Assessing the macroeconomic impact of SESAR

Final Report

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SESAR JOINT UNDERTAKING

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1. PREAMBLE

The public, governments and businesses in Europe are all affected in one way or another by the overall transport system, with air transport a significant component of it. The importance of transport and mobility as contributing factors to the economy, society, internal markets, prosperity and the quality of life is highlighted by the European Commission's recently published White Paper[1], *Roadmap to a Single European Transport Area*.

In 2010 close to 9 million commercial passenger flights crossed EU airspace, with over 750 million passengers using EU airports. In addition to passenger and cargo civil airspace users, EU airspace is used on a daily basis by civilian business and general aviation, as well as by the military.

EU airports and civil airspace users employ directly around 670 000 people, while a further 3.2 million people in Europe depend directly or indirectly on the air transport sector for their livelihood as suppliers, manufacturers or service-providers. The air transport system also generates benefits beyond the immediate aviation industry, including trade and tourism, securing investments, supplying labour and improving productivity and innovation, thus contributing to society's welfare. As such, air transport is a catalyser for general travel, tourism and transporting goods.

Despite its importance to the economy, the current air transportation system is not operating at its optimum level resulting in negative effects such as additional costs, delays, noise and pollution for the travellers and the public in general. A major reason for this situation is that the operating and communication systems and standards in the air traffic industry worldwide have not changed much over half a century. These systems no longer meet the expectations of economic growth and climate change of aviation in the 21st century. In today's European skies, civilian aircraft fly according to pre-defined routes that are managed in a fragmented way by air traffic controllers in each of the Member States. At the same time, Air Traffic Management (ATM) systems still rely largely on procedures and technologies from the 1950s. Consequently each flight is, on average, 50 km longer than necessary, resulting in avoidable fuel consumption and unwanted emissions of about 5 million tons of CO_2 per year. Today several cities are already facing capacity bottlenecks and, overall, congestion costs in Europe are estimated at about 1% of Gross Domestic Product (GDP) each year[2] – equivalent to € 115 billion of wasted resources.

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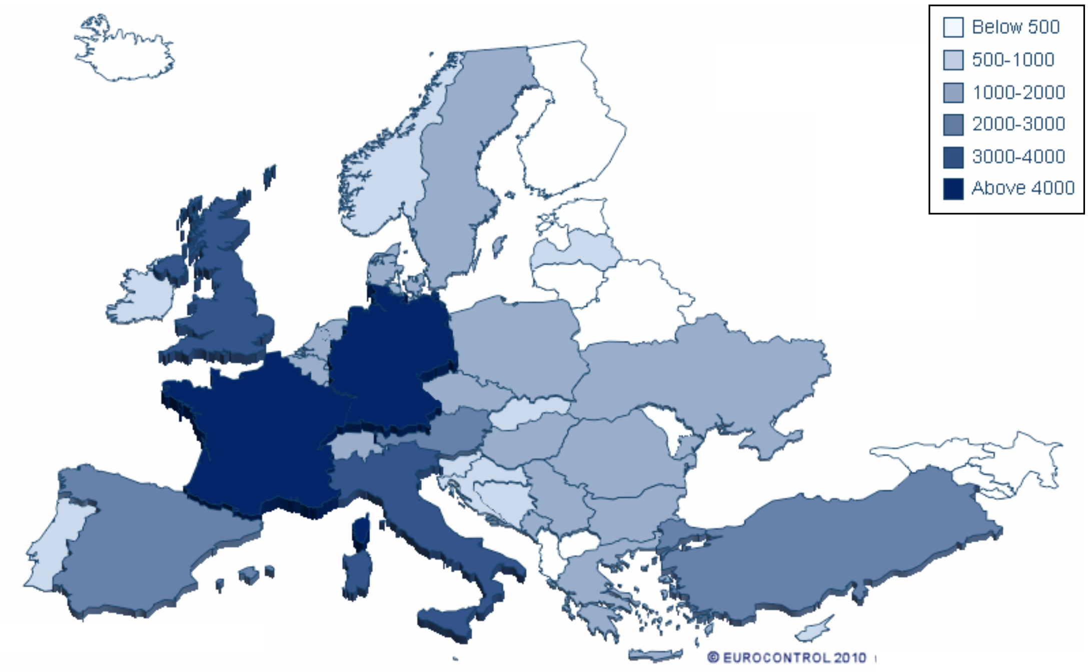
[1] EC White Paper – *Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system*, COM (2011) 144, March 2011

