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COMMISSION STAFF WORKING DOCUMENT

Annex to the

Proposal for a Council regulation on the establishment of a Joint Undertaking to develop the new generation European air traffic management system (SESAR)

IMPACT ASSESSMENT

{COM (2005) 602 final}

Executive summary

The Single European Sky legislation has been adopted in March 2004. It provides an in-depth reform of the institutional organisation of air navigation services in Europe.

Modernisation of the technical infrastructure has now become an urgency: in the last 5 years, 3 major accidents, due to Air Traffic Control, took place in Europe, with nearly 200 deaths. The technologies used for such a safety critical domain are coming from the 1970s, or even 1950s., and they will not sustain the expected air traffic increase, which is an important driver of Europe's economic growth.

Modernisation programmes have not succeeded in the past, although considerable effort and resources were devoted to the initiatives, in Europe and the USA; this is mainly due to the programmes dispersion and the lack of proper decision-making mechanisms, in a field which assembles private, corporatised or state air navigation service providers, airspace users as diverse as network carriers, general aviation or low fare airlines, military, manufacturing industry, etc…

SESAR is the Air Traffic Control modernisation federating programme for Europe. The proposed Council regulation, subject of this impact assessment, establishes a governance structure for SESAR, which would guarantee management consistency, and be an appropriate vehicle for public-private partnership.

The Cost Benefit Analysis, undertaken through an external contract, and which gave ample opportunities for stakeholders to provide input, comments and guidance, shows that the proposed option, which is to set up a SESAR Joint Undertaking, provides major benefit over a 'do nothing' or 'non EU intervention' option:

The impact on air transport safety has been assessed to be very high

The financial analysis shows a Net Present Value of 20 billion €.

The Economic analysis shows that SESAR is likely to have a substantial contribution to Europe economic growth, and will enable, through increased efficiency in transport activities and global leadership of the European aeronautical sector, substantial employment creation in Europe.

The environmental assessment shows a significant improvement in individual flights environmental efficiency, even if an overall growth in air traffic will outweighs this improvement and necessitate further measures to address environmental impact.

The proposed regulation also appears to be a perfect application of the Lisbon strategy, by fostering innovation in Europe, creating high added-value jobs, and improving competitiveness of the European industry (on this last point, the USA have launched a similar initiative, which would result in massive competitive advantages to US industry under the 'do nothing option').

Section 1: Procedural issues and consultation of interested parties

Organisation and timing

The impact assessment was subject to a contract with an external consultant, which was awarded after an open competition.

This contract focussed on the Cost Benefit Analysis of SESAR, and on the review of potential governance arrangements.

The study was organised in two main phases, the first phase being devoted to information gathering, and the second to analysis.

Consultation and expertise

Due to the high level of interest of the industry in this impact assessment study, the Industry Consultation Body, a group which has been formed according to regulation (CE) 249/2004 and which gathers representatives from all the ATM (Air Traffic Management) industry (Airspace users, Air Navigation Service providers, Airports, Staff representatives, manufacturing industry,…), decided to create a specific subgroup which would follow closely the work of the external consultants.

This subgroup comprised 23 members, providing a representative sample of ATM stakeholders, and met with the consultants both at bilateral meetings, and in plenary subgroup meetings.

The ICB subgroup met four times, at significant milestones of the project, in order:

(1) To discuss and review the methodology of the study

(2) To validate the different cost benefit analysis scenarios

(3) To discuss the preliminary findings

(4) To discuss and review the results of the study.

In order to have a wide stakeholders consultation, the Commission decided to organise a workshop to present the results of the study, open to members of the two bodies established under the Single Sky legislation (Single Sky Committee and Industry Consultation Body), made respectively of the Member States and industry. This workshop took place on June 15th, 2005, with 67 participants from the two bodies.

The external study identified a number of development scenarios for SESAR, and a number of possible governance structures.

The development scenarios were (these scenarios will be discussed in detail in the following paragraphs):

– Base case: “do nothing” scenario: development of the air traffic management infrastructure according to the existing plans and working arrangements

– Scenario 1: base case with an accelerated implementation of technological changes

– Scenario 2: Scenario 1 with rationalised developments

– Scenario 3: Scenario 2 with accelerated development.

The governance scenarios were:

– Base case: a very light governance structure leaving decision making, management and funding arrangements effectively unchanged-"do nothing" scenario

– Scenario 1: a joint undertaking, which manages common parts of the programme, and leaves it to local entities to deal with local implementation

– Scenario 2: a centralised entity which develops and implements all the ATM infrastructure in Europe.

The results of the study show that development Scenario 2 has a Net Present Value (NPV) (compared with the base case) of 21 billion €, Scenario 3 a NPV of 23 billion €. It also recommends choosing the governance Scenario 1, that is, to create a SESAR Joint Undertaking to manage the programme.

Section 2: Problem definition

What is the issue or problem that may require action?

Air Traffic Management is the art of making sure that flights are safe and efficient. Given the speed of the aircraft, the fact that they cannot stop without falling, these simple principles require a high degree of organisation and anticipation.

Hence, the air traffic controllers, who are human operators on the ground, organise traffic flows in such a manner that trajectories interact safely, through the communication of instructions to pilots on board the aircraft.

The technology used in air traffic control has changed little over the last 30 years and is, surprisingly, quite rudimentary, and the whole system is relying heavily on the human controllers capability: most of the technologies are dating from the 1970s, with in particular a telecommunication system which is still using antique VHF (Very High Frequency) radio channels. This results in a highly inefficient system, where important safety "buffers" are necessary to compensate for technology weaknesses.

In terms of safety, although the track record for aviation safety is extremely high, the trends are not reassuring: Europe faced in the last 5 years 3 fatal accidents, of which the main cause was Air Traffic Control (Milan Linate, Paris Charles de Gaulle, Überlingen).

In terms of evolutivity, the system has now reached a stage where it is so much "handicraft-based", that it is very costly to maintain, and extremely difficult to adapt to new technologies and constraints. For instance, the incorporation of satellite navigation, which will result in massive cost savings and efficiency increase, will face important technical difficulties in the current ATM systems architecture. Another example is the implementation of security

requirements, which is extremely difficult in systems of which the architecture is more than 20 years old.

Given the forecasts for traffic growth in Europe, which show that air traffic is expected to more than double in the coming 20 years, and taking into account the long lead time necessary to adapt and maintain any aeronautical product, Air Traffic Management modernisation is urgently needed.

What are the underlying drivers of the problem?

Technology is not the main issue. The real constraint for ATM modernisation is the decision-making processes. Hence, any new piece of technology needs to be fully agreed upon by very different actors with diverse interests such as airports, aircraft operators, including network carriers or general aviation, air navigation service providers, equipment manufacturers, military, etc…This often results in deadlock situations, such as the one for a new telecommunication technology which despite being standardised by ICAO (International Civil Aviation Organisation) in the 1990s, uses pre-internet technology which is now outdated, and has yet to be implemented anywhere.

These difficulties in reaching decisions are increased by the fact that the ATM market is relatively small (60 ground systems installed in Europe, with a low renewal rate), and that therefore the market forces are not sufficient to drive auto-investment and innovation by the manufacturing industry. It is a fact that, even though around 200 million€ are injected yearly into European ATM research and development, virtually no R&D results have been actually implemented in the last 20 years.

In Europe and the USA, several attempts were made at organising large scale research and development programmes. They all failed.

In the USA, it was purely a technological problem: the main automation programme, the Advanced Automation System (AAS), took place in the 1980s, at a stage where computer science was not as advanced as it is today, and was a massive technical and managerial failure.

In Europe, the only successful programmes have been operational initiatives, restructuring the airspace for instance, which did not comprise a major technological element. In effect, the Air Navigation Service Providers as national monopolies, of which 100% of costs are reimbursed by airspace users, had little incentives to optimise their expenditures. Whenever Eurocontrol, the Inter-governmental organisation for aviation safety in Europe, tried to undertake a technological programme, it failed, because, in absence of a proper regulatory framework, Eurocontrol decisions, when taken, are not sufficiently binding, and Air Navigation Service Providers basically organise their own procurement activities with their own system suppliers, with their own constraints and requirements.

