a determining role in this procedure as he responsible for assessing whether a safe landing is possible based on his knowledge of his own aircraft's characteristics. The conditions that must be fulfilled are the following:

➢ Runway must be long enough to allow safe separation between both aircraft

➢ no evidence that breaking action could be adversely affected

➢ must be performed in daylight

➢ the traffic controller must be sure that the pilot landing behind has a clear picture of the traffic situation on ground

➢ warnings must have been sent to all pilots involved.

The responsibility for maintaining separation lies with the pilot of the following aircraft.

This procedure is designed for all types of airports, but seems to be most suitable for regional ones. It is also an option for airports operating with a dual runway configuration in segregated mode as it is only applicable between two landings.

4.3.2.2. Reduced Runway Separation on the Same Runway

In good visibility, an aircraft may be cleared to land or depart while a preceding aircraft is still on the runway at more than a specified minimum distance from the threshold.

This depends on the combination of runway and runway exit configuration that governs the use of the runway. For every configuration, the distance to be applied will be depend on the number and location of rapid exit taxiways. Furthermore, different distances will be applied for piston engine and turbo prop aircraft with reversible pitch propellers on the one hand and jets and turbo prop aircraft without pitch propellers on the other.

4.3.2.3. Simultaneous Operations on Intersecting/Converging Runways (SIRO)

Procedure provides conditions under which an aircraft may be permitted to land or take off while a crossing/converging runway is simultaneously in use.

The conditions of use include the need for the pilots to be familiar with the procedure, presence of daylight for takeoff and landings (simultaneous landings may be operated day or night), a ceiling of not less than 300m and a visibility of 5km. The landing distances must be published and braking conditions must be assessed as good by a pilot of the same performance category as the landing one. No tailwind component must be present for the landing aircraft and no wind shear greater than category light must be reported. The normal stopping distance of the landing aircraft must not exceed 50% of the distance between threshold and the edge of the crossing runway. Controller-pilot communication must conform to the required phraseology and the landing pilot must read-back the hold short instructions.

The intersection must be clearly signed and, if it cannot be seen from the landing threshold, then distance-to-go signs must be provided.

4.3.2.4. Intersection Take-Offs

The procedure allows take-offs from intersections when requested by pilots or suggested by ATC. The conditions are that the remaining runway length is published in the relevant AIP for every intersection and all departing traffic receives a message that intersecting traffic is taking off. The signage at the intersecting points must inform again about the TORA.

4.3.2.5. Multiple Line-Ups

ATC may instruct line-ups of more than one aircraft at different points on the same runway in order to increase capacity.

The conditions are that the aircraft must be under the permanent control of ATC and must be on the same radio frequency. Pilots are to be advised of their number in queue and must read-back line-up instructions.

4.3.2.6.   Visual Approaches

A visual approach according ICAO [29] is considered to be when an IFR flight does not complete the instrument approach procedure and the approach is executed in visual reference to terrain. Pilots take over responsibility for the separation from the preceding aircraft.

The conditions are as follows:

➢ the ceiling must be at or above the initial approach level or the pilot must have reported a good visibility of the approaching sector

➢ the pilot must be number one in approach or must have the preceding one in sight

➢ if pilots report good visibility for a visual approach but cannot see the preceding aircraft, radar separation must be maintained until visual separation is gained.

4.3.2.7.   Modification of Application of Wake Vortex Constraints for   Departing Aircraft

This procedure provides for an aircraft to be cleared for departure without ATC applying normal wake vortex separations. ATC must provide the following information to the pilot:

➢ type of previous aircraft

➢ elapsed time or distance since its departure

➢ actual surface wind speed

➢ a possible wake turbulence warning.

The pilot will then be responsible for his separation when taking off.

The procedure was formally approved at Amsterdam Schiphol following an operational trial in 1992.

4.3.2.8.   Reduction of Radar Separation on Final Approach

The ICAO standard of 3 NM between approaching aircraft on the same localiser course will be reduced to 2.5 NM in this procedure if the following conditions are met:

➢ Wake Vortex separation minima are respected,

➢ runway occupancy time is 50 seconds or less

➢ turnoff points are visible from control tower or watched by radar or SMGCS.

4.3.2.9.   Reduction of Diagonal Separation on Final Approach

With a runway spacing of at least 760 m and under defined conditions, a minimum separation of 1.5 NM between successive aircraft on adjacent localiser courses can be applied for dependent parallel approaches.

The separation will be applied only after the aircraft has been established on parallel final approach and if straight-in landings are performed. Missed Approach Procedures must not conflict. Pilots must be familiar with the procedure and any known factor that might affect safety must be taken into consideration.

4.3.2.10.   Dependent Approaches to Staggered Parallel Runways

Closely spaced runways with a separation of less than 760 m cannot be used for simultaneous approaches and are considered as one runway when separating traffic on final approach. With thresholds displaced by a sufficient distance, this procedure permits simultaneous approaches under specified conditions.

The glidepath in both cases must be 3° and the procedure can only be applied between a heavy aircraft on the lower glidepath and a following medium on the higher glidepath. Heavy aircraft will land on the threshold that is reached earlier.

The procedure is currently being applied at Copenhagen.

4.3.2.11.   Displaced Threshold

If one of two intersecting runways is used for take-off and the other only for landings, a displaced threshold on the landing runway may shorten the runway occupancy time for that runway.

The conditions are that the runway is long enough for a displaced threshold and sufficient exits are provided. The Instrument Landing System (ILS) equipment must be displaced and runway lighting and marking must be modified.

This has been applied at Madrid-Barajas where the landing distance was reduced from 4100m to 3050m.

4.3.2.12.   Modified Departure Procedures for Short Take-Off Performance Aircraft

Special departure procedures can be applied to aircraft with short take-off performance characteristics. These mostly propeller-driven regional aircraft can leave the SIDs early as their noise characteristics allow them to fly at low altitudes where others cannot.

The conditions under VMC are a ground visibility of 1.5 km or more, a ceiling at or above minimum radar vectoring altitude, and the presence of daylight. The pilot is then responsible for maintaining obstacle clearance until reaching a defined flight level.

With IFR procedures, an SID must be set up providing an appropriate means of navigational guidance.

4.3.3.   HALS/DTOP (High Approach Landing System/Dual Threshold Operations)

The development and implementation of HALS/DTOP is based upon the fact that wake vortices very rarely rise during their lifetime. Scientific research has ruled out the possibility of wake vortices rising above a maximum height of approximately 80 meters above their originating point. Consequently, the risk of a medium aircraft (7 to 136 t) approaching on a glide path of approximately 80 meters above the glide path of a heavy aircraft (> 136 t) encountering a wake vortex originating from the heavy aircraft is close to zero.

In order to create a second glide path located approximately 80 meters above the already existing one, a second, extremely displaced threshold has to be implemented on one of the already existing runways.

With a 3° glide path for both approaches, a displacement of the second threshold by 1500 meters provides the vertical separation of 80 meters between both glide paths. The remaining runway length of 2500 meters is sufficient for landings of medium aircraft up to the size of an A321. The second, displaced threshold will be equipped with an individual ILS allowing operations up to CAT I conditions. DFS, the German ATS, is responsible for developing and implementing the ILS and the new approach procedures, while the Frankfurt Airport traffic management department is developing the new and innovative lighting and marking system for HALS-DTOP [30].