[2] Impact assessment accompanying EC White Paper – *Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system*, SEC (2011) 358, March 2011

This situation is expected to worsen in the future as the demand for air travel is expected to grow by over 70%[3] between now and 2030 (cf. ***Exhibit 1***). European skies and connections to European cities are likely to become increasingly congested. If no appropriate steps are taken, this would limit mobility in Europe, and thus the economic growth associated with it

Exhibit 1 – Total number of flights in thousand in 2030



The Single European Sky (SES) initiative and its technological pillar, SESAR, are key to addressing these issues. In particular, SESAR plays a major role in enabling the EU to meet the overall 60% emissions reduction target by 2050 set out in the White Paper.

The SESAR programme will deliver a new and global interoperable concept of air traffic management where the operations will be built around a continuous sharing of data between aircraft and air navigation service providers and airports ground infrastructure. This development of operational and technical solutions will enable improved services, more fuel efficient and energy optimized point-to-point and more direct flight trajectories, minimum CO_2 operations. In practical terms for Europe and its citizens, by 2020, this means according to the European ATM Master Plan targets[4] of:

- Shorter flight times,

[3] Eurocontrol – STATFOR – Long-term Traffic Forecast 10'; STATFOR, Statistics and Forecast Service of EUROCONTROL, a body of European forecasting and statistics experts

[4] European Air Traffic Management Master Plan, adopted by the European Council in 2009,

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- 50% fewer delays,
- More sustainable air travel through10% reduction in CO_2 emissions,
- Enhanced mobility through a better match between future demand and offer for air transport, in line with economic growth
- Safer air travel
- An overall increase in economic growth / GDP
- The creation of new jobs

Reforming and upgrading efficiency in the air transport infrastructure is also gathering pace in other regions of the world, notably, NextGen in the US, a programme publicly supported by the White House. NextGen is run by a single government authority and the US government recently established a Public Private Partnership funding mechanism to ensure its timely deployment.

The present report assesses and quantifies the economic, social and environmental impact of implementing SESAR for Europe. Its results are based on an analytical and deductive approach to understand how the operational and technological changes enabled by the SESAR program will impact the various stakeholders directly or indirectly involved in air traffic management. It also details the costs and benefits that each party can expect, based on a range of possible implementation scenarios. This report also serves as input for the European Commission's Impact Assessment process.

2. EXECUTIVE SUMMARY

The SESAR programme is key for achieving the single European Transport Area and enabling smart economic growth for Europe. SESAR will provide an effective remedy to air transport capacity bottlenecks, fills gaps in the air traffic management system, enables significant reduction of CO_2 emissions, increases safety, and reduces overall costs. SESAR benefits all EU Member States and extends beyond the air transport industry.

This study was commissioned by the SESAR Joint Undertaking and provides a quantification of the impact of SESAR on the EU economy, society and environment based on the European ATM Master Plan targets. It is based on a specific macroeconomic methodology reviewed by industry and economic experts. It is addressed to the Air Transport community and the representatives of the EU and Member States.

The results of the macroeconomic methodology applied to SESAR implementation detailed in the report show that the **timely, effective and efficient** implementation of SESAR will have a significant positive impact. As such, SESAR is expected to contribute directly to at least 3 of the 5 core goals of the EC's "Europe 2020" strategy[5], namely: creating employment, improving European R&D and helping fight climate change. More specifically, at a EU27 level, over the period 2013-2030, SESAR is expected to have an:

Impact on the economy

As air traffic is an enabler of economic growth, SESAR creates a combined positive **impact on GDP of € 419 bn over the period** (0.16% of combined EU GDP over that period), with 41% of the benefit generated by the direct effects of SESAR and 59% from effects on suppliers and third parties. The economic benefits of SESAR implementation are shared among European Union Member States and contribute as much as 2 basis points of the yearly expected economic growth.

Impact on employment

SESAR creates approximately 42 000 additional jobs in the major air transport industries. Employment created by the indirect and induced impacts of SESAR would add another 116 000 and 170 000 jobs respectively, taking **the overall job creation generated by SESAR to an estimated 328 000**. Note that the effect of shorter flight times and increased ATM efficiency on employment is largely derived from the increased number of flights enabled by SESAR.