Who is affected, in what ways, and to what extent?

The inefficiency and fragmentation of the ATM system in Europe has as a primary "victim", the airspace users: they pay for investments into and operations of a system, of which the cost grows proportionally with the traffic: 7 billion € in 2004 were paid by the airspace users for ATM services in Europe.

Although delays due to Air Traffic Management have been reduced in the recent years, mainly thanks to deceleration in demand for air transport, the current forecasts show that delays will come back as soon as in 2006. These delays have a cost impact: a number of aircraft operators are obliged to build in a "delay buffer" into their schedule and hold aircraft "in reserve", which leads to less efficient aircraft utilisation.

Moreover, airspace users are clearly advocating for a rationalisation in technological developments, since they do not want to purchase equipments which are not consistently used in Europe or even around the world.

Finally, the prospect of reaching a « capacity wall » which will result in "unmet" demand and possibly paralysis of the air transport system at some stage in the near future because of ATM is seen by airspace users as a major risk for their activity.

In a context of increased traffic pressure, Air Traffic Controllers are working with tools constrained by very lengthy and difficult evolution processes, and which are now outdated: VHF radio frequencies are congested, automation support to the controller is almost inexistent, operational procedures vary enormously, controller "mobility" is virtually impossible. The fragmentation across Europe in terms of tools and operational procedures is also a major weakness of the current system.

The Air Navigation Service Providers, in a trend towards a more "customer-oriented" approach which has led to corporatisations and even privatisations in the sector, increasingly focus their strategies on short to medium term issues, thus abandoning their research and development activities to purely research establishments, and public funding.

The European ATM manufacturing industry works on a "niche" market, in which there are virtually no "off the shelf" products, since all systems are highly customised to local requirements. This results in limited reuse of developments and very high unit costs. The manufacturing industry is therefore in a basic difficulty to invest into technological innovation. This undermines their global competitiveness since their American competitors have the benefit of one, single and large size market in the USA.

The European citizens are by large the ones who will suffer most from the lack of modernisation of the European ATM infrastructure:

In terms of affordability and choice, since air traffic growth is likely to be constrained resulting in a reduction in the number of competitive choices offered to citizens,

In terms of safety, since the system is currently reaching its capacity limits, and that fragmentation can lead to severe safety issues,

In terms of ticket price and performance, since the price the airspace users pay for air traffic management services is passed on to the passengers, and that ultimately the passengers suffer from bad performance (delays, flight cancellations, …),

In terms of environment, since the current Air Traffic Management is not capable of optimising the flight trajectories, in order to reduce fuel consumption and gaseous emissions, but also in order to reduce the noise envelope of flights,

In terms of innovation capability and jobs creation, constraints on air transport development in Europe are likely to have a negative effect on the wealth of the aeronautical industry, which is today on the leading edge of technology.

How would the problem evolve, all things being equal? Does the EU have the right to act?

The Single European Sky legislation, adopted in March 2004, provides an in-depth institutional reform of the ATM field in Europe. It forces separation within Member States between regulatory activities and service provision, establishes the ground for cross-borders operations, and sets up the framework for operational and technical interoperability standards in Europe. Moreover, the Single European Sky confers extensive implementing powers to the Commission, using the "comitology" principles.

Even though the European Commission can now support the Eurocontrol processes with its regulatory instruments, this solves only one part of the problem: the instruments the Commission can use in this framework are mainly standards, which, in a market as small as the ATM market, are likely not to result in significant implementation dynamics. Moreover, piecemeal procurements will not solve the fragmentation issues, and dispersed Research and Development activities are unlikely to come up with the kind of results needed to prepare for the new generation ATM systems: the decision-making processes will still be largely inefficient, and it is likely that the ATM infrastructure will meet its capacity limits, resulting in massive un-accommodated demand and important traffic disruptions (delays, flight cancellations, flight diversions, etc…) and accidents or incidents. As the aeronautical world needs to take into account long transition processes (the A380 lifespan is 50 years!), these will last for at least 5 to 10 years, and have an overall negative impact on European economy.

These problems have been acknowledged by the ATM industry, and they are at the origin of SESAR, the "Single European Sky Implementation Programme". They have put together an impressive team of around 200 people, coming from all sectors of the industry, including airspace users, air navigation service providers, military and staff union representatives, and will, for two years, work on an "ATM Master Plan", which forms the basis for the modernisation of the ATM infrastructure in Europe. This first step, called the "SESAR definition phase" is co-funded by the European Commission under TEN-T, and Eurocontrol. It is a "première" in the world to see such a massive commitment from such a wide range of stakeholders.

Section 4: Policy options

The different policy options are the following:

(1) a "do nothing" option (or "no EU action" option), which is basically a statu quo with the current working arrangements: SESAR is then reduced to the ATM Master Plan, which is currently being developed by the industry, and the Commission supports its implementation by setting technical standards for interoperability, which can become mandatory. In short, **this scenario can be considered as a "no SESAR" scenario.**

(2) a "SESAR Joint Undertaking" option, in which a central entity is created to consolidate and manage in an efficient manner the activities coming out of the definition phase: article 171 of the Union Treaty provides with an efficient instrument,

which has been successfully used in the context of Galileo, the satellite radio navigation programme: the "joint undertaking". This joint undertaking is a legal entity, which has the flexibility to accept as members or contributors public authorities, alongside with private entities. The tasks of the joint undertaking will be a mixture of centralised management and decision-making and local procurement flexibility, provided that the local projects are in line with the SESAR objectives.

This option has been evaluated to require an overall funding of 300 million € per annum, of which 100 million € would come from Community budget (through Research and Development Framework programmes and Trans European Network), 100 million € would come from Eurocontrol, and 100 million € from the industry.

(3) a "SESAR centralised agency" option, which is basically the same as the previous option, with a reduction to the maximum extent of the local part: SESAR would deliver under this option a uniform, "one-size-fits-all" system for all ATM units throughout Europe.

This third option was discarded early in the process, since it was meeting major resistance from stakeholders.

In particular, the air navigation service providers considered that, in a field which is becoming more and more competitive, in particular thanks to the Single Sky legislation, the technical systems are a significant part of their production assets, and they want to retain at least a minimum control over this asset.

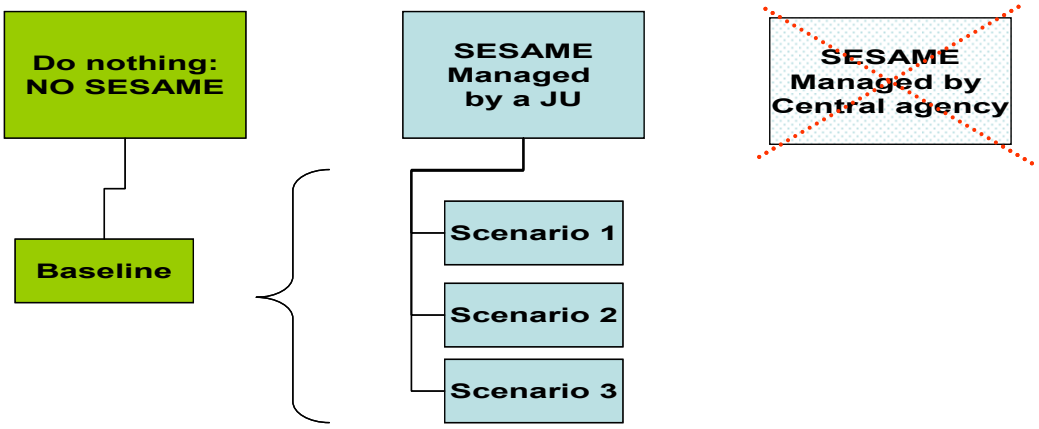
The social partners considered that, even if uniformity according to best practices could be a good thing from an end-user perspective, the transitional arrangements to arrive to this situation needed to be taken with due consideration, and, the current situation being a patchwork of very different local systems, the local part of the transition elements needed to be kept at least until a certain level of uniformity is reached.

The airspace users, whilst pushing for a uniform system, recognised the need to encourage a gradual transition process; they also warned on the technical and managerial risk involved in undertaking a unique development, for a system of such a magnitude and complexity.

