EATCHIP Overall Cost-Benefit Scoping Study

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STATEMENT FROM THE EATCHIP COST BENEFIT ADVISORY GROUP

The EATCHIP Cost Benefit Advisory Group (ECBAG) was established in 1994 to provide a forum for discussing all aspects of cost benefit analysis (CBA) and its application in the field of Air Navigation Services. The ECBAG consists of representatives from EUROCONTROL, member states and user organisations.

One of the primary objectives of ECBAG since its inception has been to provide an overall view of the value of EATCHIP. To this end, EUROCONTROL established a CBA specification at the end of 1996 for an “EATCHIP Overall Cost Benefit Scoping Study”; this was approved by ECBAG. From those firms responding to the subsequent tender action, ICON/Sofreavia was selected to undertake the study. The study was completed by mid-1997.

ECBAG considers the study a successful exercise; not only for the results it produced, but for the key issues it has highlighted, in particular areas where further effort should be targeted. The issues include:

- aircraft operators generally will benefit from EATCHIP, however, some user groups, e.g. military and general aviation, may not benefit from some developments; for all studies, therefore, it is important to clarify who will derive benefits and in which areas;

- the scope of CBA work should be extended beyond en-route given the gate-to-gate scope of future ATM strategies;

- the value of increased capacity is a key parameter in CBA studies; further work is required to provide values acceptable to all stakeholders that are applicable across the planning horizon of future strategies; these costs will be used in further studies;

- current cost estimates are based on extrapolation of current spending; EATCHIP domains are beginning to produce their strategies and cost estimates for completing those strategies;

- it is important to have visibility of the assumptions from which cost and benefit data is derived; this requirement will be enforced in future studies.

- it is important to have a common source of data so that states perform studies on a equal footing; EUROCONTROL is to produce a “benefits” data sheet containing common “averaged” values to be used in CBAs across ECAC; and it is also establishing a data base of common cost data for the same purpose.

ECBAG believes that the Scoping study has now served its purpose. It will not be revised as such but the evaluation will continue through the improvement of the cost estimates and the valuation of benefits. The study is being made available publicly, but it should only be regarded as a contribution to the on-going analysis and debate rather than as a final statement of the value of EATCHIP. It is considered nevertheless as a good basis for defining further CBA studies.

The key message to the reader is: treat the results and the data of the study with caution, they will be revised.

For further information regarding the study and benefit and cost data sources, contact the bureau responsible for CBA activity at EUROCONTROL:

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EXECUTIVE SUMMARY

The States of the European Civil Aviation Conference (ECAC) are investing approximately one billion Ecu each year in the maintenance and development of the European Air Traffic Control System. The volume of air traffic continues to increase and high levels of investment are expected to continue for the foreseeable future. The European Air Traffic Control Harmonisation and Integration Programme (EATCHIP) is the means of co-ordinating the investment. EATCHIP is managed by EUROCONTROL Agency and implemented by the Agency and the European States.

The overall objective of this study is to investigate the costs and benefits of EATCHIP and to demonstrate an order of merit for the programme.

The study has been carried out over an elapsed time of 4 months and within a very limited budget. It therefore uses information that is readily available. Where there is a shortage of information, the study makes assumptions, which are stated in the text. An important assumption of this study is that there are sufficient controllers to provide the services planned. Their availability seems not to be proven.

The main conclusion, based on the data gathered and the many conservative assumptions necessary to allow the Study to be carried out, is that there is a robust and positive result from expenditure on ATM. The internal rate of return on the basic investment case is calculated as 26% and 45% for the periods 1997 to 2005 and 1997 to 2020 respectively. The analysis indicates that capital expenditure could be increased from 1,000 to 4,500 Mecu per annum in the period 2002 to 2020 and the value of the investment would still remain positive.

The real value of the ATM investment is obtained from the increase in capacity.

The analysis is based on averages across the whole of ECAC. Core, congested areas are far more amenable to well-targeted expenditure than non-core areas and a CBA on the core areas can be expected to yield very high returns.

At least 66% of the current capital expenditure is on maintenance of the asset and is not avoidable. But, maintaining the asset does not automatically release additional capacity although there will be up-grades as a consequence. Capacity is released by co-ordinating and synchronising activities across the system. This is the role of EATCHIP. The corollary is that there is little cost saving from not having EATCHIP and the risk to capacity is substantial.

There is every indication that the Military and General Aviation will experience a cost as a consequence of increasing the capacity of upper airspace. First indications are that this cost is not sufficient to compromise the overall case for expenditure.

Quality Control Sheet

Quality Control		
	Signature	Date
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1. INTRODUCTION

1.1 BACKGROUND

The States of the European Civil Aviation Conference (ECAC) are investing approximately one billion Ecu each year in the maintenance and development of the European Air Traffic Control System. The volume of air traffic continues to increase and high levels of investment are expected to continue for the foreseeable future. The European Air Traffic Control Harmonisation and Integration Programme (EATCHIP) is the means of co-ordinating the investment. EATCHIP is managed by EUROCONTROL Agency and implemented by the Agency and the European States.

Users of Air Traffic Services have become increasingly concerned that the cost of service is rising and that service levels should improve. They are also concerned that investment should be effective and should provide a benefit to users in the short as well as the long term. Consequently, EUROCONTROL Agency has initiated a number of cost-benefit analyses to demonstrate the cost-effectiveness of each part of the investment.

This is the “high level” study covering the whole of EATCHIP and defining the costs and benefits overall. It is a scoping study because it was recognised from the outset that information was not available to conduct a detailed, step-by-step, analysis of the costs and benefits of the programme. It was thought, however, that it would be possible to gather existing data and interpret it to provide insights into the value of the programme and to identify further work required. This report demonstrates that the assumption was correct.

1.2 OBJECTIVE OF THE STUDY

The overall objective is to investigate the costs and benefits of EATCHIP and to demonstrate an order of merit for the programme.

1.3 SCOPE

The study covers the ECAC States, a list of which is contained in Appendix A. It deals with en-route Air Traffic Management only.

It is an assumption of the study that EATCHIP includes all monies expended on the development and maintenance of the ATM system and the improved benefits accruing therefrom.

The do-nothing case assumes that maintenance expenditure continues.

This approach is supported by the view taken by many technical specialists that, in many cases, system enhancements will be achieved only when elements of the system are replaced.

In general, the base year is the year to 31 March 1997, chosen because it represents the first full year for complete CFMU data.

The year 2005 has been chosen as the first threshold because it represents the point at which the European Air Traffic Management System (EATMS) is expected to have a significant impact on the operation and infrastructure of the system, although implementation will be gradual.

The year 2020 is the second threshold on the basis that, at that point, EATMS will have been in effect for 15 years and we may well be on the verge of implementing the next major system development.

The study is set at the level of the airspace user and service provider. It does not take a State or Governmental view of the benefits arising from the investment and its effect on air transport. As a consequence, a number of significant benefits are not included, such as:

- the economic activity generated directly and indirectly by the increase in air traffic allowed by the investment
- benefits to other industries, particularly the leisure industries, of providing air transport capacity
- benefits to aerospace manufacturing industries
- the value to passengers of a reliable and timely air transport system.

To provide some overall context for the results of the study an indication of the value of some of these benefits is provided in Section 9.