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[5] EC Europe 2020 – *A Strategy for smart, sustainable and inclusive growth*, COM (2010) 2020, March 2010

Impact on mobility[6]

For passengers, SESAR means flight times shortened by approximately 10%, 9 minutes per flight on average[7], as well as 50% fewer cancellations and delays, an increased predictability and punctuality on arrival and departures, plus a tenfold increase in safety.

The additional flight capacity enabled by SESAR would allow continued mobility of people and goods within the European Economic Area and with the rest of the World. Continued mobility and convenience would help to reinforce the EU internal market, as well as promote greater EU cohesion.

If the civil airspace users pass on their savings to customers due to increased price competition, this could lead to a reduction in fares of up to € 5 per ticket on average, with a relatively unchanged total impact on GDP (at a price elasticity level of -1). The direct benefits identified from SESAR would shift partially towards indirect and induced effects in this scenario.

Impact on the environment and CO_2 emissions

SESAR helps to achieve carbon-neutral growth, compared to a situation in which no new ATM technologies and systems would be implemented. It eliminates a net amount of 50 million tons of CO_2 emissions during the 2013-2030 period – equivalent to the annual emissions generated by 5 million EU citizens. In addition, **despite the additional air traffic created, SESAR would have a positive net effect on total CO_2 emissions in the period from 2013 to 2030**.

Overall SESAR presents an important innovative and technological component with a high share of resulting benefits shared among a variety of sectors in the economy such as transport, tourism, while the impact on the ATM equipment manufacturing industries remains limited to less than 10% of total benefits.

The magnitude of SESAR benefits is very sensitive to the timeliness and effectiveness of its implementation. Any negative departure from the timeline for implementing SESAR set out in the European ATM Master Plan, would put significant benefits at risk. A 10 year delay would result in loss of benefits estimated at € 268 bn of GDP (of which € 124 bn direct), the non-creation of 189 000 jobs, and the loss of 55-million-tons of CO_2 emissions saving. A desynchronized implementation[8] of SESAR, would result in the loss of around

6 *Handbook on estimation of external costs in the transport sector (IMPACT)*, February 2008, CE Delf

7 SESAR is expected to shorten average flight duration by 8 to 14 minutes (*Today's partners for Tomorrow's aviation*, SJU, November 2009). Based on average flight duration in the EU, an average of 9 minutes is used in this report.

8 SESAR desynchronized scenario, assuming a 5 year de-synchronization between implementation and effective utilization implying a delay to achieve targets

€ 117 bn of GDP (of which € 62 bn direct), the non-creation of 72 000 jobs and a 35-million-ton reduction in CO_2 emissions saving.

The EU-wide implementation of the first new generation SESAR capabilities is planned for 2013. This emphasizes the importance and urgency of taking appropriate policy decisions at Institutional level, Member States and European Parliament, on governance and funding for the SESAR deployment phase.

3. STUDY PROCESS AND METHODOLOGY OVERVIEW

3.1. Study Process

The following study was conducted during the period of February-June 2011. It was made up of two phases: phase one during which the methodology used for assessing the macroeconomic impact of SESAR was developed, and phase two, a review of this methodology and proposed sources of data with economic experts from both the private and public sector.

During phase one, the developed methodology, further detailed in the next section, was used to assess the macroscopic impact of SESAR. The methodology was developed taking into consideration previous impact assessments and cost-benefit analyses (CBA) done for SESAR. Examination of publicly available studies on the economic impact of air transport (e.g., reports from ATAG or Oxford Economics) and industry practices, as well as consultations with experts from both the private and public sectors were carried out to properly set up the methodology.

During phase two, the methodology and proposed sources of data were reviewed by experts from a variety of backgrounds. In order to ensure an objective and robust review of the proposals, there was a strong focus on obtaining objective review from multiple subject-matter experts from multiple backgrounds.