The Member States were keen to see a certain degree of competition remain on the systems supply side in Europe, and the fact that transition needed to be organised properly. They also viewed such a centralised agency as duplicating numerous tasks of Eurocontrol.

The Commission also supported a gradual approach, which takes stock of local constraints and requirements.

Section 5: Analysis of impacts



The financial and economic analyses were made with reference to the base case ("do nothing" scenario, or "no SESAR" scenario). It is worthwhile noting that the do nothing scenario still assumes significant investments in ATM, and leads to capacity enhancements in Europe, but following the path which is currently used. It has been designed as a "most likely scenario" based on the implementation of existing ATM plans under existing arrangements, which imply risks of delays and of some projects not delivering all the planned benefits.

An extended EX ANTE assessment will specifically be made by the Commission, in 2007, on the basis of the detailed work programme resulting from the definition phase.

Three different development scenarios were considered:

– **Scenario 1** looked at a scheme in which, there was sufficiently strong decision-making at a European level, thanks to the Joint Undertaking, to enable to prioritise investments into new technology and therefore accelerate the implementation of such technologies.

– **Scenario 2** enhanced scenario 1 by reducing investments duplication in Europe, and undertaking joint development and procurement activities. When compared with the previous one, scenario 2 enables significant economies of scale to take place. It is worthwhile noting that the responsibility for implementing such European products would still reside with the local authorities. But the common dimension of the SESAR "products" would have a very significant impact in terms of interoperability and safety.

– **Scenario 3** was a more "aggressive" scenario, in which large upfront investments are made into new technology development, in order to further accelerate their introduction into operational service.

The impact of SESAR in these scenarios as compared to the base case results from:

– earlier implementation of concepts and technologies;

– a smaller number of parallel developments therefore reduced costs;

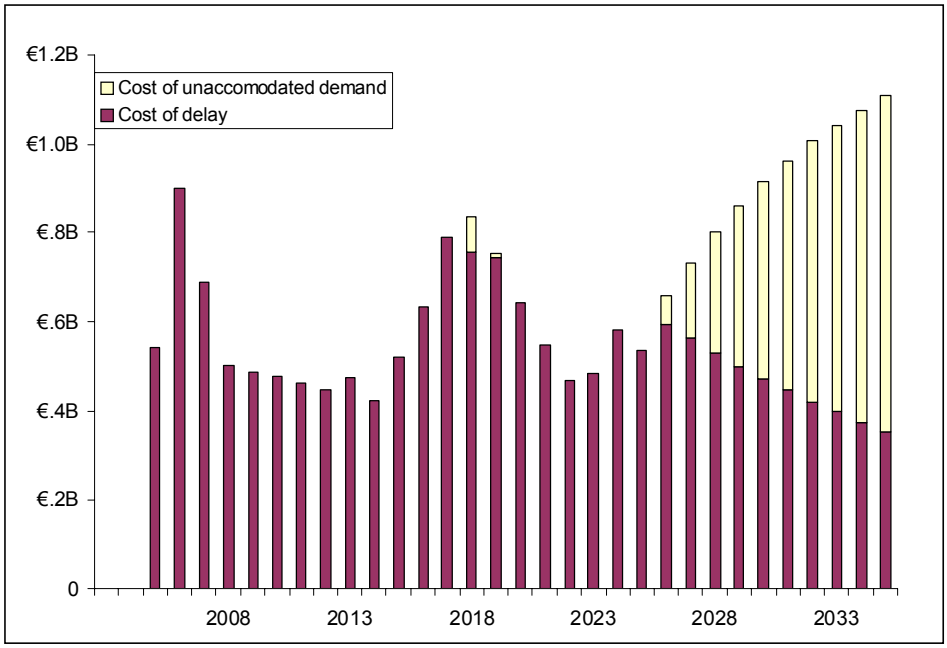
– a higher probability of delivering the planned improvements.

One important element of the analysis is the widely shared belief in the aviation community that the current working arrangements will not enable the air transport infrastructure to meet air traffic demand. This was taken into account in our analysis by comparing the projected demand with the likely capacity that the base case would deliver.

It is worthwhile noting that this "capacity wall", even if there are questions about when and where it will be reached, is to some extent already a reality: certain areas in Europe have reached their limit in terms of capacity, whereas in others there is some leeway. The analysis has considered the dates when most of the European airspace is likely to be congested, irrespective of the fact that some areas may have already reached their maximum capacity.

For illustrative purposes, an estimate of the possible costs implications of the capacity wall has been made. Based on a risk assessment of the delivery of existing programmes, the potential cost of congestion under the base case has been estimated to be 21 billion €. This calculation is composed of the cost of delays, which are foreseen to increase significantly in the coming years, and the cost of "unaccommodated demand" which are flights that cannot take place because their level of systematic delays would be operationally unbearable. It does not include the social and economic knock-on effect on the European economy.

The analysis showed that all three "SESAR" scenarios would deliver sufficient capacity to meet demand, and would therefore relieve congestion due to Air Traffic Management and sustained traffic growth.



Due to the uncertainty surrounding the capacity wall, this "congestion cost" has not been taken into account in the financial cost benefit analysis below.

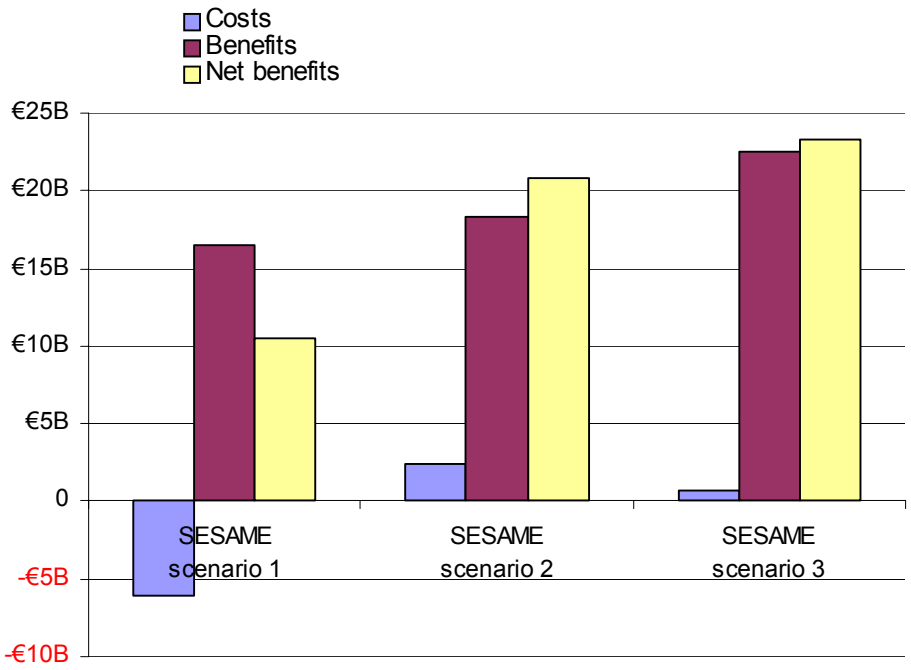
Financial Cost Benefit Analysis

Figure1 shows the Net Present Values (NPVs) of the **incremental** financial costs and benefits of the SESAR programme scenarios compared to the outputs of the Base Case; all scenarios are expected to provide a net financial benefit. Hence the 'costs' are the additional costs of SESAR in present value terms, in addition to a small additional management charge of a new

organisation. This is primarily because SESAR brings expenditure forward, and in present value terms it is more costly.

The assumed lower implementation cost of SESAR programme Scenarios 2 and 3 make its costs in aggregate lower than the Base Case, although it costs more in the early years as implementation is brought forward. The potential for SESAR to cost less than the Base Case is dependent on minimum waste in expenditure at all levels and will therefore require a high level of commitment across Europe. The costs shown in the figure are either increases (Scenario 1) or cost savings (Scenario 2 & 3) compared to the base case expenditure.

Figure1 - Incremental NPV of SESAR scenarios (€ billion)



The benefits shown in the above figure are a result of:

- **Increased capacity and productivity**: this has been quantified by assuming that once capacity supply exceeds demand, the excess capacity can be used to improve productivity supply, for example, by reducing the required number of controller working positions. This will result in a reduction of ATM costs.