Air Traffic Services are mainly provided to commercial aviation. Each commercial entity has its own approach to business and to maximising its position. Each responds to a shortage or an increase of capacity in a way that will maximise its own position, in the short or longer term, according to a wide variety of strategies and tactics. This study, therefore, does not try to second-guess the possible commercial strategies of individual airlines. Rather, the scenarios used represent the overall response of the industry, mainly from observations of past behaviour.

1.4 LIMITATIONS OF THE STUDY

The study has been carried out over an elapsed time of 4 months and within a very limited budget. It therefore uses information that is readily available. Where there is a shortage of information, the study makes assumptions, which are stated in the text.

To-date, there has been no attempt to verify many of the assumptions through the normal processes of extensive discussion and peer-group review and the results of the work have not been iterated towards a consensus conclusion. These constraints do not imply that the study is not valid. To the contrary, assumptions are conservative throughout and the main results are thought to be robust. The reader is invited to consider the results in the light of their own experience, to test the assumptions, which are stated, and to contribute their own view to future stages of the work, which will refine the results.

Because this is an overall study, the results represent an aggregation across all the ECAC States. There are wide variations in service levels and capacity between the States and often even within a single State.

1.5 STRUCTURE OF THE REPORT

To assist the reader with the understanding of a vast and complex subject, the main report is confined to describing the scope, approach, results, conclusions and further actions. All supporting material, including the many assumptions, are provided in the appendices.

In detail the report has the following sections:

Section 2 provides an overview of the approach used to provide a cost-benefit analysis of EATCHIP. It also differentiates the study from the CBAs currently being performed at the technical domain level in EUROCONTROL Agency.

Section 3 describes the main stakeholders and their relationships.

Section 4 describes the current status of ATM in the ECAC area – the base ATM infrastructure.

Section 5 describes the principal performance and behavioural characteristics of the ATM system and those that are used to describe the costs and benefits of the overall system.

Section 6 discusses the basis of the financial analyses.

Section 7 presents the results of the CBA from all stakeholder perspectives.

Section 8 provides a sensitivity analysis and an assessment of confidence levels.

Section 9 provides some information on the indirect and induced benefits that are not included in the CBA analysis.

Section 10 draws conclusions from the CBA analysis.

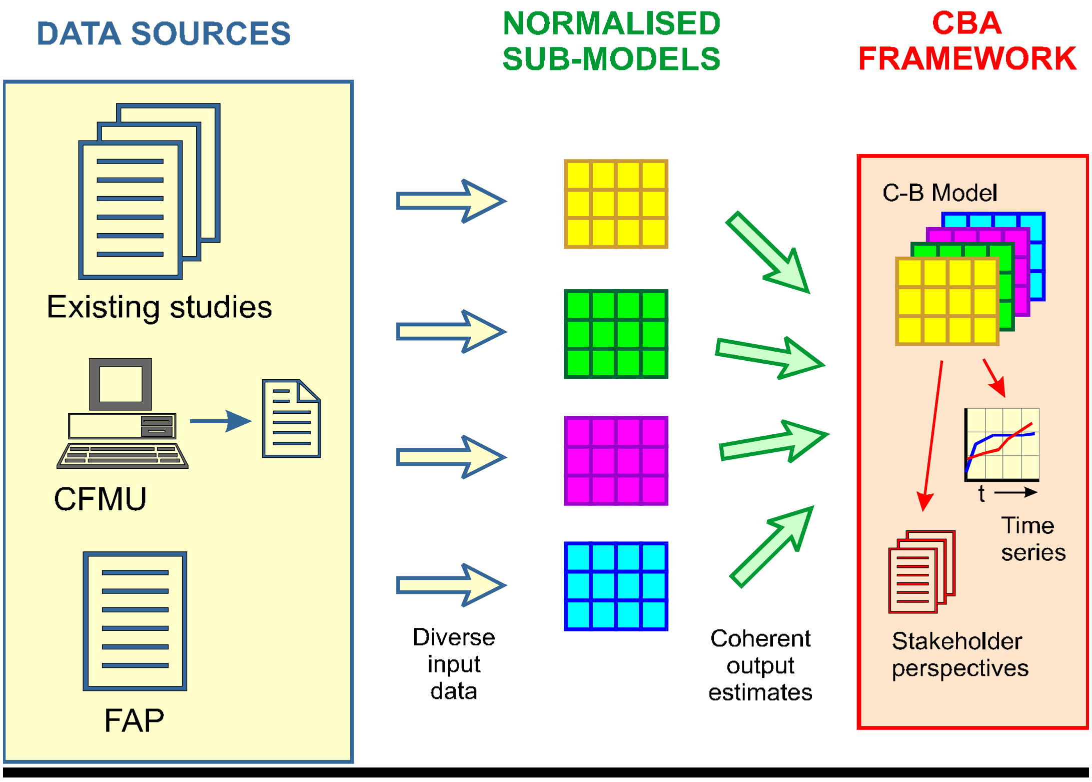
Section 11 sets out a schedule of future actions.

A set of references, shown in [ ], is provided to the many sources used throughout the report.

2. OVERALL APPROACH

The overall approach to the Study is shown in the figure below.

Figure 2-1 - Overall Approach



The study consisted of the following tasks:

- Collect existing information (e.g. Future ATM Profile (FAP) Study [1], CFMU statistics [2])
- Define the physical system at threshold dates
- Define system performance parameters
- Normalise existing information
- Define and prepare sub-models
- Combine sub-models into overall cost-benefit cases
- Evaluate the results
- Produce the Report.

2.1 THE DIFFERENT LEVELS OF COST-BENEFIT ANALYSIS

There is a fundamental difference between this study and the cost-benefit work being carried out for each of the EATCHIP technical domains.

Cost-benefit analysis for the technical domains can serve a number of purposes:

- To compare alternative technologies and assist with choosing the most cost-effective solution
- To test the effect of different technology implementation strategies
- To test the effect of technology improvement in different geographical areas
- To measure the absolute affect of initiating a change.

This study is concerned with measuring the effect of overall system changes and the performance of the air traffic system. It identifies current performance in the limited number of key areas that are of fundamental importance to airspace users. It makes a series of assumptions and measurements to project the performance into the future and measures the benefits and dis-benefits that accrue to airspace users as a consequence.

This study is concerned with establishing the overall business effectiveness of the investment and the overall performance required from the system if the investment is to be worthwhile.

It is not concerned with fine-tuning the design of future systems or with prioritising the very wide range of secondary user requirements that have been identified. These are detailed design matters that must be resolved so that they support the overall business case.

3. STAKEHOLDERS & RELATIONSHIPS

This scoping study is tasked with looking at the interests of a small set of stakeholders for whom it will be possible to prepare useful CBAs, recognising that this first piece of work is not intended to be comprehensive.

In deciding which stakeholders to include, reference was made to the EATCHIP Stakeholder Segmentation Model. The useful dimensions are sector and organisation.

The Stakeholders represented in this study are:

1. Commercial Airlines
2. Air Traffic Service Providers
3. The Military
4. General Aviation.

In addition, the study presents an overall case that combines the benefits and costs for all the stakeholders.

A detailed discussion of stakeholder segmentation is included as Appendix B.