Presently, HALS/DTOP is planned for operation on one runway with one displaced threshold only. As a first step the system will be used at Frankfurt Airport only for staggered approaches. The concept and design of HALS/DTOP was conceived under the assumption that in the future two thresholds on one runway will be used simultaneously. Hence, one runway could be exclusively used for landing while the other runway is fully usable for departing traffic. Together with a ground based Wake Vortex Warning System the implementation of HALS/DTOP is a key factor in reducing the current wake vortex separation. It is the first implementation of such an innovative system anywhere in the world. The construction phase has been finished and flight tests are to follow later this year.
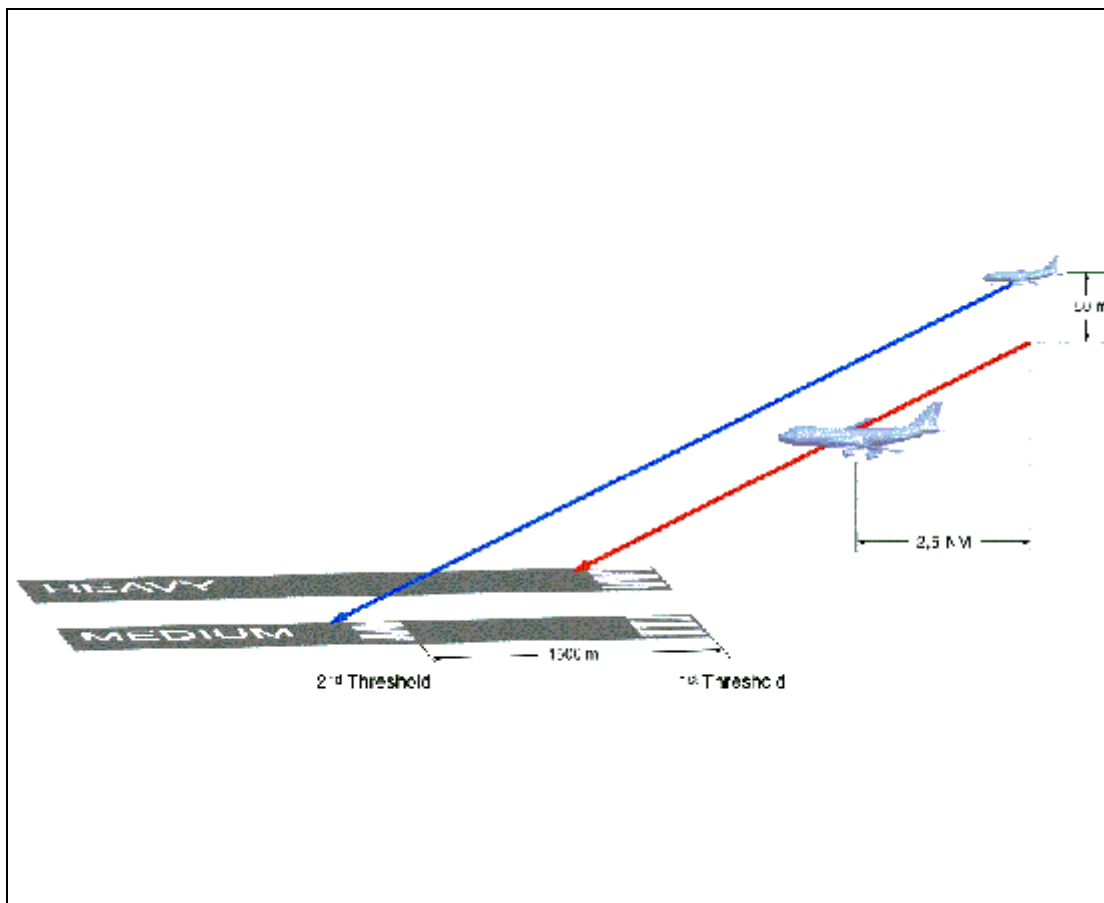

Figure 4-3 Principle Layout of HALS/DTOP

4.3.4. PRM (Precision Runway Monitoring)

Airports with multiple runway layouts have to contend with the problem of dependencies between the runways. When runways are used simultaneously ATC procedures and approach paths must meet high levels of safety.

Most airports cannot make completely independent use of their multiple runways at any time. The highest landing rates at these airports are always reached with an optimal traffic mix and under good visibility, when certain highly efficient ATC procedures can be used. But during poor visibility these procedures cannot be applied. The aim of PRM is to enable these optimal procedures to be used under all weather conditions.

This aim requires the use of improved radar equipment. In particular the airport surveillance radar (ASR) equipment must reach a higher azimuth accuracy and a considerably higher update rate than the systems presently in use.

The system development and testing of a secondary surveillance radar (SSR) meeting these targets was sponsored and coordinated under the patronage of the FAA in the United States and has now been going on for several years.

The heart of the system is a stationary, electronically scanned monopulse secondary surveillance radar (E-Scan). This uses of a circular phased-array antenna therefore has no turning parts. Consequently, the relatively low update rate of conventional systems (typically 5 seconds) which is caused by the turning rate of the antenna can be increased by 5 to 10 times to 1 or 2 pictures per second. The E-Scan has both the capabilities of a surveillance antenna and the tracking/resolution features of a radar. It scans both military and civil aircraft transponders. The visual presentation to controllers meets the demands for parallel approaches.

With an update rate of 1 picture per second course deviations of aircraft can be detected more quickly and the actual track and trend of the deviation can be defined with much more detail. These features together with improved data processing creating audible alerts in the case of route deviations enable the air traffic controller to reduce the radar separation down to 1,5 NM in the final approach phase.

Together with PRM other systems like DGPS and MLS in combination with new cockpit displays will improve the flexibility of approach routes and thereby increase airport capacity.

The first installation of PRM took place at Minneapolis/St. Paul airport and has been tested and accepted. Four others are to follow in Atlanta, New York JFK, Philadelphia, and St. Louis.

4.3.5. Recent Developments in Advanced Surface Movement Guidance and Control Systems (A-SMGCS)

4.3.5.1. Introduction

A-SMGCS is currently a focus of major research efforts within Europe. These efforts are driven by a need to handle increasing surface congestion in general and, in particular, under low visibility conditions. A-SMGCS seeks to improve on current SMGCS by combining a number of technological enhancements to ensure that controllers, pilots and drivers of ground vehicles all keep a safe level of situational awareness particularly in poor visibility. These enhancements include:

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➢ the use of advanced cockpit avionics,

➢ enhanced communications, including automated data links between subsystems,

➢ improved visual aids,

➢ surveillance systems for monitoring all ground traffic,

➢ automated/semi-automated conflict detection and alerting,

➢ automated/semi-automated scheduling and planning functions.

A complete A-SMGCS will thus comprise a number of disparate, but integrated, subsystems. A range of projects to research these different aspects have been conducted as part of the Fourth Framework programme, and were reported at the 2nd OPTAS B Workshop. The following section provides an update on the status of these projects.

4.3.5.2.   Current and Recent European Commission-Sponsored Research Projects

4.3.5.2.1.   Overview

Under Framework 4, research projects into A-SMGCS were primarily aimed at investigating different specific aspects, although **DEFAMM** also provided an operational demonstration of the major A-SMGCS functions.

Thus, **MANTEA** and **ARAMIS** have investigated the functions of planning, guidance, control and conflict resolution, **ATHOS** and **ATOPS** have investigated the requirements for the ATC controller's Human Machine Interface (HMI) and the associated operational procedures, **DAFUSA** has developed tools for investigating the data fusion aspects of the communication function and **DA VINCI** has defined a prototype architecture for integrating the A-SMGCS functions. **SAMS** and **SEEDS** have both developed real-time simulation environments which can be used for evaluating procedures or technologies.

Although these projects, each of which is discussed in greater detail below, address different aspects of A-SMGCS, the interrelationships between many of them have been strong. The following diagram illustrations the interdependencies between the some of these projects.
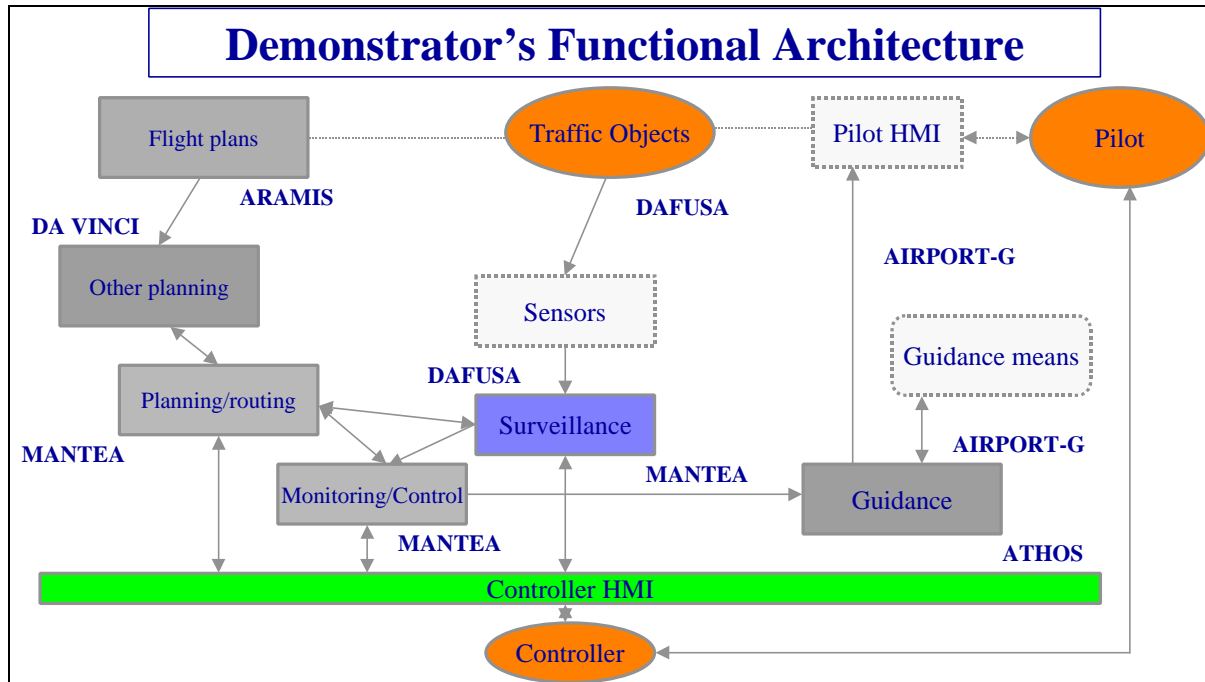
Figure 4-4: Relationship between Projects

4.3.5.2.2. BETA (operational Benefit Evaluation by Testing an A-SMGCS) DG TREN

BETA [28] is a recently initiated project under the 5th Framework programme which draws on the results of all of the 4th Framework studies discussed below. The objectives of BETA are as follows:

➢ to identify the constraints on airport efficiency and capacity currently associated with movements on the taxiway, runway and apron,

➢ on this basis to generate an A-SMGCS operational concept,

➢ demonstrate quantitatively and qualitatively the operational benefits which can be expected from an A-SMGCS system by conducting live trials,

➢ similarly demonstrate the reductions in environmental impact that can be achieved through an A-SMGCS implementation,

➢ provide detailed performance data on A-SMGCS systems and sub-systems as inputs to the ICAO A-SMGCS Manual [2].