- **Increased flight efficiency**: this reflects the benefits of more direct routes that aircraft will fly and therefore reduced fuel usage. It is based on Eurocontrol estimates of the benefits of increased flight efficiency.

- **Increased schedule predictability:** providing reduced buffers between flights. This uses a cost per minute of buffer delays as estimated in a recent Eurocontrol study[1].

Additional benefits, such as reduced emissions, are discussed in the analysis of social and economic benefits later in the chapter.

For all SESAR programme scenarios, the split of value of the types of benefit are approximately 88% in increased capacity and productivity, 7% in increased flight efficiency and less than 4% for reduced buffers. The results vary by a range of plus and minus 1% by scenario.

SESAR Scenario 1 shows the benefits of advancing project timescales at approximately 10 billion €, while SESAR Scenario 2 shows the additional benefits of programme rationalisation is approximately 11 billion €.

Sensitivity analysis

The main sources for uncertainty and risk for a technological programme of this size and complexity are the following:

– financial risk aversion of the private partners, which can be reflected in the discount rate used for the financial analysis,

– risk of delay in the receipt of SESAR benefits,

– risk of cost increase,

– risk of lower or higher traffic growth

The other factors of uncertainty, such as the extent to which a particular technology can deliver adequate capacity or not, were recognised, but, since they apply to both baseline and SESAR scenarios, they were deemed not to introduce a bias in the analysis.

We have undertaken a sensitivity analysis of the results of the financial analysis along these factors of uncertainty.

Sensitivity to the discount rate

Different private stakeholders are likely to have a range of discount rates. Therefore, we have chosen to examine the impact of two sensitivities. One representing high risk funding (15%), the other low risk funding (5%). The results could be interpreted as if all funding was provided through high risk user (high), or through taxation receipts (low).

The results provided in Figure 2 and Figure 3 demonstrate that changing the discount rate has a significant impact on net benefits. For example, SESAR Scenario 1 benefits vary between 3 billion € and 17 billion € for the high and low discount rate cases. Our results provided in Figure1 use a mix of stakeholder discount rates that lie between the two extremes on the continuum.

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[1] University of Westminister for the Eurocontrol PRC, "Evaluating the true cost to airlines of one minute of airborne or ground delay", May 2004.

Figure 2 - Key results with High discount rates

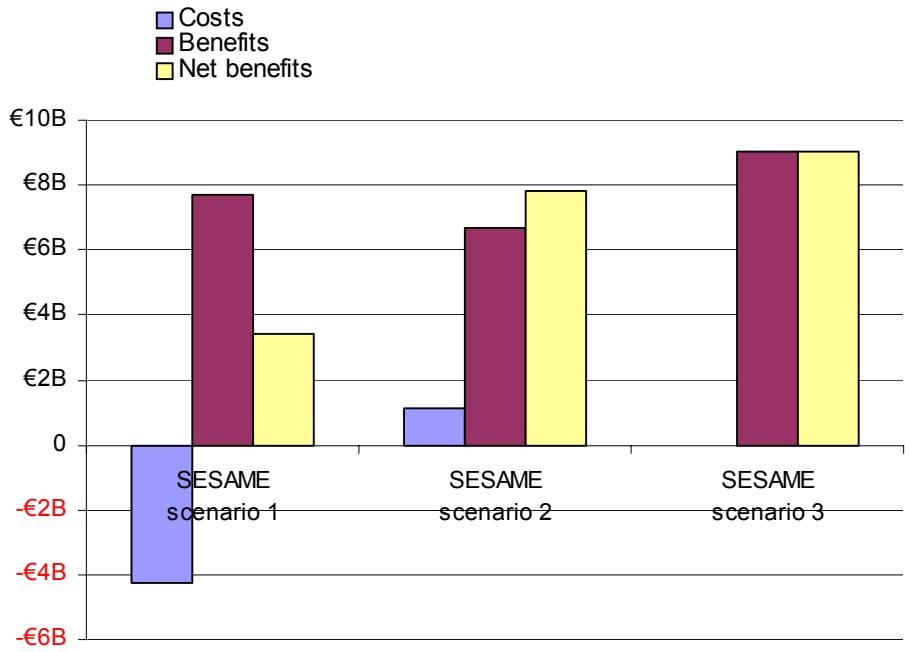
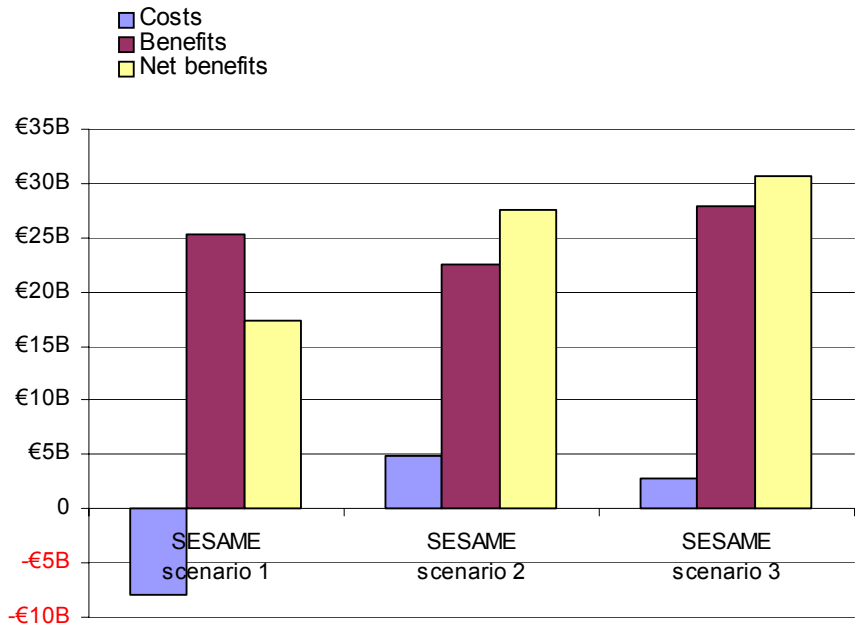


Figure 3 - Key results with Low discount rates

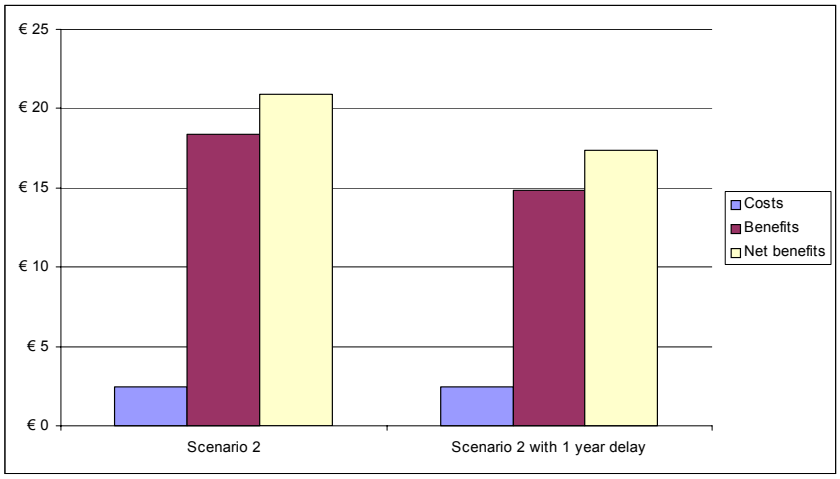


Sensitivity to the timing of receipt of benefits

Our sensitivity test looks at the impact of delaying the benefits of SESAR. In this case, we have delayed the delivery of each scenario's benefits by 1 year, but with no impact on costs. This reflects a situation where SESAR programmes incur costs as planned but are late in delivering their benefits. The impact of this is shown in the following figures. For SESAR Scenario 1 the impact is a reduction in net benefits of 7 billion €, for Scenarios 2 and 3 the net benefits reduce by approximately 3 billion €. The lower net benefits demonstrate the importance of SESAR in avoiding delays in implementation.