4. THE PHYSICAL INSTALLATIONS

4.1 AIR TRAFFIC CONTROL INFRASTRUCTURE

Details of the implementation timetable of EATCHIP until 2005 are presented in the Common Implementation Plan [3] & [4] and the EATCHIP Work Plan [5]. EUROCONTROL Agency publishes these two documents, together with progress reports. They are substantial and cannot be included with this report. We therefore include an abbreviated summary in Appendix C to provide an outline of the physical installations to the year 2005 and also an extract from the EATMS OCD [6]to demonstrate the target for 2020.

Because the technical cost-benefit analyses are not yet complete, there is little information on the linking of technical improvements and benefits to the overall system.

4.2 THE COMMERCIAL AIRLINES POSITION

From reference to the RVSM CBA Study the approximate numbers of commercial aircraft flying in the ECAC area are:

Table 4-1 Commercial Aircraft Type

Commercial Aircraft Type	Nos. operating in ECAC Area
Pressurised, operating above FL290	3,282
Pressurised, operating below FL290	1,036
Total	4,318

The various avionics costs are:

Figure 4-2 Commercial Aviation Equipment Prices (Kecu)

EQUIPMENT	> FL 290	< FL 290
GPS+RAIM	93	34
B-RNAV	52	26
P-RNAV	163	0
GPS+RAIM+Nav Computer	46	74
WAAS/EGNOS/GLONASS	9	0
LAAS	3	0
LAAS (VHF)	3	0
MMR with ILS	39	0
MLS	7	0
DME-P	50	0
SATCOM (high gain)	44	20
SATCOM (low gain)	0	0
VDL TDMA	30	40
Mode S data link	20	10
ADS	20	10
ADS computer with ADS	40	20
CMU (DMU)	40	30
CPDLC	8	4
CPDLC computer	16	8
TOTAL	**683**	**276**

4.3 THE MILITARY POSITION

We have held limited discussions with NATO to determine the effect of changes to civil ATM on the Military. The result is recorded in Appendix E, the principles of which have been agreed with NATO although the statements are our own.

From reference to JANES we have established the following numbers of military aircraft in the ECAC area.

Table 4-3 Military Aircraft Type

Military Aircraft Type	Nos. registered in NATO countries in the ECAC Area
Trainers & Transport operating above FL290	1,852
Trainers & Transport operating below FL290	2,309
Total	4,161

Note: Not all of the above will need re-equipping. See Appendix E for details.

4.4 THE GENERAL AVIATION POSITION

We have had limited information exchanges with the IOPA representative at EUROCONTROL. From reference to the International Aircraft Registration Book for the ECAC countries we have established the approximate numbers of GA aircraft for the following categories:

Table 4-4 General Aviation Aircraft Type

GA Aircraft Type	Nos. registered in ECAC Area
Pressurised, operating above FL290	812
Pressurised, operating below FL290	663
Non-pressurised, operating below FL100	24,667
Total	26,142

Note: This number does not include any commercially owned (i.e. airline) aircraft as these are included in the commercial airline fleet numbers.

The different categories of GA Aircraft Type determine the type of airspace flown in. We further assume that these aircraft would wish to receive the same type of service and benefits available to the commercial airlines and hence the level of avionics fit required is similar to the commercial aircraft.

Appendix D is provides for further discussion.

5. THE PERFORMANCE PARAMETERS

Costs and benefits are driven by the performance of the system. The most important criteria for measuring the performance of the system are the following:

- Safety
- Traffic growth
- Costs of Air Traffic Services
- Cost of delays
- Flight efficiency
- Value of a flight
- Cost of Avionics.

The first 5 of these criteria were identified in the preparation of performance indicators for the European Air Traffic System as reported in Making Europe Fly [7].

It is a feature of this Scoping Study that the value of a flight is used to demonstrate the value of capacity.

The EATMS targets as stated in the Mission Objectives and Strategy Document [8] are to provide by the year 2015 an increase in capacity of 121% and an increase in ATM productivity of 100%. The assumptions in this study (e.g. fixing costs, etc.) give a capacity increase of 115% and a productivity increase of only 60% by that date. Thus the study result is conservative compared to the EATMS targets.

A number of other criteria were identified in the EATMS User Requirements document [9], perhaps the most important being flexibility and the ability to respect the requirements of the military. Most of these requirements cannot be quantified at present and are not included. The response to the military is discussed in Appendix E.

Details of the assumptions made are set out in Appendix F. The following sections demonstrate the effect of the assumptions in the period to 2020.

5.1 Safety

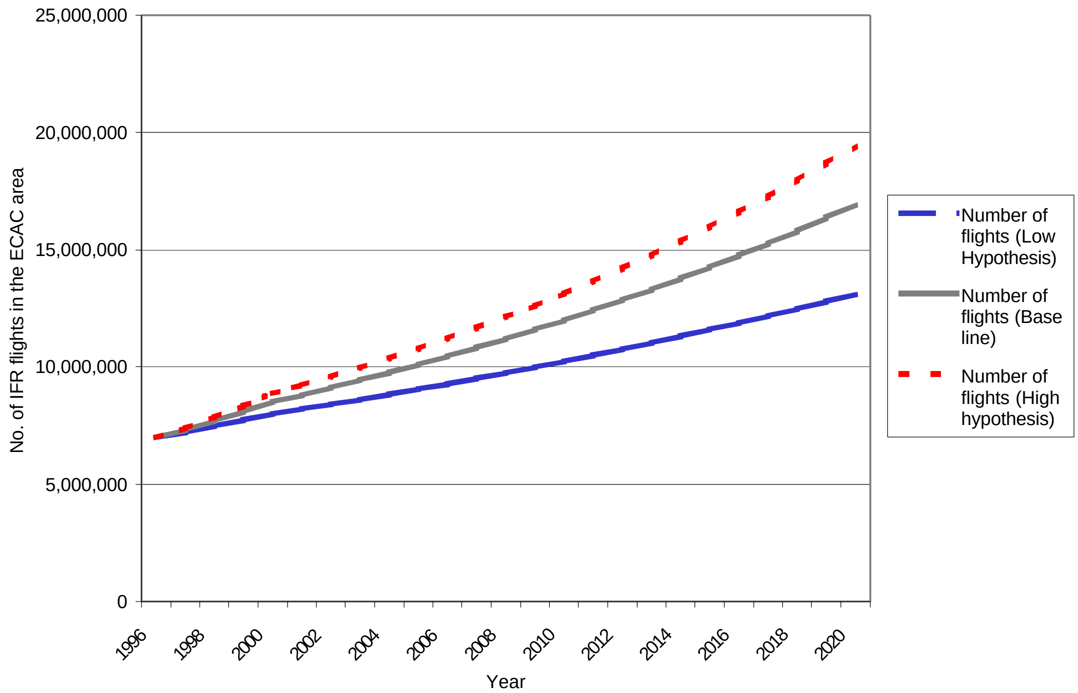
The whole of the EATCHIP development is predicated on maintaining and, if possible, improving, safety. This target is translated into the cost of supplying air traffic services and the capacity that the system can provide. As far as we are aware, the relationship between these parameters has not been formally established for the overall system.

5.2 Traffic Growth

The base source for traffic figures is the June 1996 STATFOR study [10].

Figure 5-1 shows the forecast traffic growth figures across the whole of the ECAC area until the year 2020.