The review, which took place as part of group workshop sessions and a number of bilaterals, was supplemented by comments made during bilateral discussions and exchanged information. The below mentioned experts were presented with the overall approach for SESAR and were given the opportunity to review and comment on any component of the methodology. In addition, they were invited to focus in particular on their own areas of expertise. Specific technical input came from representatives of:

- Institutions: DG MOVE, DG ECFIN (relaying on expertise from the JRC), OECD,EUROCONTROL, SESAR JU,
- Civil airspace users : IATA, IACA, ELFAA, EBAA, Air France and Lufthansa
- Airports: ACI and AENA
- ANSPs: CANSO and NATS
- Aircraft and ATM equipment manufacturers: ASD, Thales and Airbus

In addition, economists assigned by ministries in six countries (France, Germany, Italy, Poland, Spain, UK) reviewed the entire methodology and provided support based on country-specific information. In total, more than 20 reviewers provided input to the defined methodology. All comments raised by experts were addressed, either by adjusting the methodology or by satisfactorily explaining the reason why it had not been included (e.g., lack of available data, need for maintaining a macroscopic perspective as opposed to conducting an individual stakeholder cost-benefit analysis – part of other ongoing SESAR projects). Based on feedbacks from various experts, the methodology and documentation were updated accordingly and submitted to the SESAR JU.

This report presents the EU27 results that were obtained with the reviewed methodology using the most up to date publicly available figures from the most reliable sources. A detailed list of references is available in the appendix.

3.2. Overview of the methodology

The impact of SESAR was evaluated using a four-step approach:

- Understanding the operational and technological changes involved with the implementation of SESAR and their direct effects on the various stakeholders
- Using specific multipliers[9], to work out the indirect and induced effects generated by these changes on the economy and employment, and to account for the increased activity at the supplier level, as well as to assess the increase in purchasing power generated by the direct effects on job creation
- Evaluating changes to air traffic forecasts created by the implementation of SESAR using the *Eurocontrol – STATFOR[10] – Long-term Forecast 10' – Regulated Growth* scenario due to the associated increased capacity at airports and in airspace while checking and ensuring the overall consistency with forecast figures included in EC's Transport White Paper
- Assessing the impact that delaying, desynchronising or not implementing the SESAR programme would have on identified and quantified direct, indirect and induced economic and employment effects, **using 4 scenarios** ("No new ATM", "SESAR on time", "SESAR desynchronised" and "SESAR delayed" scenarios).

3.2.1. SESAR-enabled changes and the direct effects of SESAR

The implementation of SESAR involves major technological and operational changes that would address many of the current concerns highlighted in the EC's Transport White Paper. These include reducing greenhouse gas (GHG) emissions and limiting the increase of congestion, with the aim of achieving a

[9] Multipliers were discussed and validated with experts from the OECD

[10] STATFOR, Statistics and Forecast Service of EUROCONTROL, a body of European forecasting and statistics experts

sustainable system by 2050. SESAR will require the installation of advanced, interoperable and automated traffic management systems both on aircraft and on the ground. The most notable changes include:

A. **The introduction of trajectory-based air traffic management**

   Aircraft trajectories are currently controlled by Air Traffic Control rules which are applied based on traffic situations, airspace and local decision-making. This often results in-flight route extensions and less efficient climb and descent paths compared to what an aircraft can perform. In the future, all aircraft would be managed based on their end-to-end trajectories from planning through execution. This would allow the air traffic management system actors to collaborate on flight trajectories and allow to take the shortest available routes, cruise at optimum available altitudes and use continuous climb and descent paths on flights operating across multiple sectors regardless of traffic density.

B. **The improvement of system interoperability with increased standardisation and information management (SWIM[11])**

   SESAR would contribute to enhancing system interoperability and efficiency through the definition of common, compatible standards and specifications. In addition, the use of an integrated communication and decision-making network concept (SWIM), would enable all of the parties involved to share appropriate information securely and have a common view to support collaborative decision-making

C. **The simplification and automation of Air traffic Management (ATM) procedures**

   The frequent voice interactions required between air traffic controller and pilot (e.g., whenever a change of sector or altitude occurs) represent currently a significant portion of the controller's workload. Automated data exchange would simplify procedures, thereby offloading a number of manual control tasks, optimize ATC personnel workload and improve the efficiency of their interactions with pilots. As a result, the implementation of SESAR would reduce long-term Air Navigation Service (ANS) operational costs, also impacting charges to civil airspace users, in line with the 'Multilateral Agreement relating to route charges'[12].