The results are illustrated for Scenario 2 in the following figure:

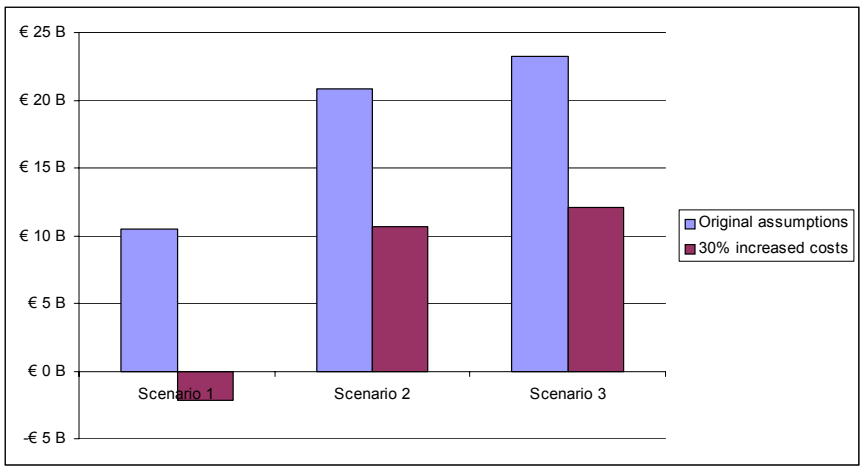
Figure 4 - Key results for Scenario 2 with and without 1 year delay to benefits



Sensitivity to greater costs

Our third sensitivity looks at the impact of increased SESAR costs. The following figure shows the result of a 30% increase in SESAR programme costs above those originally assumed. It can be seen that the net benefit reduces, particularly for SESAR Scenario 1 which has the highest costs. Here the net benefit reduces from 10.2 billion € to -2.2 billion € PV.

Figure 5 - Sensitivity of 30% increased costs (net benefits)



Sensitivity to changes in demand growth

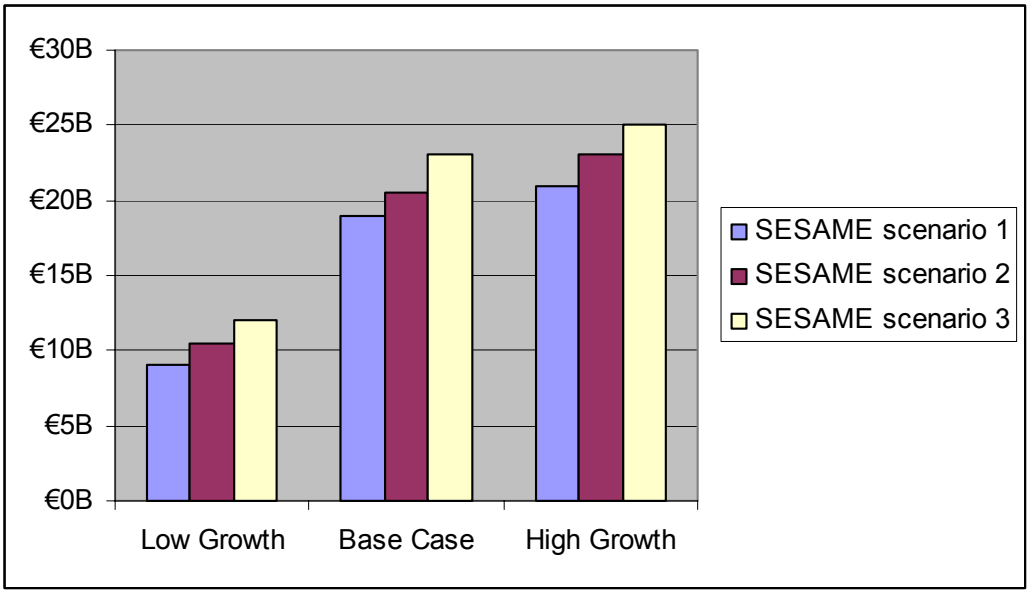
Our final sensitivity examines the implication of a reduction in the level of traffic growth assumed in the cost benefit analysis. This sensitivity was suggested by members of the ICB and SESC working group at our meeting in the middle of June 2005.

The unconstrained traffic growth projections used in this study are based on the Eurocontrol long-term traffic forecasts (2.9% per annum to 2025), extrapolated using our assumption of the same annual growth rate out to 2035. The long-term forecast takes into account a number of factors, such as macro-economic growth airport runway constraints and transport modal choice for passengers. However, there is a risk that this long-term growth rate could be over or under estimated. For example, through an international crisis or slower / higher growth in the European economy than used in the core traffic projection, leading to slower or faster traffic growth.

We have investigated the impact on the SESAR financial cost benefit analysis results of reducing and increasing traffic growth to 1.9% and 3.9% respectively per annum from 2010 to 2035.

The impact of these changes to the key results is shown in Figure 6 below. Changes to traffic demand have a limited impact on the financial CBA analysis because the CBA measures the benefits of SESAR compared to the Base Case. The changes in traffic demand affect both the Base Case and the SESAR scenarios. Therefore, the incremental impacts are more limited.

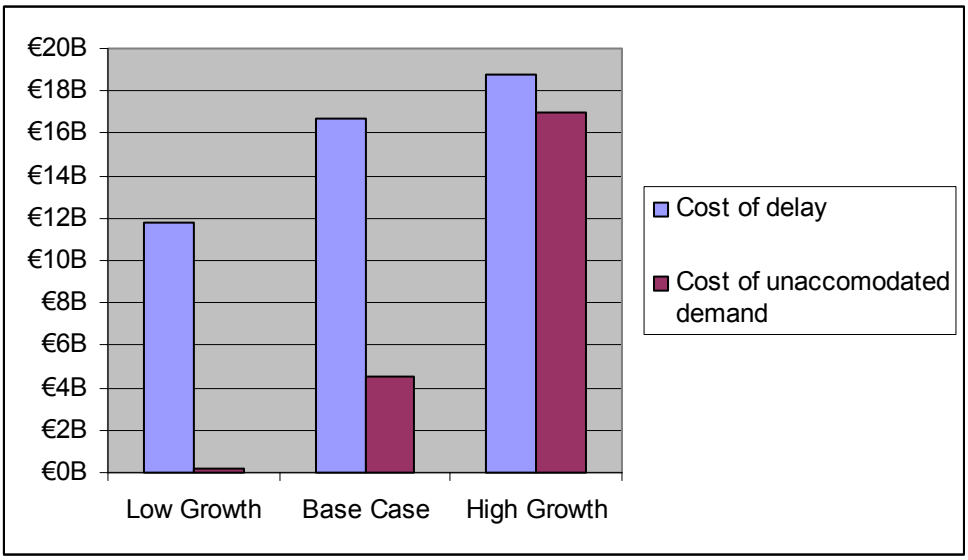
Figure 6 – Sensitivity to changed demand growth.



The next figure shows the impact on changed demand on un-met costs. Here the effect is more dramatic. It can be seen that costs of unaccomodated demand, ie flights that are cancelled because of insufficient capacity, rise very quickly with the high growth rate.

This means that the capacity wall would become a more critical issue than before. The benefits of SESAR, if it can avoid a capacity wall that would otherwise occur, would therefore increase considerably.

Figure 7 – Sensitivity to changed demand growth- illustration of impact on unmet demand



Social and Economic Costs and Benefits

Our analysis looked into the impact of the different SESAR scenarios, in comparison with the base case, in particular along the following lines

– Overall economic impact on the European economy

– Social impact

– Environmental impact

Overall economic impact

All SESAR Programme Scenarios are expected to provide incremental GDP growth and passenger time-savings benefits as compared to the Base Case.

Air Traffic Control being an infrastructure service, it is very difficult to assess precisely its direct impact on European economy. Still, the magnitude of SESAR net economic benefits is likely to be important, since the programme, by reducing congestion, enhancing flights efficiency and accommodating air transport demand growth, will enable productivity gains and increased exchanges within the European economy.