This will feed into the specifications of requirements for A-SMGCS being defined by international organisations.

The project will therefore involve the following core activities:

➢ refining the Operational Concept,

➢ development and integration of the necessary systems and sub-systems,

➢ conducting two series of live trials at three European airports (Prague, Hamburg, Braunschweig),

➢ using the trials data to quantify the operational and environmental benefits,

➢ using the trials data to refine the Operational Refinement.

The project plan is based on a spiral model, so that the results of the first set of trials can feed back into refinements of the Operational Concept and the system design, which can then be tested in the second set of trials.

It will be seen from this summary that BETA is a large and complex project, considerably larger than any of the 4th Framework projects which preceded it. It will produce a range of outputs, which will support the implementation of A-SMGCS, provide a clear view of the requirements for further work, support the processes of standardisation and user acceptance and help to prepare European companies for competing in the world market.

4.3.5.2.3.   DEFAMM (Demonstration Facilities for Airport Movement Management) DG TREN

DEFAMM [32] drew together the results of a number of earlier projects to implement an operational A-SMGCS demonstrator. A system was implemented which incorporated the functions of surveillance, control, routing/planning and guidance as well as a HMI and supplementary functions such as technical system control, data recording for off-line test evaluation and a datalink sub-network. Different system components were tested at separate trials at Milan Malpensa, Bergamo, Paris Orly and Braunschweig. These were followed by a full-scale functional demonstration at Köln/Bonn.

The functional demonstration highlighted both the difficulty and the necessity of conducting live operational tests of A-SMGCS systems. It also demonstrated the feasibility and usefulness of the individual A-SMGCS functions, as well as the underlying integration architecture. In addition, it provided an opportunity to elicit feedback from controllers, pilots and drivers of ground vehicles.

4.3.5.2.4.   ATHOS (Airport Tower Harmonised Controller System) DG Information Society

The objective of ATHOS [33] was to develop and test prototype future Controller Working Position (CWP) suitable for use within an A-SMGCS and other future ATC systems. The prototype was specified on the basis of an extensive survey of user requirements. It was subjected to testing and evaluation using a simulation environment based on the results of the MANTEA project, which was run on two scenarios, one using simulated traffic flows at Madrid-Barajas and one using traffic movement data recorded at Paris-Orly. On the basis of these tests, a consolidated specification was produced for a future integrated CWP.

4.3.5.2.5.   MANTEA (MANagement of surface Traffic in European   Airports)   DG Information Society

MANTEA [34] was concerned with the development of a range of decision support tools. This included tools intended to support strategic infrastructure planning, but it also involved the development of a suite of tools to assist ATC controllers in managing traffic flow on the ground.

These tools provide support to the following A-SMGCS functions:

➢ routing/planning,

➢ conflict detection and resolution,

➢ surveillance.

Validation tests of these were performed at Rome Fiumicino, Milan Linate and Paris Orly.

4.3.5.2.6.   SAMS (SMGCS Airport Movement Simulator) DG TREN

The objective of the SAMS project [35] was to develop a real time man-in-the-loop simulation platform for testing and demonstrating new A-SMGCS tools and procedures.   It allows the pilots and controllers to evaluate new A-SMGCS concepts prior to purchasing new A-SMGCS equipment, within a safe environment.

The SAMS platform includes a A-SMGCS simulator, two working environment simulators (B747 cockpit and control tower), a traffic generator with interconnection between the components. It pulls together the results of a number of other projects including ATHOS [33], MANTEA [34], AIRPORT-G [36], DEFAMM [32] and ARAMIS [37].

Tests were carried out at London Heathrow and Amsterdam Schiphol.

4.3.5.2.7.   ATOPS (A-SMGCS Testing of Operational Procedures by Simulation) DG TREN

The ATOPS, which is due to end in mid 2000, project aims to identify operational procedures for A-SMGCS on the basis of questionnaires and "in-person" interviews and then to evaluate these using the real time simulation platform developed in SAMS.

The ATOPS project has been set up to reach several objectives. These are:

➢ The first objective, related to the definition of operational procedures will be met by : · defining a list of ATC procedures based on the use of an A-SMGCS,· testing a limited number of these procedures in a simulated busy airport environment (such as Heathrow, Schiphol), · identifying benefits arising from the use of such procedures.

➢ The second objective, related to performance parameters, will be met by carrying out tests of some new A-SMGCS based operational procedures in such a way that data can be derived and used in the process of defining sub-systems and equipment performance parameters.

➢ The third objective, related to the validation of simulation means, will be met by demonstrating through test scenarios similarities between the simulated and real world operations.

➢ The fourth objective, providing a baseline for the 5th FWP, will be met by the preparation of a report outlining testing that could be usefully performed in the context of the 5th FWP.

➢ The last objective, consulting and/or informing all interested parties, will be met by setting up internal consultations and two forums. Forum 1 is a consultation forum and will

be set up prior to the start of the simulation to consult end users and Forum is a dissemination forum to inform end-users, equipment providers and regulatory authorities on the results of the simulation.

4.3.5.2.8.   AIRPORT-G (Airport Integrated Research & Development Project for Operational Regulation of Traffic-Guidance) DG Information Society

AIRPORT-G [36] investigated the exploitation of A-SMGCS ground surveillance technologies for security surveillance in the airport parking area. It explored the concept of using ground surveillance radars to detect security breaches, such as incursions into parking areas. These would then cue more conventional video surveillance equipment, which would identify the possible intruders.

This concept relates in particular to the planning, surveillance and guidance functions of A-SMGCS. From this starting point, the study went on to develop a specification for a low-cost A-SMGCS architecture. This drew on the results of DEFAMM [32] and MANTEA [34] and was specifically aimed at the needs of a medium sized airport, with clearly defined characteristics, and its development was supported by a cost benefit analysis which identified security improvements as the primary benefits of an A-SMGCS system.

The components of this concept architecture, including on-board visual displays for guidance information, were evaluated using simulator trials.

4.3.5.2.9.   SEEDS (Simulation Environment for the Evaluation of Distributed traffic control Systems)

SEEDS involved the development of a real time multiple man-in-the-loop distributed simulation environment which can be used for training A-SMGCS operators, defining and evaluating new A-SMGCS procedures and evaluating new A-SMGCS technologies.

In the project, a distributed interactive Simulation Environment (SE) for the analysis and evaluation of distributed traffic control systems has been designed, set-up and tested. The SE provides a general purpose tool kit for the simulation of a wide range of industrial applications of strategic relevance, such as air and maritime traffic control systems.

4.3.5.2.10.   ARAMIS (Advanced Runway Arrivals Management to Improve airport Safety and efficiency) DG TREN

The main objective of the ARAMIS project [37] was to develop models and tools for 4D-planning, guidance and control, during the approach phase of a flight and until runway threshold. The project started with a survey to analyse ATC procedures in relation to aircraft, airlines and airports. Aircraft performance models where studied to derive a model for approach and landing in accordance with approach and landing procedure reports. Then weather models are studied with particular attention to the wind component. These three issues contribute to the developing and prototyping of the 4D-planning,guidance and control tool complying with the defined operational requirements. Co-ordination with other SMGCS activities will also be ensured to incorporate ATC and airport requirements

4.3.5.2.11.   DA VINCI (Departure and ArriVal INtegrated management system for Co-operative Improvement of airport traffic flow)

The main objective of the DAVINCI project [38] was to define and demonstrate the feasibility of integrating and/or co-ordinating the various components of existing or future Automation Airport Traffic Management System (APTMS) systems.