Figure 5-1 TRAFFIC FORECAST

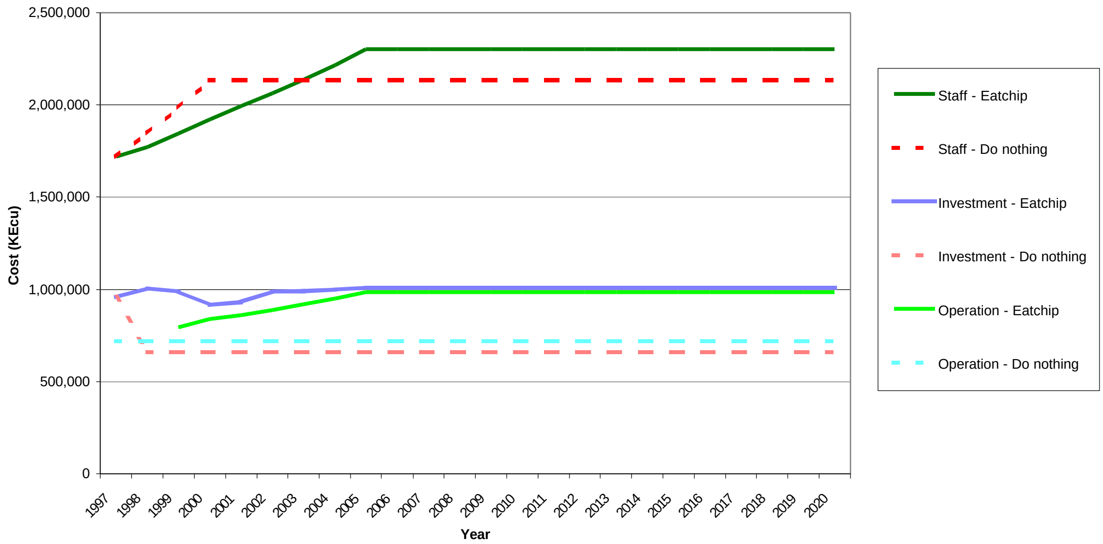


The sources for this data is EUROCONTROL's STATFOR document [10] and the OCD [6].

5.3 Costs

The costs of providing the air traffic service include both operating costs and investment costs. Figure 5-2 below shows the profile of costs to 2020 for the Do-Nothing and EATCHIP Cases.

Figure 5-2 DO-NOTHING AND EATCHIP COSTS



Description:

The source for this data is MATSE5.

EATCHIP

Up to 2001 **Staff costs** are the MATSE5/CRCO estimates; from 2001 to 2005 the costs are extrapolated from previous years trends since the majority of growth is in eastern Europe which is catching up with the rest; from 2006 to 2020, the costs been fixed at the 2005 level, as it is expected that the new systems will provide the necessary controller productivity and that increasing the number of controllers will be both unacceptable and unattainable.

The current **Investment** trend is extrapolated till the year 2005. Missing countries' expenditure to 2005 is based on the use of the one hour peak demand / capacity ratio for individual ACCs. From 2006 to 2020, the capital expenditure has been fixed at the 2005 level, as most capital expenditure is budget constrained and it is believed that the emphasis is on getting better performance from the current levels of expenditure versus increasing the level of expenditure.

Up to 2001 **Operating costs** are the MATSE5/CRCO estimates. From 2001 to 2005 the trend for the period to 2001 is used but bounded by the requirement for capacity. From 2006 to 2020, the costs been fixed at the 2005 level, as the operating costs are significantly related to the previous investments. Note: At this time there is no evidence for either increasing or decreasing these costs.

Do-Nothing

From 1997 to 2000 there will be a growth in **Staff costs** that evolves as the square of the capacity together with a differential increase of 5% in Eastern European countries' staff salaries from 1998 to 2005, as further controller productivity tools will not be available. After 2000 all staff numbers are fixed, as there is no further increase in ATM capacity.

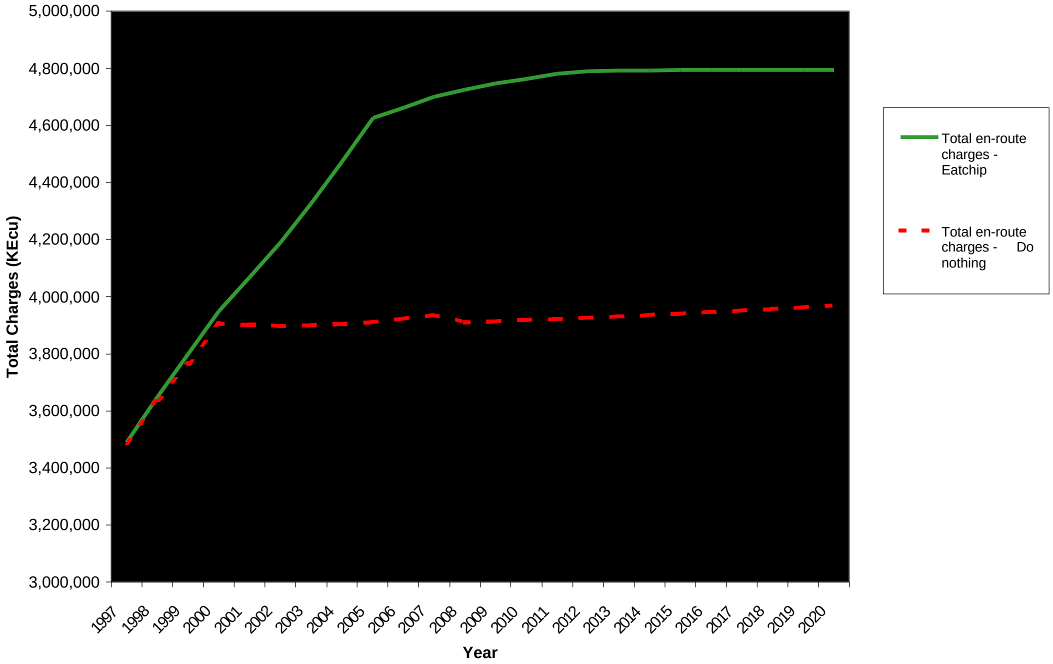
From 1998 to 2020, the **Investment** for each country is assumed to be constant and fixed at the lowest level of capital expenditure from the year 1994 to 1996, as the lowest figure is assumed to be the minimum level of expenditure necessary to replace equipment and infrastructure that has come to the end of its useful life.

Non-staff **Operating costs** are held constant at 1996 levels up to 2020, as there is no change in the set up of equipment and infrastructure.

See Appendix F for detailed discussion on the profile of costs.

Figure 5-3 shows the resulting en-route charges.

Figure 5-3 DO-NOTHING and EATCHIP TOTAL EN ROUTE CHARGES



Description:

The figures shown are a direct consequence of the data displayed in Figure 5-2.