Our economic analysis, using multipliers which have been used in other studies[2] showed a possible net contribution of 45 billion € to European economy, taking into account direct,

[2] Oxford Economic Forecast (1999) : « The contribution of the aviation industru to the UK economy », study for UK Department for Environment and Transport and the Regions. The multiplier approach used in this study is based on the assumption that there is a strong causality from transport growth towards GDP growth, i.e. the more air transport there is, the higher GDP growth will be.

indirect and induced impact. We nonetheless prefer to be cautious with these figures, which are provided for purely illustrative purposes.

Our analysis shows that the European manufacturing industry needs SESAR to be able to compete on equal footing with their competitors, mostly coming from the USA. The United States have indeed the privilege of being one single, large size market. The Federal Aviation Administration faces the same modernisation problems as Europe, and they have already launched a large scale modernisation programme, the New Generation Air Transport System (NGATS) programme. A specific organisation was set up for the management of this programme, the Joint Planning and Development Office, which is an inter agency facility, which reports to the US Congress. The modernisation contracts for the USA are likely to result into major technological advances for the US industry, which need to be at least matched and if possible outrun by SESAR.

Economic impact table synthesis:

Impacts on:	SESAR scenarios with reference to the base case
Competitiveness, trade and investment	Positive competitive advantage of EU aeronautics industry More efficient EU aviation sector Increased economic exchanges within and outside of the EU
Competition in the internal market	Level playing field of all European regions ATM infrastructure Increased cost effectiveness of aviation Local competition for ATM systems adaptation enhanced
Operating costs and conduct of business	New investment paradigms, with a public-private partnership Important cost savings to the industry thanks to programme rationalisation
Administrative cost on business	Cost of running the Joint Undertaking small compared to the benefit The SESAR JU should be a lean and small entity
Property rights	Property rights of the SESAR products need to be identified on a case by case basis, according mainly to the funding and procurement specific cases
Innovation and research	Extremely positive impact on innovation and research, pooling together resources into a consistent programme oriented budget SESAR will dramatically increase the introduction of new technologies SESAR will increase the level of industrial research SESAR will promote a greater resource efficiency
Consumers and households	Positive impact on the ticket prices Positive impact on the level of choices offered to citizens for air transport services
Third countries and international relations	SESAR should be coordinated with third countries Some third countries are already interested in joining the programme The proposed regulation takes into account the existence of specific aviation agreements in order to take part in the programme
Public authorities	SESAR funding will partly come from public money This public funding is foreseen to be gradually replaced by private investment

Social impact

Increased schedule predictability and the subsequent reduction in buffer delays leads to passenger time savings. Gains in passenger time are a significant driver of economic benefits and certainly a key comfort factor for the European citizens.

It is difficult to estimate the direct impact SESAR has on employment. We can nevertheless, for illustrative purposes only, quote a study done by CERMAS (Centre Européen de Recherche en Management de l'Aéronautique et du Spatial, ESC-Toulouse) in the frame of ACARE (Advisory Council for Aeronautic Research in Europe), which compared different development scenarios for air transport in Europe. Although not strictly comparable to the scenarios used in the present Impact Assessment, CERMAS compared a 'constrained growth' scenario with the baseline, and came up with a loss of 300 000 jobs for the European economy through direct, indirect and induced effects. Again this figure cannot be used as such in our context, but it indicates that a constrained air transport growth could have a quite significant impact on the economy.

It is worthwhile noting that, since Air Traffic Management is a labour-intensive industry, SESAR is likely to generate a transformation in the current working methods of air traffic controllers, enabling the human operators to concentrate on high added value activities, and let automation deal with repetitive tasks.

SESAR will also significantly increase the safety of air transport in Europe. The base case, in which piecemeal procurements are conducted, can lead to significant discrepancies in the level of equipment of different regions of Europe. This could easily lead to "safety holes" in the ATM network, of which the overall safety would then be reduced. Moreover, the level of standardisation and uniformity, the degree of commitment from the industry to work on a common project, will have a definite very positive impact on safety. Congestion is also a factor of non safety: it puts pressure on operators to operate at their limits, it forces the whole ATM system to function at its limits, with a higher risk of massive disruption.

The past 5 years have seen in Europe 3 major accidents in which Air Traffic Control was the major contributor (Milan Linate, Paris Charles de Gaulle, Überlingen). Recent technical failures in Air Traffic Control systems show that the technical systems are reaching their limits. SESAR is seen as the only way by which this trend can be reversed: **an accelerated renovation of a system which in many ways is coming to its technical limits is a safety critical priority.**

Social impact table synthesis

Impacts on:	SESAR scenarios with reference to the base case
Employment and labour markets	SESAR will significantly increase productivity, by enabling time and cost efficient air travel SESAR will enable the creation of several thousands jobs in Europe, in the aeronautical sector as well as in the overall economy through indirect or induced effect. SESAR will have a favourable impact on the European labour

	market by bringing uniformity to ATM tools and operations
Standards and rights related to job quality	SESAR will have an impact on the relationship between the human operators and the automation support SESAR will enable human operators to concentrate on high added value tasks by letting automation take care of repetitive tasks The Air Traffic Controllers jobs will become more added-value jobs, with more tactical intervention rather than real time actions, which will contribute to relieve the pressure on human operators Technical staff will work with modern, high technology hard and software, which will add to job satisfaction
Social inclusion and protection of particular groups	N/R
Equality of treatment and opportunities, non discrimination	N/R
Private and family life, personal data	SESAR will improve the range of choices offered to European families in terms of air travel Passengers information systems are not part of SESAR
Governance, participation, good administration, access to justice, media and ethics	SESAR brings new working methods across the industry The Air Navigation Service Providers will be integral part of the decision making processes, and use SESAR as a vehicle for efficiency gains Eurocontrol will be an integral part of the SESAR Joint Undertaking, and will realign its activities according to SESAR (and be a founding member of the SESAR Joint Undertaking) Aircraft Operators will be integral part of the decision making process (by participating to the funding and also part of the SESAR Joint Undertaking administrative board). Staff representatives will also participate to the decision-making process (in the administrative board of the SESAR Joint Undertaking) Manufacturing industry will be part of the decision making process (in the administrative board of the SESAR Joint Undertaking)

	Member States, through the Single Sky Committee, will be part of the oversight of SESAR
Crime, Terrorism and Security	SESAR will be built taking into account security constraints SESAR will bring uniformity in operational data exchanges, thus enabling to have a complete, accurate view of the aviation situation, including possible security threats
Access to and effects on social protection, health and educational systems	N/R

Environmental impact

The performances of new generation aircraft such as the A380 enable to obtain flight trajectories with a minimised environmental impact, in terms of gaseous emissions and noise.

Similarly, the use new radio satellite navigation systems such as Galileo, enable the aircraft to follow shorter, more efficient trajectories, instead of having to go over fixed way-points.