The main objectives of DAVINCI are achieved by:

➢ Determination and analysis of user needs for efficient integration and co-ordination of the functionality of APTMS (various on-going projects relate to this topic).

➢ Definition and specification of techniques which support the:

   ➢ Description of the system model, and the integration and co-ordination process.

   ➢ Description and analysis of the decision making process.

➢ Design and description (using specified techniques) of the proposed method for integration and co-ordination of the various functions described previously (based on existing and foreseen APTMS).

➢ Analysis and description (using specified techniques) of the decision making process and identification of the various options for decision allocation.

➢ Specification and design of an open architecture to support the designed integration and co-ordination method. The architecture should make it possible to model the progressive integration of the various functions (present and future) involved, taking into account the required flexibility to cope with different methods of decision allocation (according to different organisational structures).

➢ Demonstration of the feasibility of the proposed method and architecture and evaluation of its adequacy, using a demonstrator which integrates some of the existing systems (real or modelled).

4.3.5.2.12.   DAFUSA (Data Fusion for Airports) DG Information Society

Because an operational A-SMGCS will be processing data from many different sources, it will require a powerful and robust data fusion mechanism. The objective of DAFUSA [39] was to develop an SMGCS simulator which can act as a test bed for evaluating potential data fusion algorithms.

The resulting system simulates the generation of surveillance data from multiple sensors, passes these to the candidate algorithms and provides an analysis of the performance of the algorithms.

4.3.6. ETNA (Electronic Taxiway Navigation Array)

ETNA is a guidance and management system for vehicles on the apron being developed in a co-operative venture between FAG and a research group at the Technical University at Darmstadt.

The system consists of an onboard navigation unit combining the precision of D-GPS with the reliability of conventional sensors like Inertial Platforms, Gyroscopes and Steering Angle Sensors. The fault-tolerant navigation software determines the vehicle's position and displays it on an onboard display which also shows an artificial 3D view out of the cockpit to increase onboard safety.

The position of the vehicle is also transmitted to a central monitoring station where an operator receives a picture of total traffic levels in sensitive areas of the airport. The operator can also transmit information on problems such as obstacles or temporary closures of streets and taxiways to all vehicles using the system.

The system concept is modular and can be adapted to suit particular users' requirements, so that even large fleets of vehicles can be equipped with the system at relatively low cost.

4.3.7. Summary

This section surveys some recent and ongoing initiatives in the area of airside operations. Although these initiatives cover a very broad range, they are by no means an exhaustive list.

4.4.   Landside Initiatives

4.4.1. Introduction

A steady growth in passenger traffic is creating serious challenges for airport terminal infrastructures. Advances in aircraft technology in the 1970´s and 1980´s have enabled the volume of passenger traffic at airports to increase dramatically. A B747, for example, can now discharge close to three times the number of passengers that its predecessors could have carried, while an A3XX could even carry double the number of passengers of a B747. Airport infrastructure has not developed at the same pace as these advances in aviation technology. Additionally, growing concerns over security in general and the risk of illegal entry and directly associated imported criminality in particular have led to increased aviation security checks, border controls, customs, entry and exit inspections. As a result of these factors, increased passenger processing times at check-in, security, border control, embarkation and disembarkation have become the norm.

As a consequence the ratio of flying time to waiting time is becoming poorer, thus eating away at the principal advantage of air travel over the other forms of travel, especially as comfort levels are driven down significantly during the increasing time spent waiting and undergoing inspection.

Increasing border control and security capacity to handle increased passenger loads (which might require a doubling after introduction of New Large Aircraft) is not feasible in most cases. Thus, a variety of approaches have already been developed to achieve improvements in passenger clearance without physically extending existing terminal infrastructure.

4.4.2. Security Initiatives

4.4.2.1.   <u>Advanced Technologies for Passenger Processing</u>

The driving force for the development of automated passenger processing systems is the fact that much of the extensive infrastructure currently in place is used for processing low

risk travellers. A more efficient use of the infrastructure could be achieved if the large proportion of low risk travellers could take advantage of automated clearance.

4.4.2.2. FAST (Future Automated Screening of Passengers)

The automated border inspection concept called FAST is based on the use of biometrics to screen travellers. This could support the prevention of further increases in control channel and personnel requirements.

This could in turn lead to a more effective deployment of staff, who would be free to concentrate on passengers who are relevant in terms of border control issues. At the same time travellers participating in FAST could avoid long queues at border controls. In principle FAST is based on the idea of a two-line inspection process in which the first line is replaced by an automated clearing process.

However, after initial enthusiasm and much work FAST is not yet in operation.

Tests with FAST were planned at **BAA** in UK in 1998. Test installations have been introduced at **Schiphol Airport** in 1990 but a decision to install the system in operation has not yet been reached. No more trials are in place and there is no progress towards international standards concerning biometric and support systems.

4.4.3. INSPASS/CANPASS

Two other initiatives aimed at easing the burdens on border controls have been started in the USA and Canada.

INSPASS was launched by the US Immigration and Naturalisation Service (INS) in 1993. Three test sites including New York (JFK), Newark and Toronto have been selected. Potential users who could apply for the special pass were frequent travellers from USA, Canada, Bermuda and visa waiver countries as well as diplomats and members of international organisations.

The data of more than 65,000 people who took part in the test programme were stored in a database. Two biometric measurements - fingerprints and hand geometry - in addition to biographic data were taken. Approved applicants were supplied with an ICAO compliant machine readable identification card which acts as a token for access to an online database containing all personal information.

At the arrival airport the traveller presents his INSPASS card to an reader and simultaneously places one hand in a hand reader. After a successful verification the traveller receives a printed receipt and can then proceed through the gate area and customs. Total processing times of 11 seconds have been achieved.

The INSPASS programme is derived from research carried out by an international advisory group called PASS which has representatives from the UK, Germany and the Netherlands as well as the USA and Canada. In spite of a successful field test with more than 200,000 admissions and the fact that the technology has achieved the required level of interoperability, the system is not yet in operation.

A similar programme called CANPASS was launched in Canada with total processing times of 25-30 seconds.

4.4.3.1.   Automated Profile System (APS)

This initiative was developed and introduced by Amsterdam Schiphol Airport in 1998. The principle on which APS is based is to select passenger categories which require different levels of security check, i.e. one category is considered to be "safer" than the other. This method enables more time to be spent on the less safe category.

A more descriptive name for the system would be pre-screening passengers before arriving at the airport. The system was especially developed for passengers on so-called high risk flights thus requiring more extensive security measures. Before the introduction of APS, all such passengers were assessed by means of an interview and related inspections of documents such as passport, ticket and boarding pass on the basis of which the some passengers were selected for intensive screening. Obviously this is an intensive procedure in terms of both time and cost. In the past few years the number of high risk flights has increased steady and for many such flights half of the passengers were on short time transfer. These factors led to a lack of space and a marked rise in security costs as well as a weakening in the quality of the profile checks. It was because of this that Amsterdam Schiphol decided to choose a new method of passenger profiling.

APS requires certain information to be gained from the selected airline's database. A software application contains checks the airline data against a number of criteria. The questions are designed to identify "positive" signs only (i.e. positive indications that the passenger should be assigned to the "safe" category). Passengers with positive signs get a boarding pass marked with a positive security code. All others, including passengers where data was not available, have to pass through the intensive "personal" screening procedure. The check is carried out 24 hours before departure. Estimates indicate that approximately 60 % of the passengers are given a positive security code.

The development of APS was a private sector initiative and the system is privately owned. However the responsibility for the system falls to Minister of Justice. Two of the requirements on the system were that passenger data from the airlines may only be used positively and that the automated profiles must not to be stored.

The benefits of APS are characterised by decreased personnel costs, more efficient use of gate areas and reducing waiting times for passengers.

A similar system called CAPS – computer assisted passenger screening - was developed in the USA with FAA funding and is now being widely deployed.

4.4.3.2.   One Stop Security

The one stop security is intended to speed up the security procedures at hub airports by avoiding duplication of security controls for hold baggage, hand baggage, passengers and cargo. Passengers and their baggage undergo only one initial security check even on a journey involving multiple airport transfers.

One stop security could help to reduce the problems caused by the implementation of 100% Hold Baggage Screening. For hubs with more than 50% transfer passengers and minimum connecting times of as little as 30 minutes it will probably not be feasible to screen transfer baggage within this short timeframe.

However no multilateral agreements for one stop security have yet been signed, although one bilateral agreement between Switzerland and Belgium was initialled in April 1999 and

the United Kingdom is in the process of negotiating a number of one stop agreements for cargo with Ireland, Sweden and Denmark [40, 41, 42].

For border control the Schengen Agreements have already created a European area of free movement of travellers by abolishing passport controls and this has led to higher passenger throughput.