EATCHIP

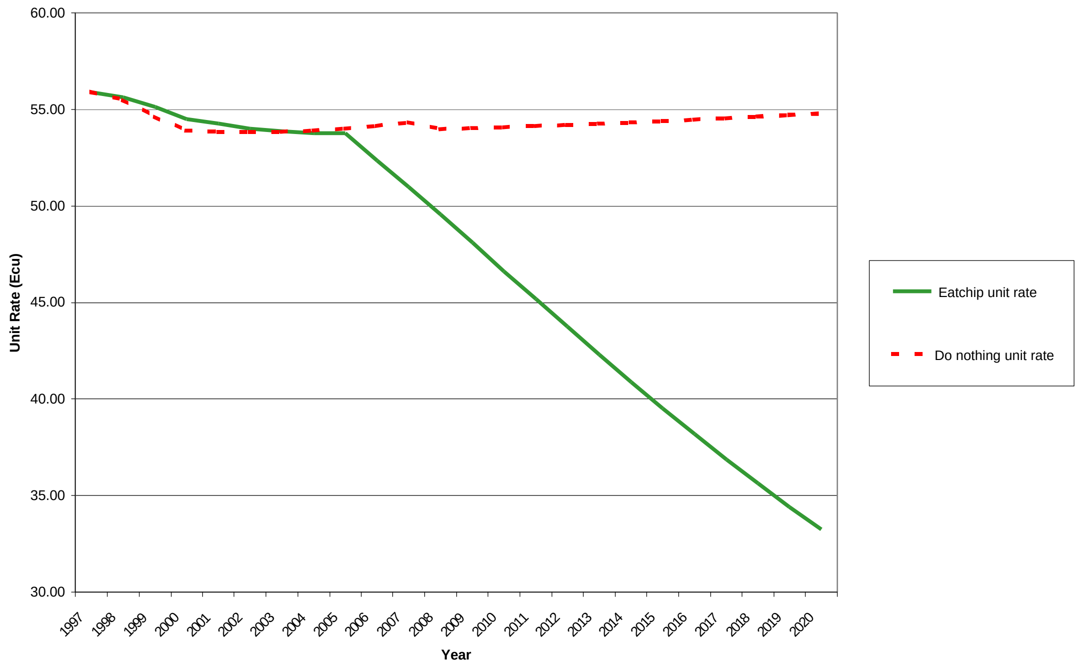
Up to 2005 the growth in Staff and Other operating costs will result in a growth in Total En Route Charges. After 2005 the constant capital expenditure from 1998 will result in a gradual plateau in the Total En Route charges in 2011.

Do-Nothing

From 1997 to 2000 the growth in Staff costs will result in a growth in Total En Route Charges. After 2000 all expenditure is fixed and the resulting total en-route charges plateau.

Figure 5-4 shows the calculated CRCO Unit Rate for the Do Nothing situation versus EATCHIP.

Figure 5-4 CRCO UNIT RATE COMPARISON



Description:

EATCHIP

Up to 2005 the growth in traffic will result in a gradual reduction in the overall CRCO Unit Rate. From 2005 the continued increase in traffic with a nearly constant total en route charge will result in an accelerated reduction in the Unit Rate.

Do-Nothing

Up to 2005 the growth in traffic will result in a gradual reduction in the overall CRCO Unit Rate to a rate less than that for EATCHIP. From 2005 the capping of traffic levels will result in a constant Unit Rate.

5.4 DELAYS

Figures 5-5 and 5-6 show the projected delays for the do-nothing case and the EATCHIP cases across the whole of the region until the year 2020.

Figure 5-5 AVERAGE DELAY PER MOVEMENT

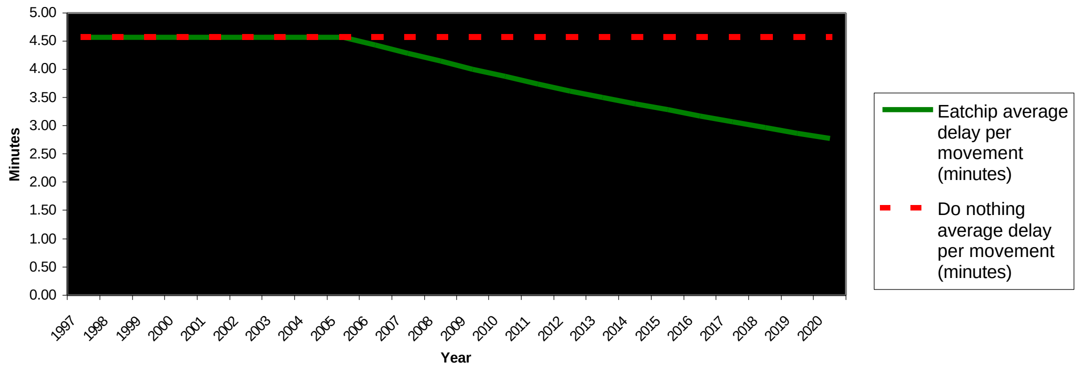
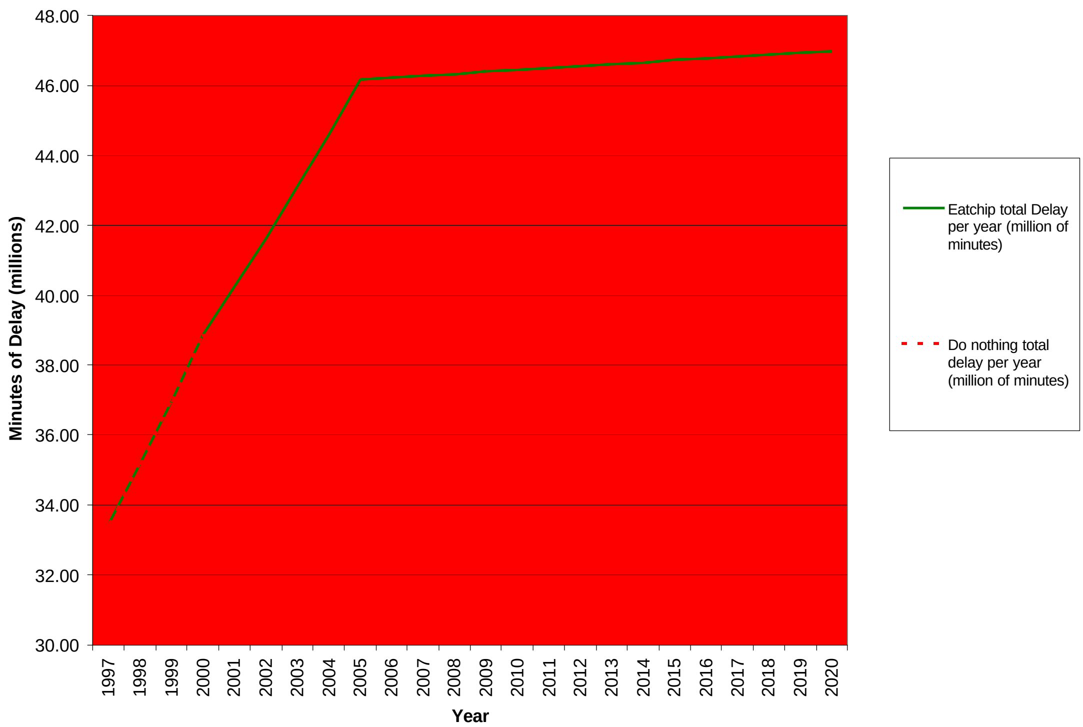


Figure 5-6 TOTAL DELAY PER YEAR



Description:

EATCHIP

Delay/movement is held constant at the 1996 level till the year 2005 due to CFMU actions and the ability to increase capacity. Thereafter it is assumed that after 2005 delay decreases linearly until 2020, when it reaches a level which is the “1997 off-peak residual delay per movement” applied to the 2020 number of movements.