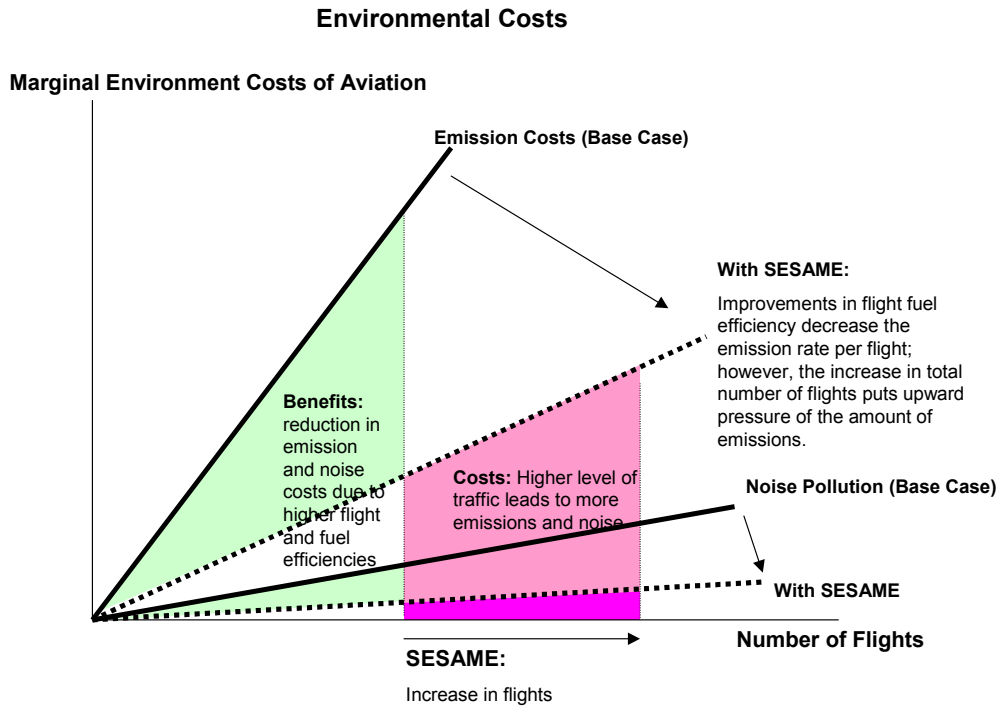
There is an urgent need to modernise the ATM systems so as to minimise the marginal environmental cost of air transport. It is estimated that the new generation of ATM systems could at least double the efficiency of flight trajectories, and incorporate the flexibility which enables flights to operate safely "environmentally-friendly" trajectories. Hence, the SESAR will enable incorporation of GALILEO technologies, which will enable fully flexible radio-navigation procedures and trajectories. It is assessed by Eurocontrol in its Performance Review Reports that the current trajectories inefficiencies amount to around 12% (both vertical and horizontal deficiencies), which represent the difference between the 'optimal' trajectory and the flown one. It would be illusory to plan that this can be reduced to null. However, a conservative estimate can be made that, since with SESAR more flexible trajectories (and no longer ground-navigation-aids-based ones) will be allowed, we can obtain at least a 4% to 6% gain in individual trajectory efficiency, which would mean that gaseous emissions per flight could be reduced in the same proportion.

This important aspect will also enable the progressive decommissioning of "traditional" ground-based radio-navigation aids (VORs and DMEs), thus limiting the level of radio radiation of these tools.

Finally, the use of advanced airports air traffic management tools will enable the air transport to take full account of noise constraints around airports, whilst maximising the utilisation of exiting runways. The reduction in ground congestion will further reduce unnecessary fuel burn on the ground and in holding patterns.

Our impact analysis nevertheless suggests that, even if SESAR enables substantial environmental benefits per flight, air transport growth in itself will result, if no compensating accompanying measures are taken, in a net negative environmental impact.

Figure 8 - Illustrative Diagram of Net Environmental Impacts of SESAR



Environmental impact table synthesis

Impacts on:	SESAR scenarios compared with the base case
Air quality	SESAR will optimise flight efficiency, thus minimise fuel consumption and gaseous emissions (to be reduced by 4 to 6%)
Water quality and resources	N/R
Soil quality or resources	Less congestion will lead to less emissions and wastes on the ground, whilst the aircraft is waiting for take off
The climate	SESAR will minimise the emission of CO2 and NOx through an increased flight efficiency
Renewable or non-renewable resources	N/R
Biodiversity, flora, fauna and lanscaptes	N/R
Land use	SESAR will optimise the use of existing runways

Likelihood or scale of environmental risks	N/R
Mobility and the use of energy	SESAR will result in a sustained air traffic growth
Environmental consequences of firms' activities	SESAR will result in more environmentally performing approach and climb trajectories

Section 6: Comparing the options

The industry initiative which gave birth to SESAR was already a sign that the current working arrangements within the ATM world were not successful. The case for SESAR, examined by our consultant, and summarised in the previous chapters, is very positive, when compared with the "do nothing option".

The main points are summarised in the following table:

	Do Nothing	SESAR
Financial benefit		+ 20 billion €
Economic benefit	High congestion costs	Significant positive contribution to European economic growth Competitiveness of European industry Improved innovation and research
Social Benefit		Very significant safety increase Several thousands jobs created in Europe Security increase
Environmental Benefit		Flight efficiency increase Optimised flight trajectories

The proposed regulation appears to be a perfect application of the Lisbon strategy, fostering innovation and European technological leadership, sustaining economic growth, and creating high added value employment in Europe.

In terms of development scenarios, the most appropriate scenario seems to be the Scenario 2, which involves a rationalisation of work, without a heavy upfront investment which would further advance the technology implementation. The Commission believes it is the most balanced approach, which enables a certain degree of uniformity to be reached throughout the European ATM system, and a reduction of duplication and fragmentation. It is also the most robust scenario, in terms of resistance to uncertainty and risk factors for a programme of such a magnitude.

The policy option put forward by the Commission has been carefully designed in order to take benefit of the formidable commitment of the overall aviation industry, whilst minimising the regulatory and administrative burden on the activity.

The administrative instrument of the "Joint Undertaking", which has been very successful in the case of Galileo, a programme which has a lot of commonalities with SESAR in terms of technological complexity, seems to be the right vehicle for ensuring that SESAR will be managed properly:

– It is a legal entity, which can therefore organise procurement and place contracts under its own name,

– It can be funded by public and private sources,

– It can in particular incorporate private members,

– It enables a high level of synergy with community regulatory activities under the Single European Sky,

– It can act as a single entry point in relation with third countries.

The Commission proposes that this Joint Undertaking is as light a structure as can be, and should therefore rely to a large extent to external technical expertise, coming from the industry, to fulfil its tasks and responsibilities. Its founding members will be the Community and the European Organisation for Air Navigation Safety, Eurocontrol.

Section 7: Monitoring and evaluation

The SESAR Joint Undertaking will be fully evaluated by the Commission every 3 years. Moreover, SESAR will follow a stepwise approach, which will already implement parts of the programme in 2010, thus providing the possibility to have rapid and operational feed-back on the efficiency of the programme.

The proposed SESAR Joint Undertaking will cease to operate in 2013, when the programme will be transferred in totality to industry.

As SESAR will be a major component of the Single European Sky, the Commission intends to use its two committees, the Single Sky Committee, and the Industry Consultation Body, as organs which will permanently monitor progress of the programme. Moreover, it is proposed that the industry takes part in the management board of the Joint Undertaking, by being granted a number of seats, with voting rights.

In terms of concrete evaluators, one of the key items of the definition phase will be to determine a performance assessment framework for the ATM system. This framework will take into account economic as well as social indicators, such as safety and security or environmental impact. It is expected that all SESAR programme deliveries will be defined and then assessed against this performance framework, which will be used by the Single Sky Committee and Industry Consultation Body.

Last but not least, the USA are launching a similar programme, the Next Generation Air Transport System (NGATS). According to Eurocontrol studies, the American ATM system is already twice as performing as the European one.

The Commission is currently discussing a Memorandum of Cooperation with the Federal Aviation Administration of the USA, by which appropriate coordination between the two

initiatives could be set up, in order for the technological choices to be consistent between the USA and Europe. The exchange of information on NGATS and SESAR, the monitoring of NGATS progress, will provide an excellent benchmark to monitor the performance of the European programme.

APPENDIX: THE SESAR DEFINITION PHASE

Introduction

The definition phase is co-funded by the European Commission (under TEN-T) and Eurocontrol. Most of the work will be carried out by a consortium, which has been chosen by Eurocontrol after a public call for tenders. This consortium is composed of 39 different companies, including aircraft operators, equipment industry, air navigation services providers, airports. The project directorate is led by Airbus. Associated members of the consortium include staff professional organisations, military representatives, and non EU companies.

The key objectives of the Definition Phase are:

- Define European air transport system performance requirements up to 2020 and beyond
- Identify globally interoperable and harmonised ATM solutions to meet the performance requirements
- Produce the detailed Research and Technology and validation work programme, including planning, costs and priorities, as required to meet the performance requirements
- Establish a detailed and phased implementation and deployment plan, including costs and priorities
- Propose the legislative, financial and regulatory framework required for successful deployment, including possible incentives schemes and funding models

The European ATM Master Plan: the key deliverable of the definition phase

Learning from the experiences in the establishment of GALILEO, to further enhance the chances for a timely and efficient outcome, this ambitious programme will require the production of a comprehensive plan where commitment by all ATM stakeholders will be sought to ensure a clear roadmap for future developments and investments.