4.4.4. Initiatives to Improve Passenger Handling Procedures - Airport Automation

ICAO, ECAC [42] and ACI [43] have set up a variety of recommendations and proposals for ways in which airport operators together with airlines, border control and security authorities could improve passenger handling and security.

Automation of passenger handling processes plays a vital role in the more efficient use of existing facilities and the facilitation of traffic. The following overview introduces some of the state of the art technologies which may help to cope with future increases in passenger numbers.

4.4.4.1.   <u>Smart Cards [45]</u>

Smart card technology is seen as a promising solution to speed up and ease passenger and baggage handling processes. Currently Europe accounts for about 80 % of smart cards in use.

There are three different types of smart cards in use; contact, contactless and wide range.

Contact technology relies on a chip which is embedded in the card and has to touch the reader much in the same way as magnetic stripe cards do.

Contactless technology works with a copper coil embedded in the chip which acts as an aerial and allows readings to be taken from the card from a distance of 20cm.

The **Long Range** smart card works in a similar way to the contactless ones but up to distances of 1,5 m. However this type of is still under development.

Smart cards can be used quite flexibly for a wide range of different purposes.

The following areas for the use of smart cards can be identified in the terminal area:

➢ self-check-in, where passenger gets access to the booking record

➢ border control

➢ self boarding

➢ baggage tag

4.4.4.2.   <u>RFID-Radio Frequency Identification Data</u>

This technology is an attempt to replace the means of identification (e.g. barcode) currently used by the transport devices in automated sorting systems. It replaces the conventional barcode label by a very thin RF-transponder suitable for laminating into a paper tag. The chips could also be included into a smart card or the suitcase itself. All flight and passenger

related data is saved during the check-in process in a transponding microchip. Reader antennas are placed, separated by defined distances, in the handling systems, dictate the direction the baggage travels to be correctly discharged from the system and give a unique bag ID to the sorting system. The combination of reader and label can also be used as a passenger/baggage reconciliation system, when linked to the airlines' check-in systems.

The installation of the reader equipment is easier and less expensive than for conventional systems. A capacity gain can be reached with RFID by more efficient use of the baggage handling system and a reduction in incorrectly sorted baggage. The reading accuracy is, however, only as good as that of codes used for DCV systems (approximately 97%). The system facilitates a substantial increase in security, as the baggage is time-stamped when it enters the conveyor system and has to arrive at the following reader within a given timeframe. If the system detects irregularities, the baggage is redirected to a special location.

A test version has been implemented at Stockholm Arlanda airport. Investigations are in progress at CDG. The increased expense involved, however, means that the system would only become economic if the whole airline industry were to adopt it.

4.4.4.3.   Machine Readable Travel Documents (MRTDs)

In order to automate and speed up passenger clearance through border control, ICAO adopted worldwide standards for machine readable documents such as passports, visas and crew member certificates in the early 1980s. Today more than 250 million machine readable passports (MRPs) and approximately 20.000 automated readers are in use around the world. As the introduction of MRPs was quite successful in terms of speeding up processing and reducing forgeries, the USA has launched initiatives to use enhanced capabilities of automated readers by involving airlines.

The programme called Advanced Passenger Information System (APIS) has resulted in more than 8.000 reading devices being installed on the check-in desks of airlines that have routes into the USA. Data collected from MRPs during check-in is electronically transmitted to the US customs service at the point of disembarkation in the USA. Passengers that are pre-cleared may then use the special blue lanes established for enhanced processing, greatly increasing the speed with which they can clear customs and immigration.

Currently, to be eligible for blue lane processing, airlines must provide advanced passenger information for 60% of the passengers on a given flight. A memorandum with airlines foresees an increase up to 90% by April 2000.

The introduction of APIS also resulted in problems for the airlines. While immigration processing times decreased at the arrival airport, check-in process times increased at the departure airport. This conflicts directly with the airlines' customer service objectives to minimise service times.

4.4.4.4.   Passenger and Baggage Check-in

4.4.4.4.1.   Self Service Kiosks

Check-in areas including space for waiting use a lot of resources and space in passenger terminal. Self service devices have now been in operation for some years. The implementation of self-check-in machines allows airports and airlines to increase their check-

in capacity without extension of facilities. Self service devices can reduce processing times for passengers who are familiar with the procedures (e.g. frequent travellers). Furthermore check-in hours are more flexible due to all day long operation. These machines require electronic tickets (magnetic stripe or smart card). The survey of airports conducted as part of the OPTAS A project [40,47] showed that self-check-in is most common at German Airports driven by the main carrier Lufthansa. At Frankfurt there are about 65 machines instead of 6 at Brussels or 4 at London Heathrow.

Lufthansa intends to develop the system in the mid term to have at least 50% self check-in of all potential customers with electronic tickets. On some specific major business routes the share has already reached 80%.

Up to now only passengers with hand luggage only could take advantage of self-service check-in. But a solution to make them usable also for passengers with hold baggage has been found. A new generation of fully automated check-in machines were developed and are currently undergoing tests at Frankfurt. Passengers put their pieces of baggage on the belt of the machine and label them themselves. The destination identification barcode is identified by a gate equipped with several readers. After identification the baggage is transported automatically to the make up area.

As space for these machines is restricted, the interest of airport operators in future development is for a self-service environment for common use in which several airlines share the same equipment.

4.4.4.4.2.   Off Airport Check-in [48, 49, 50]

As terminal area is restricted and cannot be extended without limit, airports and airlines have an interest in removing check-in to off airport locations. Another important fact is that down town check-in facilities encourage more passengers to use public transport to the airport (in this case express trains) and therefore help to relieve congested roadway access. Railway stations and hotels are typical locations where check-in is offered for airlines.

Switzerland has a unique check-in and fly baggage system through Zürich and Geneva airports. Check-in is possible at 23 Swiss railway stations to destinations worldwide at a cost of 20 SFr for each item. Check-in is possible as early as 24 hours before departure and as late as 3 to 11 hours.

Other airports known for large scale off airport check-in are London Heathrow and Gatwick with Victoria station and Hong Kong with in town check-in facilities at Kowloon. Trials have also been started in Germany.

Baggage transport requires close cooperation with the rail companies which offer the service to the airports. It is often the most difficult aspect in setting up these services because of security considerations. All pieces have to be screened either at downtown stations or at the airport before feeding into the sorting system. Another important aspect is the development of intelligent solutions for quick loading/unloading procedures and access to the baggage handling system. For example, Hong Kong uses a mechanised system with container transfer, while at London manual (un)loading is necessary.

4.4.4.4.3.   Simplifying Passenger Travel (SPT) Project [48]

This promising initiative, which is currently still at the concept stage, includes all technologies and procedures introduced in this briefing document and covers the whole of the passenger

handling chain. The project idea was developed by ACI, IATA, ICAO and other organisations representing airlines, airports, control authorities etc. with the aim of facilitating passenger handling in general and to improve the situation at congested airports. It is not only concerned with single processes in isolation but with the whole chain which the passenger has to follow from before departure until after arrival.

The realisation of this vision demands a close cooperation between all the participants in the chain: airlines, airports, border control authorities and customs.

The definition of the SPT vision is as follows:

Passengers, equipped with a multi-functional smart card including biometric ID, provide information in a "one-stop" check process which, together with other information generated from the journey and shared between all involved parties, would facilitate subsequent processing, and allow controls to be effected on a risk assessment basis.

The one-stop concept is built around a travel smart card which combines all functions needed for reservation, check-in, security, immigration and baggage pick up. This would hold secure personal data including biometric and passport/visa information. All partners would have to be linked electronically to share passenger information as needed.

The process chain for passengers could look as follows:

1. At first passengers will be able to make their reservations on a PC. Important data for further processing such as visa information, special need requirements, preferences, frequent flyer membership etc. are collected. All features which are necessary for the flight are then provided to the passenger on a print out and visually on screen.

2. After entering the terminal building the passenger proceeds to a one-stop gate where the smart card has to be inserted into a reader. After confirmation of flight number a biometric scan is necessary. If the match is successful information such as gate and seat assignment will be provided. The check-in will also cover connecting flights.

   The check-in area will be divided for those passengers wishing to use a fast track which directly leads to the gate and those wishing to shop. Passenger acceptance times will therefore be different.

   Passengers who prefer to check-in before leaving for the airport will be able to use remote check-in facilities which will have the same functions as the devices described above.

3. Baggage will be registered by an automated device which also produces a baggage tag containing a Radio Frequency chip which makes it possible to track the baggage to the baggage make up area.

4. The service kiosk prints a boarding card and baggage receipt.

5. Along with his carry-on luggage the passenger passes through security and proceeds further on to the gate area. It would be certainly feasible that an additional chip in the smart could be used for tracking and guiding the passenger through the terminal to the departure gate.

6. For countries or specific passengers where "manual" border control is still necessary this procedure could be integrated into the one-stop check area.