Do-Nothing

> Delay/movement is held constant at the 1996 level till the year 2000 due to CFMU actions and the ability to increase capacity. From 2000 onwards the delay per movement is constant because the demand is fixed and constrained by the capacity.

See Appendix F for detailed discussion on the profile of delays.

5.5 Flight Efficiency

Flight efficiency refers to the effects of direct routes and improved vertical profiles. Please see the overall cost-benefit spreadsheet in Appendix I for the benefit profiles.

5.6 Value of a flight

It is a basic assumption of this study that additional flights have a value to the airlines and the airlines require additional capacity in order to exploit that value. The calculation of the value is based on the requirement of each flight to cover its direct operating cost and also make a contribution to the overhead of the company. It is this contribution to overhead that is used as the value of extra flights. The figure used is 1,570 Ecu per extra flight.

A detailed discussion of the value of a flight is included as Appendix G.

6. BASIS OF THE FINANCIAL ANALYSIS

6.1 Discount Rates

There are two ways of looking at investment in the Air Traffic Management infrastructure:

i). As a part of the public provision of transport infrastructure for the public good in the same way that, historically, roads and railway track have been provided. In this case the investment is competing with other government budget items for monies from the public purse.

ii). As an infrastructure for supporting commercial activities. In this case the cost of providing and operating the infrastructure is eventually borne by the commercial operator. The operator will be concerned that:

- the benefit of the investment is justified compared to the other projects in which he could be investing his funds
- the return on the investment is at least equal to the return available from investment in other industries.

Discount rates used in the calculations are 4.5% for Government investment and 10% for commercial investment. Both rates will give a slightly conservative result. The logic for these rates is set out in Appendix H.

We believe that the technically correct discount rate is that for commercial investment on the basis that airlines have to behave in a commercial manner and their shareholders will expect commensurate returns for the risks being carried. However, summaries for the Military are presented using the 4.5% rate. All spreadsheets in Appendix I are presented using the commercial rate.

All cost-benefit calculations are carried out using real rates of return i.e. the discount rate. The costs and the benefits are calculated in 1996 figures without inflation.

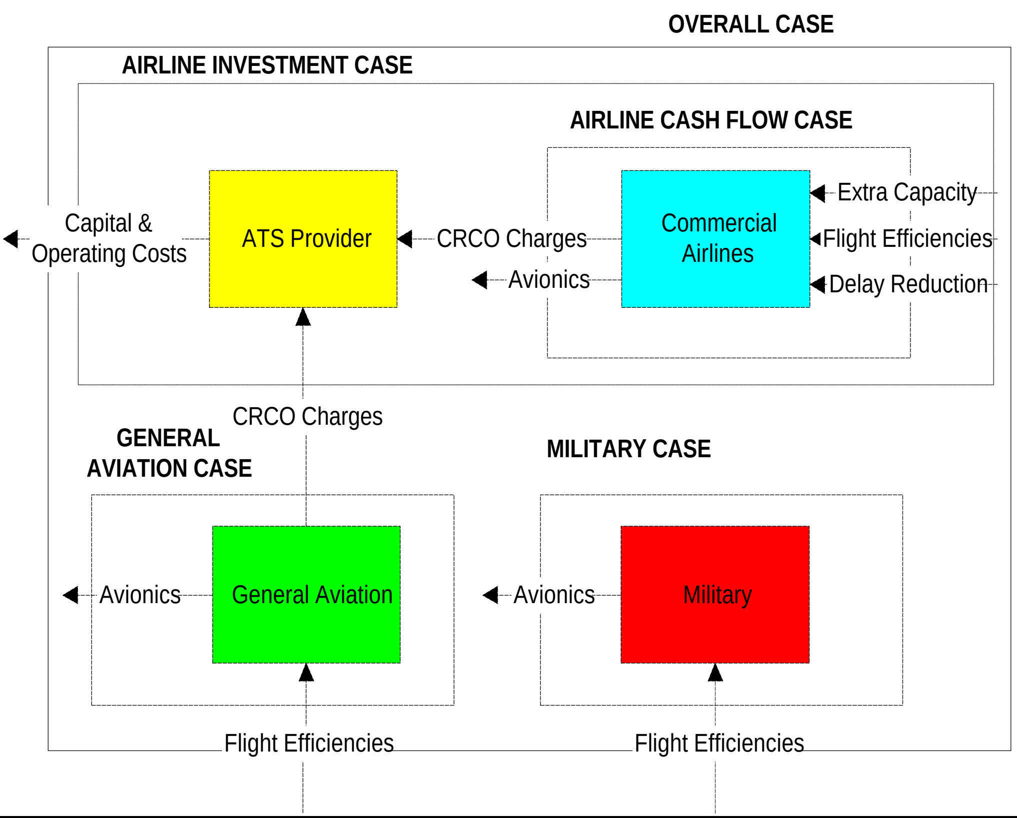
6.2 THE INVESTMENT CASE AND THE CASH FLOW CASE

During the study it became clear that there are two ways of looking at the airline and GA cases and the overall cases - see Figure 6-1:

- As a normal financial analysis that is concerned only with the flow of expenditure (ATM and Airline avionics) and benefits - **The Investment Case**
- On the basis of the actual charges that the users can expect to pay through CRCO - **The Cash Flow Case**.

The results of both analyses are presented.

Figure 6-1 Investment and Cash Flow Cases



7. PRESENTATION OF RESULTS

All figures represent the difference between the situation without EATCHIP and the situation with EATCHIP, i.e. additional costs and benefits. The current costs and the current benefits of the ECAC ATM system are not presented in the figures.

In the following sections, results are presented for each of the Stakeholders. These are presented as values for:

- the two periods, 1997 to 2005 and 1997 to 2020, and
- as snapshots in the years 2005 and 2020.

In section 8 the sensitivity of the Investment Case is analysed for variations in the parameters. All figures are presented in MEcu. See Appendix G for the set of yearly figures.

7.1 THE AIRLINES

7.1.1 The Airline Investment Case

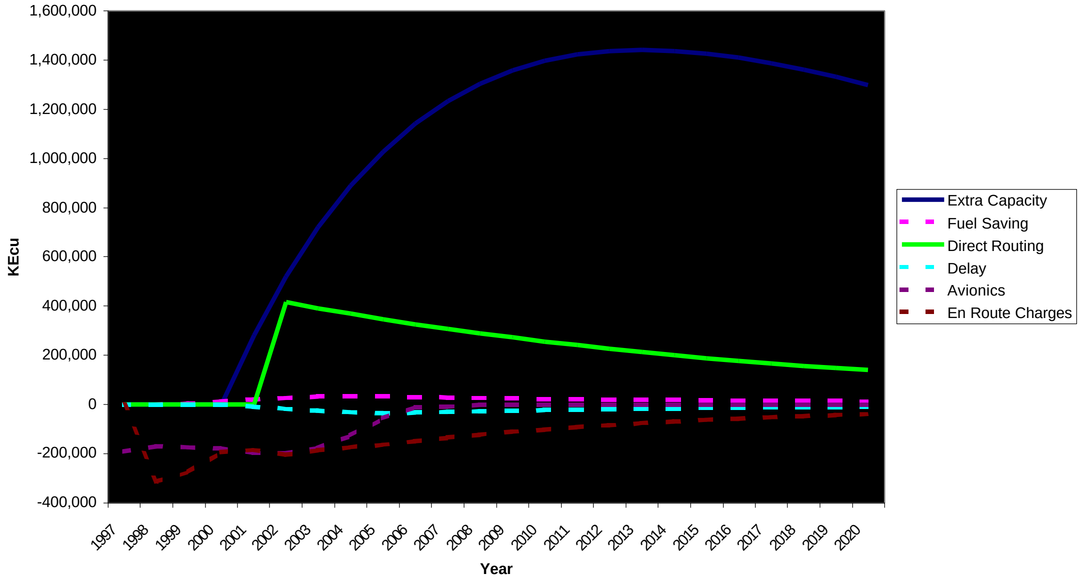
The discount factor used is 10% unless otherwise stated.