The European ATM Master Plan will be a performance based living Plan with a 15-20 year time horizon

It will provide an integrated view of:

- The characteristics and requirements of the 21st century airspace users;
- What are the regulatory and performance requirements that ATM will have to satisfy over time;
- What benefits can be expected following the deployment of proposed individual improvements and when;
- What programmes have to be launched to support the objectives;
- The research landscape, the actors, competences, facilities and those that are missing;

- What ATC operations and services need to be deployed;
- What infrastructure and technology should be developed;
- How transitions are to be managed between successive steps over time;
- What financial and investment scheme is required;
- Regulatory / legislative / social actions to be undertaken;
- Certification and standardisation activities to be established.

A framework to construct commitment

The only way to meet the ambitious objectives defined here above is to have the ATM system's stakeholders involved in all aspects of the definition phase activities, at various levels of responsibilities, up to definition phase programme management level.

In summary, the definition phase represents an unprecedented joint effort of the air transport industry to define its future and propose the way to deploy new air traffic solutions for the benefits of airspace users and service providers.

The success of the venture is largely dependant upon the ability to assemble a balanced and representative set of actors from all concerned stakeholders, make them directly contribute and obtain appropriation and commitment from the beneficiaries or customers to the results of this initial planning phase. Their needs, expectations and requirements will be the drivers in establishing the Master Plan, taking into account the inevitable trade-offs that must be applied between the major performance axes, e.g. capacity and cost-effectiveness.

Wide stakeholder appropriation will ensure that issues relating to convergence and transition, which in many cases slowdown and even stop evolution, will be addressed in a timely and efficient manner. Transition planning, accompanied by a long term strategy targeting the rationalisation of infrastructure and service delivery, with particular attention paid to the social dimensions of the stepped change can only be constructed and appropriated by the active participation of the end customers.

Short term convergence of investment plans together with the identification and planning of longer term investment are essential elements to the Master Plan where customers will contribute directly, allowing the timely realisation of expected benefits.

Clearly, a measure of success will be the ability to obtain appropriation and commitment from the beneficiaries or customers to the results of this definition phase.

Scope

This definition phase will establish the necessary supporting structures to manage the overall implementation process by creating synergies within the aviation industry while preserving the entrepreneurial freedom of the economic actors.

The work includes the consideration of civil-military co-ordination and accommodation of military airspace users: this is important to maximise use of available capacity, increase interoperability and facilitate cost-effective transition.

Work description and main deliverables

The Definition Phase of the Single European Sky implementation programme, covered by this application, will provide the foundation upon which the stakeholder community can commit toward a performance based implementation plan and will therefore address:

Capture of airspace users formulating a set of key strategic objectives, translating them into concrete performance requirements and expected benefits for each group of stakeholders.

Conceiving and consolidating the design of the underlying concepts, system architecture, procedures and infrastructures while paying specific attention to existing but unused capacities and also capitalising on existing initiatives in Europe and in other regions of the world (in particular the USA).

An agreed European ATM Master Plan covering the roll out of performance based improvements over time to ensure the growth requirements, with particular attention on transition issues and taking due account of short term deployment constraints and technology availability.

The definition phase also covers the following areas of activity:

- **Regulatory and Business Framework:** To set the scene by establishing the social, economic and institutional framework for the Master Plan. To develop an in-depth understanding of the Air transport value chain with a detailed definition of the role of the ATM System within this overall chain. The goal is to ensure that future investment strategy and trade-offs take into account the supporting role of the ATM system within the global Air transport framework. The following aspects will be addressed:

  - analysis of the decision making processes and criteria, and proposals for improvements;

  - proposition of new financing mechanisms to facilitate investments; for example one will examine the potential of pan-European public/private partnerships through joint initiatives based on the technological platforms concept, of common agendas leading to the implementation and deployment in fields of industrial relevance, on the model followed in the European Community's European Growth Initiative;

  - need for new regulations;

  - safety regulation issues for the future ATM system and their impact on planning;

- **Human Resources:** identification of the social necessities out of the evolution of roles and responsibilities and the accompanying transition measures. The human beings play a key role in achieving system safety and capacity enhancements by making real-time safety-critical operational decisions. This activity will address the human factors involved by the proposed changes to procedures, automation and systems. Particular attention will also be paid to increased mobility, the harmonisation of recruitment, training and licensing, and skill requirement evolutions for the mid and long term.

- **Performance Requirements and Assessment:** The translation of high level strategic objectives into a performance based organisation and objective driven methodology,

metrics and tools; this will enable the establishment of Master Plan performance targets and the subsequent assessment of results against these targets. Key areas for attention will be to provide a systemic view of safety, economic efficiency, capacity, security, environmental impact and sustainability, whilst developing the tools to enable the identification of trade-offs amongst these.

- **Operational Concepts:** Identification and refinement of the target operational concepts and operational scenarios for each successive step in the identified evolution toward the performance targets, taking into consideration as necessary the ongoing areas of work which have contributed to the definitions, i.e. ICAO, EUROCONTROL and National Plans and the requirements of the SES regulation. The scenario descriptions will address a wide variety of operational environments to be representative for the daily practice of operations in the ECAC area. The most highly congested operations in the core area will deserve a main focus together with the most critical bottlenecks for hub operations, but the concept will be appropriate also for operations in less congested areas of Europe.

  The activities will in particular address the operational consistency of the ATM operations along the transition path and the possibility to effectively generate benefits at each change step and in conditions of mixed equipage. Work will be iterative to take into account the findings of the other non-operational perspectives.

- **Enabling Systems:** Identification of the future functional, architectural and technological requirements to support the operational visions and technical performance requirements for the successive timeframes. Particular focus will be placed upon inter-operability and standardisation, both within Europe, and between Europe and other regions, in particular adjacent areas and the USA, as well as the level of automation.

  Activities will take into consideration the results of past and recent studies. They will particularly call upon the industrial expertise to assess the suitability of the possible technological options to the needs, and the development, certification and operating costs and timescales, and the transition issues, including the standardisation. The definition of the scope of the ATM network and subsequent overall ATM/CNS architecture work will allow industry to propose system architecture features to be standardised and propositions for the rationalisation and transition of existing CNS infrastructure, which will include the retrofitting of aircraft.

- **Validation Requirements and Planning**: Identification and mapping of expertise, facilities and services at a European level for the execution of validation. The objective of this activity is to define the specific questions that validation will need to address, and the timescales by which the answers are needed to timely meet development and implementation needs. It will also identify the means, available or to be developed, i.e. models, prototyping, fast time and real time simulations, large scale trials and testing, together with the supporting methods, tools and metrics to allow assessment of conformance with the established performance targets. Establish a clear management process to ensure the coherent application of validation techniques and to collect and collate results. Establish baseline measurements for comparison.

- **The ATM Master Planning core effort itself**, whereby all relevant information are analysed together and turned into a consistent overall set of planning information. This activity will address:

– A review and consolidation of ongoing and planned initiatives and their contribution to the various objectives (performance, interoperability, etc.). This will in particular include the update of the short- to medium-term implementation and deployment plan, which will in turn be the basis for planning the subsequent steps.

– The identification of the areas and magnitude of additional gains to be found from the shorter-term baseline;

– Full life cycle cost assessment of the various components to the Master Plan, including the implementation costs and their associated trade-offs, the estimated cost of research and technological development.

– The preparation of deployment scenarios, setting possible avenues for transition to the future, and the assessment of these scenarios, with a view to determine the best combination of changes to maximise the achievement of the objectives. In doing so, trade-offs will be analysed regarding the attainable performance (capacity, investments/costs, return on investment, technological choices, financing mechanisms, dates, etc.). This activity will involve a number of iterations before converging to an acceptable situation.

– The selection of the retained scenario and its full elaboration as the Master Plan. This will use IT support to consolidate all relevant information and produce synthetic and specific reports. The information will encompass all relevant aspects and cover the full life cycle, the operational/performance improvements and the enabling conditions.

In particular, the ATM Master Plan will comprise specific plans and/or views: ATM Research Master Plan to address the relevant research needs, Regulatory Plan to facilitate the elaboration of regulatory, standardisation and certification material, and Industrial Plan leading “ready for deployment dates” of the required system components.