7. The check-in system at origin will automatically provide passenger and flight information to the control authorities at destination. Therefore passengers are asked to respond to a series of simple on-screen questions during check-in. This pre-check will facilitate fast tracking of passengers at destination airport.

8. Entering the departure lounge or boarding the aircraft is only possible by inserting the smart card into the reader and an additional biometric scan. If the match is successful this information is automatically sent to the baggage reconciliation system which authorises the baggage for transport.

9. After arrival at the destination airport and pick up of baggage the passengers will be guided to an electronic exit gate. Again exit is only possible with a match of smart card information and biometric scan. Simultaneously the RF chip at the baggage will be matched with the airline's records to make sure that all pieces belong to the passenger. Where discrepancies arise or interviews become necessary for other reasons, passengers will be redirected to special areas.

4.4.5. Initiatives to Improve Processing of Passengers with Reduced Mobility (PRMs)

The group covered by the term PRM does not only consist of people with disabilities but also of the elderly, unaccompanied minors or those with heavy baggage, children and in general all passengers who do not have the same flow speed as usual passengers. There are about 60 million people with some kind of disability in Europe. Furthermore, the number of people aged over 65 will double in the next 50 years and people over 80 will treble. These people thus represent a very large and growing potential market for the travel industry. Consequently the European Commission [52] and international organisations like ACI [53] and ICAO [54] pay high attention to improvements of the airport facilities aimed at making access to and movement through terminals and all passenger handling processes quicker and easier for all PRMs. The general aim is that PRMs should have the opportunities to use the same facilities and paths as any other member of the public.

Many measures have already been taken and have to be considered when planning the construction of new terminals so as to meet the recommendations of the international organisations and improve the present situation. As the OPTAS A airports survey showed, the minimum requirements are in general met by airports.

These minimum requirements can summarised as follows:

➢ Car parking close to terminal

➢ Clear marking with international symbols

➢ Provision of information desks or telephones

➢ Level or ramped access to all areas

➢ Wide doors

➢ Contrasting colours

➢ Matt surface

➢ Non-Slip surface

➢ Adequate lighting

➢ Specially equipped washrooms

➢ Wide lifts

➢ Moving walkways

➢ Low level telephones

➢ Low level desks for passport control or clearly marked bypasses for special control

➢ Alternative routes for security control where automated security devices are used

➢ Lifting vehicles for (dis)embarkation at remote stands

The likely increases in PRM traffic mentioned above imply that additional measures will have to be undertaken. The following are examples of additional measures some which have already been implemented:

➢ Brochures from airport authorities for pre-information

➢ Telephone device for deaf or hard-of-hearing passengers

➢ Braille telephones

➢ Braille indicators on elevator buttons

➢ Synthesised voice floor callers in lifts

➢ Tactile maps and signing

➢ Induction loops for hard-of-hearing passengers

➢ Tile pattern aids for wayfinding

➢ Different floor surfacing for different areas

➢ Low level check-in, service and information counters for wheelchair users

➢ Low level self-information kiosks

➢ Low level flight information display systems

➢ Provision of electro-mobile services

➢ Improvement of information flow in order provide services at the right time and place

These measures can contribute to improved terminal operations in general. Widening access also has economic implications for airport operators. The airport can capture a

significant market and is a fundamental component serving the public. The following facts should change the way of thinking at some airports.

➢ The rising number of PRMs with access to retail facilities will generate increased revenue.

➢ Improved access means that less staff will be required for assistance.

➢ The number of people benefiting from barrier free operation is increasing parallel to the rising number of PRMs

➢ Most people with disabilities are accompanied. From the marketing perspective this means the target market effectively doubles.

4.4.6. Summary

As the examples in this paper have shown a large number of initiatives have been launched around Europe and elsewhere to increase passenger throughput with the existing terminal facilities. However most of the identified initiatives are still in their development phase and are not yet widely spread. There are also many cases where economic restrictions are slowing down the development process.

However the recommendations of European civil aviation organisations and their task forces provide a framework and a direction for developing intelligent solutions to improve landside capacity.

4.5.   Capacity Enhancement Through Simulation

4.5.1. Introduction

Today's airlines, airports, and civil aviation authorities face the challenge of satisfying increased demands. Improving an airport's physical layout and traffic flow so as to improve efficiency or increase capacity requires expertise and the application of sophisticated analysis techniques. Simulation tools enable users to analyse the need for improved capacity and efficiency and assist them in determining appropriate solutions for designing new facilities, remodelling existing facilities, and developing methods for improving operations.

4.5.2. The Need for Airport Modelling and Simulation

Constraints on capacity are a problem for an increasing number of European airports. If projected increases in European air traffic are to be accommodated, then measures must be undertaken at individual European airports to increase the capacity to handle both aircraft and passenger movements.

Important ways in which increases in capacity may be achieved include the introduction of new traffic management procedures and associated changes to the layout of runways, taxiways, aprons and related ground facilities. But **the cost of building or modifying virtually any infrastructure or equipment element usually starts at several million Euros**.

How can an organisation prevent mistakes and protect savings that are built into projects before such large amounts of money are committed? Careful planning minimises risk, but

'paper-and-pencil' planning falls short of the level of analysis demanded by the risk exposure. To make a benefit case, reliable quantitative figures are needed.

The Solution is Simulation Modelling

A model may be used to analyse and evaluate a specific concept, at a fraction of the cost of building or using the actual system. Risk is reduced by delivering a more reliable analysis and by evaluating alternative scenarios.

4.5.3. Overview of Airport Fast-Time Simulation

It should be emphasised that this paper is concerned only with **simulation modelling**, as distinct from **real time** simulations. The latter, which typically involve humans-in-the-loop or real aircraft, comprise another extensive class that is not addressed in this report. As they require extensive facilities and significant staff commitments, they therefore tend to be costly. Moreover, a high level of demand for a few real-time simulation facilities inevitably leads to long waiting lists, and it is therefore easy to understand why real-time studies are usually focused on a very small number of specific issues.

However, "fast time" simulation makes it possible to ask a broader range of questions and to evaluate a larger number of options. 'Fast time' means that the processes being simulated proceed faster than real time. A scenario covering a few hours of real time may run in a few seconds or minutes, depending on the speed of the tool in use. In general, human interventions are not required during a fast-time simulation run. Human input is only required for defining or altering scenarios, running the tool and debugging.

4.5.4. European Studies and On-Going Research

Several European studies deal with airport capacity assessment. The following list is not exhaustive:

➢ The **TAPE** project [55] aimed at identifying the factors affecting airport efficiency and capacity in a broad sense, including passenger and ground handling, ramp and apron services, airport access and information, with the final objective of modelling the whole to assess potential improvements. The major objective was therefore to develop a computer aided capability for evaluating the impact on the entire airport of various alternatives for increasing airport capacity and efficiency, both in the air and on the ground. This capability was implemented in the form of a multi-layered toolkit consisting primarily of analytical models, as well as of a few carefully selected simulation models, and managed through a set of utility programmes.

➢ **TOSCA** (Testing Operational Scenarios for Concepts in ATM) is a Eurocontrol project, one of the objectives of which is to investigate the perceived beneficial effects of existing EATMS concepts for technological systems and operational procedures affecting airport and terminal area operations and, using fast time simulation, to compare these with predicted future demand composition on airport and terminal manoeuvring area (TMA).

➢ The **MACAD** (MANTEA Airport Capacity and Delay model) tool has been developed under the **MANTEA** (Management of Surface Traffic in European Airports) project [56]. The objective of the MACAD tool is to provide an integrated set of models which will assist airport operators and managers in planning strategically for optimising airfield capacity given (1) any particular level of (existing or predicted) demand and (2) a desired level of service.

➢ The aim of **MUFTIS** is to develop practical methodologies in the evaluation of existing or enhanced ATM concepts, of proposed systems, new technologies, new tools and new procedures as well as in the dimensioning of systems and subsystems. The contribution of work package 1 of MUFTIS is to specify a hierarchical set of models and simulation facilities that can be used for the evaluation of enhanced ATM designs with respect to the strategic objectives of their development. This hierarchical set is referred to as the Model and Simulation Representation (MSR).

➢ The **Reduced Aircraft Separation SIMMOD (Airport and airspace SIMulation MODel) Study** [57] used SIMMOD, the FAA's airport and airspace simulation model, to measure the impact of changes in approach and departure aircraft separation procedures on airport and airspace delays for example airports. Three concepts were investigated :

   ✓ The reduction of intrail separations on final approach and departure for segregated operations on parallel runways (using France's Orly Airport as an example).

   ✓ The reduction of intrail separations on final approach and departures for a single runway operations (using a modified version of France's Orly Airport as an example).

   ✓ The implementation of staggered approaches for closely-spaced parallel runways (using France's Toulouse Airport as an example).