Table 7-1 - The Airline Investment Case

Period	1997-2005	1997-2020
Overall NPV	1,473	22,507
NPV of Costs	3,652	6,623
NPV of Benefits	5,125	29,130
Rate of return at which NPV is zero (IRR)	27%	45%

Year Snapshot	2005	2020
Cost in Year	972	793
Benefit in Year	3,016	12,989

Figure 7-2 DISCOUNTED DIFFERENTIAL COSTS AND BENEFITS



Description:

The discounted value of Extra Capacity increases significantly from the year 2000 to a maximum 2013, thereafter gradually declining. The extra capacity provided with or without EATCHIP is the same until 2000. The value of the extra capacity eventually declines as the increase in capacity per year (approx 4.5%) is less than the discount rate of 10%.

The discounted value of Direct Routing starts dramatically in 2001 and peaks in 2002 with the reorganisation of the route structures, thereafter gradually declining.

The discounted value of Fuel Saving starts in 2000 and is maintained by the increasing number of flights which benefit from improved profiles.

The discounted differential cost of delays increases until 2005, thereafter gradually declining as the average delay declines.

The discounted differential cost of avionics increases to a peak in 1998 and gradually declines to 2006 when the equipage is complete.

The discounted cost of the differential CRCO charges remains fairly constant until 2005, thereafter gradually declining as the total charge are nearly constant after 2005.

7.1.2 The Airline Cash Flow Case

Table 7-3 - The Airline Cash Flow Case

Period	1997-2005	1997-2020
NPV	2,234	23,179
NPV of Costs	2,791	5,951
NPV of Benefits	5,125	29,130
Rate of return at which NPV is zero (IRR)	44%	57%

Year Snapshot	2005	2020
Cost in Year	897	892
Benefit in Year	3,016	12,989

By comparison with the Investment Case, it can be seen that the Cash Flow Case gives a more favourable result.

7.2 THE MILITARY CASE

The discount factor used is 4.5%.

Note: Only the Investment Case is presented as the military are exempt from en route charges.

Table 7-4 - The Military Case

Period	1997-2005	1997-2020
NPV	-816	-672
NPV of Costs	866	892
NPV of Benefits	50	221
Rate of return at which NPV is zero (IRR)	Negative	Negative

Year Snapshot	2005	2020
Cost in Year	47	0
Benefit in Year	17	29

7.3 THE GENERAL AVIATION CASE

Table 7-5 - The General Aviation Case

Period	1997-2005	1997-2020
NPV	-253	-155
NPV of Costs	343	440
NPV of Benefits	91	284
Rate of return at which NPV is zero (IRR)	Negative	Negative

Year Snapshot	2005	2020
Cost in Year	49	25
Benefit in Year	44	73

7.4 AIR TRAFFIC SERVICE PROVIDERS

Air Traffic Service Providers do not experience a cost or a benefit from EATCHIP unless there are distortions caused by the CRCO charging mechanism. Given that the basis of the CRCO mechanism is a full cost recovery and that there are adjustment mechanisms for over and under recovery year-by-year, the scope for distortion should be limited and negligible overall.

7.5 COMBINED CASE USING THE "INVESTMENT" CASE

The combined case is created by adding the Airlines Investment Case, the Military and General Aviation.

Table 7-6 - The Combined Investment Case

Period	1997-2005	1997-2020
NPV	545	21,738
NPV of Costs	4,707	7,790
NPV of Benefits	5,252	29,528
Rate of return at which NPV is zero (IRR)	16%	38%

	2005	2020
Cost in Year	994	917
Benefit in Year	3,077	13,091

The cost-benefit calculation does not take account of the benefits that are accruing from EATCHIP as the result of activity before 1997.

8. SENSITIVITY ANALYSIS AND CONFIDENCE LEVELS

The Investment Case gives the smaller return on the Programme and is used in the paragraphs below to demonstrate sensitivity and confidence levels.

8.1 TRAFFIC GROWTH

The figures presented are for the STATFOR baseline hypothesis. For other traffic levels, the benefits change, but so also do the delays. This study does not predict the relationship between the two and hence there is no sensitivity analysis on traffic levels.

8.2 COST OF AIR TRAFFIC SERVICES

Costs are Operating Cost, Staff and Capital Investment.

Table 8-1 - Sensitivity Of Cost Of Air Traffic Services

Value	NPV change to 2005	NPV change to 2020
Assumed less 10% p.a.	+11%	+1.7%
Assumed (EATCHIP 4,000 Mecu)	0	0
Assumed plus 10% p.a.	-18%	-2.5%

Confidence Level:

High for capital investment in the short term on the basis of planned expenditure. There are no formal estimates for the cost of EATMS. However, the figures used for investment over the EATMS period (2002 to 2005 = 13,000 MEcu) compare well with other studies (ATLAS = 11,000 MEcu).

In general, assumptions maintain the CRCO unit rate nearly constant, which is in tune with commercial pressures.

It has been calculated that investment can be increased substantially after 2002 and the NPV will remain positive:

- For the 2005 Case, the investment can be increased by 500 to 1,500 MEcu per annum in the period 2003 to 2005
- For the 2020 Case, the investment can be increased by 3,500 to 4,500 MEcu per annum in the period 2003 to 2020.

8.3 DELAYS

Table 8-2 - Sensitivity Of Delay

Value	NPV change to 2005	NPV change to 2020
Assumed less10% p.a.	+23%	+3%
Assumed (Rises to 4.36 minutes per flight in 2005 then reduces to 2.78 in 2020)	0	0
Assumed plus10% p.a.	-30%	-5%

Confidence Level:

Good confidence in the ability of CFMU to hold delays on the ground and therefore control the cost.

Good confidence in the ability of CFMU to maintain equity of delay.

The figure used is 20 Ecu per minute of delay (source IATA). In reality there is not a linear relationship between the length of a delay and the total cost of a delay (a 1 minute delay costs less than a sixtieth of an hour's delay). We have a concern that the cost of delay may be over-stated, but see below.

It is possible that some of the benefit from improving delays is actually the result of increasing airport capacity and this amount cannot be identified. However, delay reduction contributes only 1.4% to the total benefits in both 2005 and 2020 and therefore any inaccuracy is not significant.

In the long term, confidence is based on the ability of EATMS to deliver. It is not in the scope of this study to assess the likelihood that EATMS will deliver the capacity required.

8.4 Flight Efficiency

Flight Efficiency is the result of more efficient vertical profiles and Direct Routing.

Table 8-3 - Sensitivity Of Flight Efficiency

Value	NPV change to 2005	NPV change to 2020
Assumed less10% p.a.	-10%	-1.9%
Assumed (Approx. 700 MEcu p.a.)	0	0
Assumed plus 10% p.a.	+10%	+1.9%

Considerable work by others [11] & [12], has been put into estimating the potential flight efficiencies and there is a high level of confidence in the resulting value.

8.5 VALUE OF A FLIGHT

Table 8-4 - Sensitivity Of Value Of A Flight

Value	NPV change to 2005	NPV change to 2020
-10%	-25%	-11%
Assumed (1,570 Ecu /flight)	0	0
+10%	+25%	+11%
Other Studies' assumptions [15]	-200%	-87%
Other Studies' assumptions	+224%	+97%

Confidence level:

The upper bound average for all European carriers on all routes is 1,757 Ecu (Ref. Derived from AEA). Calculated lower bound figure on the basis of changing the ratio of fixed to variable costs is 988 Ecu. The lower bound figure reduces the NPV to almost zero.

On the basis of the calculations used, an estimate was made to examine the effect of doubling the fleet size but keeping the overhead constant. This produced a value of 753 Ecu per flight and would be realised some time around 2015. With this increase in industry size it is reasonable to assume that the overhead would increase, thus moving the figure towards the lower bound of the 1995 figure.

The values are based on 1995 operating conditions, which could be threatened by competitive changes in the industry.

Of all the figures used in this study, the value of a flight is the most sensitive and the least well understood. It is important that industry gives the value further consideration if an appropriate level of ATM investment is to be achieved.

8.6 COSTS TO THE MILITARY

There is little detailed information on the cost of fitting avionics to military aircraft and more detailed work is required. Although the number of aircraft is thought to have been identified reasonably accurately, the cost of fitting avionics could be substantially higher than assumed, although these are not fighter aircraft. See Appendix E for details.

8.7 Discount Rate

Table 8-5 - Sensitivity Of Discount Rate

Value	NPV change to 2005	NPV change to 2020
Assumed less 10%	+11%	+16%
Assumed (10%)	0	0
Assumed plus 10%	-10%	-13%

Confidence level:

The calculation of the rate and its application is thought to be technically sound.

8.8 Comparison with other studies

INSTAR [13] identified an ATM performance improvement potential of approximately 2.4 – 2.9 billion Ecu per annum. This was broken down into:

- Delays 1,200 - 1,700 MEcu
- Route inefficiency 600 MEcu
- Cost inefficiency 600 MEcu

By comparison, this scoping study:

- Uses the total value of additional flights of 2,205 MEcu in 2005
- Identifies the value of flight efficiency, including improved vertical profiles, in 2005 as 740 MEcu
- Holds staff costs constant from 2005 onwards giving an implied productivity gain, with the help of technology, of 60% in 2015. On 1995 volumes this is worth more than 1,000 MEcu per annum but will not be achieved in the short term.

9. FURTHER BENEFITS

An increase in aviation activity has impacts on a number of levels:

- The direct impact measured as the direct revenue accruing from the activity
- The indirect impact such as revenues and employment in tour operator companies and hotels
- The induced impact by which there is a multiplier effect on the regional economy from direct and indirect impacts.

This study considers only the direct impact of additional aviation capacity as a benefit. AACI estimate that indirect and induced impacts can account for twice as much again. It is estimated that the value of additional revenue between the years 1997 and 2005 is 64,000 MEcu and between 1997 and 2020 is 1,196,000 MEcu. Applying multiplier effects to these massive numbers far outweighs the direct benefits.

10. CONCLUSIONS

These conclusions are based on the data we have gathered and the many assumptions necessary to allow the Study to be carried out. The assumptions of this scoping study are intended to be conservative throughout.

1. There is a robust and positive result from expenditure on ATM. The internal rate of return on the basic investment case is calculated as 26% and 45% for 2005 and 2020 respectively.

2. The real value of the ATM investment is obtained from the increase in capacity.

3. The analysis indicates that capital expenditure could be increased from 1,000 to 4,500 Mecu per annum in the period 2002 to 2020 and the value of the investment would still remain positive.

4. The analysis is based on averages across the whole of ECAC. Core, congested areas are far more amenable to well-targeted expenditure than non-core areas and a CBA on core areas can be expected to yield very high returns.

5. At least 66% of the current capital expenditure is on maintenance of the asset and is not avoidable. But, maintaining the asset does not automatically release additional capacity although there will be up-grades as a consequence. Capacity is released by co-ordinating and synchronising activities across the system. This is the role of EATCHIP. The corollary is that there is little cost saving from not having EATCHIP and the risk to capacity is substantial.

6. There is every indication that the Military and General Aviation will experience a cost as a consequence of increasing the capacity of upper airspace. First indications are that this cost is not sufficient to compromise the overall case for expenditure.

7. The case relies on the value of a flight. This is not a well-tested concept and should be subjected to wide debate. It is probable that there will be different interest groups amongst the airlines, some of whom may not welcome the addition of capacity but would rather achieve a greater profitability from their existing operations.

8. It is an assumption of this study that there are sufficient controllers to provide the services planned. Their availability seems not to be proven.

11. NEXT ACTIONS

11.1 CONFIRM ASSUMPTIONS

i). Consult with interested parties to obtain feedback on the report and conclusions, edit report accordingly and plan future developments arising.

ii). Produce a more developed and agreed view of the value of a flight in the context of the value of extra capacity.

iii). Consider the split of delay between airports and en-route airspace so that there is a clear understanding of the limitations imposed by a shortage of airport capacity.

iv). Confirm that controller availability will allow capacity to be added and that controller workload assumptions are well founded.

v). Examine the relationship between the level of safety of the future system and the cost of its provision. Confirm that current assumptions are not at risk from the need to enhance levels of safety to maintain the headline rate with the increased traffic levels.

vi). Investigate the relationship between the time of a delay and the cost per delay.

11.2 FOCUS AND PRESENTATION

i). Prepare clear and presentable material for different audiences.

11.3 UPDATE

i). Formalise and check the links between the physical infrastructure and cost and benefit delivery in the light of the technical strategies.

11.4 INTEGRATION WITH THE TECHNICAL CBA'S

i). Prepare the benefits stack so that the sub CBA calculations being carried out by the domains do not claim more than 100% of the benefits.

ii). Prepare a full cost build up from the technical CBA's.

iii). Make comprehensive statements about the sequence of implementation and tighten up the match of cost, benefit and implementation.

iv). Review the capacity and delay figures to take account of airspace changes, FUA and new route structure, in the period 1998-2000. To do this effectively it will be necessary to consider the system in parts rather than in aggregate as in this study.

v). Test the sensitivity of the CBA against the timing of investment in avionics and the effect of bringing activities forward.

11.5 DEVELOPMENT

i). Break out the overall figure by core and non-core areas.

ii). Make a more formal comparison with the US and New Zealand so that we can understand how the performance of the system might, quite rightly, be different.

iii). Identify the number of General Aviation and military aircraft not based in Europe and flying in European airspace and equipping accordingly.

iv). Consider the effects of competitive changes in the industry on the overall cost-benefit case.

v). Consider the effect of changes to the timing of ATM developments on the cost-benefit case.

vi). Extend the study to include gate-to-gate.

vii). Use the analysis to assess the effect of overall performance standards for ATM.

viii). Form a more complete and quantified view of the military position.

ix). Form a more complete and quantified view of the General Aviation and Regional Airline position.