➢ The aim of **MAICA** [58] is to evaluate the effects of changes in ASM, ATC, airports and aircraft as foreseen for future ATM systems, in terms of capacity, efficiency, safety and the other benefits . It starts by defining the possible changes in the operations of the participants who are connected with any part of the flight of a given aircraft: ASM, ATC, airports or the aircraft themselves. It goes on to prepare the simulation activities addressing the global goals of the tools, the scenarios and the associated data and evaluation criteria.

➢ The aims of **OPTAS A** [47] were

   1. the evaluation of possible improvements in European airport capacity which may result from the introduction of new procedures and technologies in the airside and the landside

   2. the development of a high level airport simulation application, combining the airside and the landside, to support airport design and planning.

4.5.5. Coverage of Simulation

There are really two applications for airport simulations:

1. The detailed optimisation of specific airport day-to-day operations;

2. Forward planning investigations of the likely effects of new technologies, procedures, airport configurations and operations.

Several issues may be covered by simulation, such as airside capacity, landside capacity, safety, noise, etc.

4.5.5.1. <u>Airside capacity enhancement [59, 60, 61]</u>

Capacity and delay are two of the principal measures of performance of air traffic management (ATM) systems. To obtain estimates of these measures, a considerable number of models have been developed over the years. Indeed, this is the oldest area of model development in the ATM field, with the first significant models dating back to the late 1950s. It is also the area where the most advanced modelling capabilities currently exist. They enable an analyst:

➢ to analyse **airport capacity bottlenecks** (apron, gates, runways, de-icing pads, etc.),

➢ to study **traffic growth**, in order to assess whether the airport in its present form will cope with future growth,

➢ to study **new airport ground procedures**, which can be modelled to address capacity constraints without requiring investment in infrastructure (models can also simulate the effect of the changes being made without disrupting current operations or jeopardising safety),

➢ to evaluate the **benefits of planned new airport infrastructure components**, such as new gates, taxiways or runways, taking into account projected traffic growth.

➢ to allow aviation professionals to accurately model the **impact of a brand new airport**,

➢ to study the impact of introducing **new aircraft types**,

➢ to analyse the **impact of severe weather** in the vicinity of the airport and to evaluate how existing procedures may be customised in response to such conditions,

➢ to determine optimal positions of de-icing pads or optimal numbers of de-icing trucks through a sophisticated simulation of de-icing procedures, both on-ramp (at gate) and at remote de-icing stations.

4.5.5.2. <u>Landside operations enhancement</u>

The simulation of passengers, escorts and meeters allows the user to test new airport terminal designs with different levels of passenger demand and assess measures of their operational efficiency. As well as aiding in the design of new terminals, models can be used to assess the performance of existing terminals. Modifications can be tested to see if the benefits justify the expenditure involved.

Typical analyses of landside applications can be:

➢ Terminal layout requirements:

◆ security facilities: analysis of relocating systems, focusing on impact to passenger and baggage processing

◆ corridors: measure the occupancy of each corridor

◆ passenger hold rooms: to accommodate both seated and standing passengers and compare with the space required and the space available.

- ◆ shuttle bus services to provide connection facilities between terminal buildings

➢ Security:

- ◆ analysis of implementing of new systems to enhance security

- ◆ estimate the expected queue and processing time requirements at each security checkpoint

- ◆ assessment of the number of security positions needed

➢ Check-in customer service

- ◆ estimate expected queue lengths

- ◆ total number of passengers waiting at each counter area

- ◆ time spent in queue

- ◆ analysis of different types of check in counter configurations

- ◆ staffing requirements

➢ Baggage processing

- ◆ check-in

- ◆ movement through sorting systems

- ◆ staging of bags in carts or containers

- ◆ loading and unloading bags on and off aircraft

- ◆ delivery to baggage claim areas

➢ Customs and immigration

- ◆ identify any bottlenecks in passenger flow (number of passengers, peak queue lengths)

- ◆ time required for passenger to complete processing

➢ People mover

- ◆ transport time of passengers needing to reach connecting time

➢ Transfer passengers

4.5.6. Levels of Detail

Models may be classified into *macroscopic, mesoscopic and microscopic,* corresponding respectively to a low, intermediate and high level of detail. While the boundaries among these three classes are not particularly sharp (e.g., the same model might be characterised

as "low-level-of-detail" by some or "intermediate-level" by others) it is nonetheless very useful to classify models along these lines.

Macroscopic models omit a great deal of detail, since their objective is to obtain approximate answers with emphasis on assessing the *relative performance* of a wide range of alternatives. For example, air traffic demand may be described in such a model by simply an hourly rate of arrivals at an element (airport, sector, etc.) of the ATM system and a simple probabilistic description of how these arrivals occur over time (e.g., "Poisson arrivals"). These models are used primarily for policy analysis, strategy development and cost-benefit evaluation. Ideally they should be fast, in terms of both input preparation and execution times, so they can be used to explore a large number of "scenarios".

Mesoscopic models, while more detailed than macroscopic ones, are still rather strategic in nature. For example, a mesoscopic model may be concerned with aggregate flows per unit of time through one or more elements of the ATM system (e.g., for flow management purposes) without being concerned with how these flows are handled, as long as the flows remain below some pre-defined "capacities".

Finally, **microscopic** models are designed to deal with more tactical issues. Typically, such models represent aircraft on an individual basis and move them through the ATM elements under consideration by taking into consideration each aircraft's performance characteristics. Such detailed features as conflict resolution, airport taxiway and gate selection, pushback manoeuvring, etc., are generally included only in microscopic models.

4.5.7. Methodology

With respect to methodology, we distinguish between **analytical** and **simulation** models. The former are abstract, necessarily simplified mathematical representations of airport and airspace operations. By manipulating these expressions (either in closed form or numerically) analytical models derive estimates of capacity and delays in airspace and/or airports. In contrast, the classical approach of simulation modelling is to create objects (typically aircraft) which move through the airspace segments and airports of interest. By observing the flows of such objects past specific locations (e.g., the threshold of a runway) and the amount of time it takes for aircraft to move between such points, the simulation models compute appropriate measures of capacity and delay. There is a strong correlation in practice between methodology and level of detail: specifically, analytical models tend to be mostly macroscopic in nature, whereas most simulations are mesoscopic or microscopic.

Models (whether analytical or simulations) can be further distinguished in terms of methodology, according to whether or not they are (a) **dynamic** and (b) **stochastic**. Dynamic models will accept input parameters that are time-dependent and will capture the fluctuations over time in the performance metrics of airports and/or airspace traffic. Similarly, stochastic models will accept input parameters which are specified probabilistically (i.e., are random variables) and will capture the impacts of uncertainty on the performance metrics of airport and/or airspace traffic. Stochastic *simulation* models are often referred to as *Monte Carlo* simulations.

4.5.8. Overview of some Airport Simulation Tools

The lists of airport simulation tools are not exhaustive. Only the major and widely recognised tools are quoted here.

4.5.8.1.   Airside

Table 4.1 lists the most significant airside simulation tools. The * indicates an analytical model

Scope of the tool Level of Detail (type of study)	Aprons, taxiways, gates	Runways and final approaches
Macroscopic (Policy analysis, cost-benefit studies)		LMI Runway Capacity Model* FAA Airfield Capacity Model* DELAYS* AND*
Mesoscopic (Traffic flow analysis, cost-benefit analysis)		NASPAC TMAC FLOWSIM ASCENT
	OPTAS	
Microscopic (Detailed analysis and preliminary design)	TAAM SIMMOD (with restrictions) The Airport Machine HERMES II	

Table 4.1:Airspace simulation tools

Existing **macroscopic** models concentrate on runway capacities and associated delays or on en route sector operations. General purpose, macroscopic models of taxiway/apron operations and of terminal airspace operations do not exist, because such models need to be location-specific. Of the runway/final approach models listed in Table 4.1, the top two estimate capacity, while DELAYS and AND (Approximate Network Delays) estimate airport-related delays.

The four **mesoscopic** models listed in Table 4.1 are all recent (the oldest, NASPAC (National Airspace System Performance Analysis Capability), was initially developed in

1988). NASPAC was initially designed as a national- or regional-scale, macroscopic simulation whose objective, like that of AND, was to study a network of airports and compute how delays in any part of that network would "spread". However, many details were subsequently added to NASPAC, so that today it is primarily used to deal with traffic flow management (TFM) issues, rather than predictions of capacity and delay. The focus of the other three models listed, FLOWSIM, TMAC and ASCENT is also on TFM.

Most of the models in the **microscopic** category are well known. SIMMOD, TAAM (Total Airspace and Airport Modeller) and The Airport Machine have been used in numerous airspace and/or airport studies in many parts of the world. The former is a model developed with support from the FAA and is available at little direct cost, while the latter two are proprietary and carry significant license fees. SIMMOD and TAAM [62] cover both airspace and airport operations, while The Airport Machine is limited to airport operations only.

The HEuristic Runway Movement Event Simulation model (HERMES II) was originally developed by the UK's National Air Traffic Services Limited (NATS) in 1992 and has been the subject of a continuous improvement programme since that date. It is used as the basis for yearly and twice-yearly capacity declarations at the major UK airports to which NATS provides operational air traffic control services. Assessments for runway capacity in Summer 2000 using HERMES II have been carried out at the three BAA London airports (Heathrow, Gatwick and Stansted) and also at Manchester and Birmingham International.

HERMES II can be used for single and multiple runway airports operating in both segregated and mixed mode. It has been designed to reflect features of runway operations for which other airport simulation models do not cater. NATS' capacity assessment methodology, which includes HERMES II, is based on detailed study of actual operational data including measurements taken during visual observations of airport operations by scientific personnel.

4.5.8.2.   Landside

A few landside simulation tools share the market. All of them allow terminal representation in great detail and take security (screening equipment and passport control procedures), passengers flow, baggage handling and cargo facilities into account. In order to model an environment, a simulation tool needs data, like airport layout or airline schedules. Users typically input the data by entering a computer aided design system to define the layout, and then adding passenger flow data. An animated display simulates an operation. This may show up bottlenecks at certain times during check-in or baggage handling. New conflicts like increased baggage or late arriving aircraft can be added to see how a given system would cope.

4.5.8.2.1.   ARTS (AiRport Terminal Simulation)

ARTS' major domains of interest are the airport terminal building and passenger processing procedures.

ARTS is used mainly by Massport, the Massachusetts Port Authority. It has already been used to perform detailed analysis of alternative solutions for the Logan 2000 modernisation program at Massport. The project is currently in its implementation phase at Logan Airport in Boston.

4.5.8.2.2. SLAM

Simple Landside Aggregate Model is an analytical model, designed to evaluate the airport terminal level of service and to analyse queues at check-in desks. It allows the estimation of capacity and delays at airport passenger terminals.

Airport Operators use SLAM in order to evaluate Levels of Service (LOS) of infrastructures. SLAM has been applied to:

a.   Milano Linate and Malpensa (SEA).

b.   Catania (Fontanarossa).

c.   Venezia (Tessera).

4.5.8.2.3. PAXPORT

PAXPORT [59] is a landside model. It models the movement of passengers from aircraft to airport terminal entries/exits and vice versa.   The model uses a complete aircraft flight schedule (departures and arrivals) and dynamically simulates the movement of passengers, second by second. This simulation is then presented on the 2-D or 3-D layout by levels of service (density or time related), service factor (proportion of passenger time by level of service), passenger flows, delays and occupancy levels.

Airport Operators and Consultants use PAXPORT, in order to study areas such as airport terminal expansion, new terminal designs, alternative flight schedules and passenger loading tests and location of retail facilities.

4.5.8.2.4. SABRE

This simulation tool is not a specific product, but an approach to analysing systems with ARENA. It is mainly dedicated to roadways and terminals, especially passenger processes, baggage systems, people mover systems, etc.

SABRE has been used to provide consultancy studies to a number of European airports, including Berlin Schönefeld, London Heathrow and Palma de Mallorca, to model activities such as roadways/curbsides, security screening, ticket counters, holdrooms, customs & immigrations, people mover systems, trains, automated and manual baggage systems, ramp movement; multi-level facilities (escalators & elevators between levels).

4.5.8.2.5. Terminal Management System (TMS)

TMS is not really a simulation tool. It is a scheduling tool which optimises the allocation of Stands, Check-in Counters, Gates etc. It has been successfully used by some of the busiest international airports around the world, including London Heathrow, Manchester, Amsterdam Schiphol, Vancouver, Stockholm and Sydney International, with the Implementation currently underway at Hong Kong, CLK.

TMS3 provides full facilities for long term planning and on-the-day operations in a single application suite.

4.5.8.3.   Deficiencies

The best existing capacity and delay models still suffer (albeit to differing degrees) from several fundamental drawbacks. These can be classified into a small number of categories:

➢   lack of some essential features (e.g., stochasticity);

➢   lack of flexibility (e.g., a node-link structure);

➢   lack of mutual compatibility;

➢   costly and time-consuming training, learning and input preparation ;

➢   lack of common databases and utilities/tools ;

➢   existing airport and ATM models are all essentially of the "passive" and "what if..." type: they can not suggest alternatives for solving such problems (i.e., the model does not "optimise" in any sense).

The next step in the development of airport modelling tools is the integration of the airspace, airfield, passenger terminal, and landside programme applications :

➢   TAPE integrated existing tools such as SLAM, ARTS, SIMMOD and DELAYS.

➢   OPTAS provides a wide set of equations defined using System Dynamics (SD) to integrate airside and landside at a mesoscopic level of detail.

Ideally, future modelling tools should be built into standardised, integrated application modules that can be added or removed. The Eurocontrol ESME (Enhanced Simulation Modelling Environment) project aims at defining such airport modules. These modules should run on the same operating environment, use the same commands, and easily share information. This will allow modules to be added or removed depending on modelling requirements and available funds. Most importantly it will simulate activity throughout the entire airport system. The model would report the landside conditions resulting from an airside situation input and visa versa. Only then can the model realistically simulate the complex airport operating environment.

5.   CONCLUSIONS AND RECOMMENDATIONS

The OPTAS B project has provided a forum for the sharing of knowledge and opinions on airport related research from EU Member States and Associated States and from stakeholder organisations from EU and beyond. Four Workshops have formed the heart of the project. These were supported by a range of technical, administrative and dissemination activities. These included the consolidation and assessment of research study material and the preparation of technical briefing documents in advance of the Workshops, the maintenance of a project Website (www.red-scientific.co.uk/optas_b.htm) and the establishment of mechanisms for eliciting feedback from the Workshop delegates. These activities served primarily to foster lively, informed and relevant discussion within the forum provided by the Workshops.

These discussions culminated in a final wrap-up discussion at the end of the 4th Workshop, which included contributions from a specially invited panel of senior decision-makers representing a range of stakeholder organisations. This made it possible to reach a consensus on a number of key issues arising from all 4 Workshops:

➢ The need for a **top-down and system approach to the definition of research priorities**, in order to promote a common "road map" for continued research and to foster the dissemination of best practice. It is recognised that this must be managed within the international regulatory framework of ICAO, with clear direction from the European bodies, including the European Commission and Eurocontrol.

➢ The need for **standardisation** of

♦ requirements for passenger mobility and security issues

♦ safety levels procedures, with a risk based approach to implementation

♦ airport capacity models

➢ The need for **commonly agreed definitions and metrics** for:

♦ airspace and airport capacity

♦ movement rate

♦ passenger throughput

➢ The need to **remove existing barriers to communication between stakeholders.** In particular, there is widely felt to be a need to extend the concept of CDM to the harmonisation of planning over the medium and long terms and at the strategic level. This will require the establishment of channels for information exchange which do not currently exist.

➢ The need for greater flexibility in the functionality provided by the **CFMU**. In part, this concerns the greater sharing of information between airports and the CFMU.

➢ **A-SMGCS** is seen as an important enabling system for surface movement solutions, for enhancing airport capacity and reducing emissions. Its continued development and introduction into service needs to be supported by:

♦ a tangible cost/benefit analysis

♦ the establishment of a common/flexible implementation methodology

♦ contribution to AOPG PT/2 in the development of requirements

➢ The importance of current work on **Arrival, Departure and Surface Management planning tools** (AMAN/DMAN/SMAN) is recognised, but these tools need to be integrated.

➢ The role of **Eurocontrol** is key to many of these issues. Although it is recognised that Eurocontrol is working as well as possible within its present funding constraints (triple 0), it must provide sufficient resources to tackle all the priority issues adequately. The high priority items should be given equal weight and not further prioritised. More support and collaboration is required between European Commission and Eurocontrol, cutting out the red tape.

The aviation community in Europe has recognised the importance of continuing the work of OPTAS B and the European Commission is currently evaluating tenders for a Thematic Network on Airport Activities under the 5th Framework programme. This has been the first action to establish a continuing forum for information exchange.

A disappointing aspect of OPTAS B, which future activities will need to address, has been the low level of feedback from the nominated delegates and Member States. The project concept was based on a two-way flow of information between the project team and the delegates, but in practice the information flow was largely one-way.

Taking into account the conclusions summarised above, it is also important that future research activities consider:

➢ quality of service to end-users,

➢ environmental impact,

➢ access to airports,

➢ the real efficiency of the system, though a deep cost/benefit analysis,

➢ the management of en-route and airports as a network.