These high-level operational changes will lead to **9 direct economic and employment effects** listed in ***Figure 2*** and further detailed in the appendix. They are singled out individually for the 6 different parties (legacy and low-cost airlines, airports and air navigation service-providers, avionics and aircraft

[11] System Wide Information Management is an 'intranet of the air' where the ATM information held by different stakeholders in the system is shared over a common platform.

[12] *Multilateral Agreement relating to route charges*, concluded in 1981, according which ANS charges are directly cost-related and calculated in a totally transparent manner.

manufacturers). Changes in GDP and employment have been estimated where relevant for each of the 6 parties, based on the SESAR target objectives as expressed in the European ATM Master Plan.

Figure 2 – Direct economic and employment effects of SESAR on major air transportation players

Economic and employment effects
✓ Quantified
(✓) Not quantified

	Legacy airlines & Cargo	Low-cost airlines & Business aviation	Airports	ANSP	Aircraft manufacturers	ATM Equipment manufacturers
Additional accommodated demand	✓	✓	✓	✓	✓	✓
Time enabled savings	✓	✓				
Fewer delayed flights	✓	✓	✓			
Fewer cancellations	✓	✓	✓			
CO2 savings	✓	✓	(✓)			
Fuel savings	✓	✓				
Improved ATC cost efficiency	✓	✓		✓		(✓)
Additional ATM Equipment investments	✓	✓	-	✓		✓
Changed ATM Equipment share of sales						✓

3.2.2. Indirect and induced economic and employment effects

In addition to the direct effects described above, indirect and induced GDP and employment effects were also considered. "Indirect effects" account for the resulting effects on the multi-tiered suppliers of directly involved air transport players (i.e., avionics and aircraft manufacturers, civil airspace users, airports and Air Navigation Service Providers (ANSPs)). "Induced effects" represent the effect from increased spending by employees who are directly or indirectly impacted by SESAR (e.g., an airline providing more flights would employ more cabin crew, who would in turn spend more money, thereby creating "induced" GDP and employment). These effects have a positive impact on GDP and jobs creation.

Multipliers from economic input-output[13] tables were used to assess the indirect and induced effects. These multipliers show the relationship between the direct effects and the indirect/induced changes in terms of GDP or job creation by depicting the inter-industry relations of the economy. Multipliers

[13] *JRC-IPTS EU27 IOT* (2009) – External costs

can be estimated for different countries and regions and depend on the local supply chain.

Note that catalytic effects, such as the impact on overall trade and tourism, were not quantified from an economic point of view in this study and are thus to be considered as additional benefits.

3.2.4. Implementation scenarios considered

Based on the discussions conducted during the methodology workshops, four hypothetical scenarios for the deployment of SESAR in Europe were developed to provide an understanding of the macroeconomic impact of the various assumptions:

- **No new ATM** scenario, used as the baseline for the 3 other scenarios
- **SESAR on time** scenario, in which the timeline and performance targets set out in the ATM Master Plan are fulfilled
- **SESAR de-synchronised** scenario, assuming a 5 year de-synchronisation between implementation and effective utilization implying a delay to achieve targets
- **SESAR delayed** scenario, considering the effect of a 10 year delay, due to R&D involving the technological tools required for example or a delay in operational implementation as a result of "last mover advantage", on the identified economical impacts.

A more detailed description of each scenario is available in the appendix.

3.2.4. Traffic forecasts

In order to evaluate the resulting impacts from the implementation of SESAR, appropriate air traffic forecast scenarios were developed to take into consideration the increase in capacity and associated additional demand generated by SESAR.

The traffic forecast baseline used to build the resulting forecast from SESAR integration is Eurocontrol – STATFOR – Long-Term Forecast 10' – Regulated Growth scenario as it is well known in the air transport industry. STATFOR – Long-Term Forecast is a forecast model used by major air transport players in Europe. The traffic growth rate is comparable to PRIMES forecast[14] with a maximum 8% difference between the 2 forecasts for 2030 using the same baseline. EU airport expansion plans are also taken into consideration in the STATFOR forecast providing an accurate view of airport capacity constraints in the future.

14 PRIMES is a forecast model from the European Commission to project Transport activity for aviation under different policy scenarios

Note that for the period 2030-2050, the forecasted traffic growth was made by STATFOR based on extrapolation of historical data up to 2009 and STATFOR forecast up to 2030.

Figure 3 – Air traffic forecast

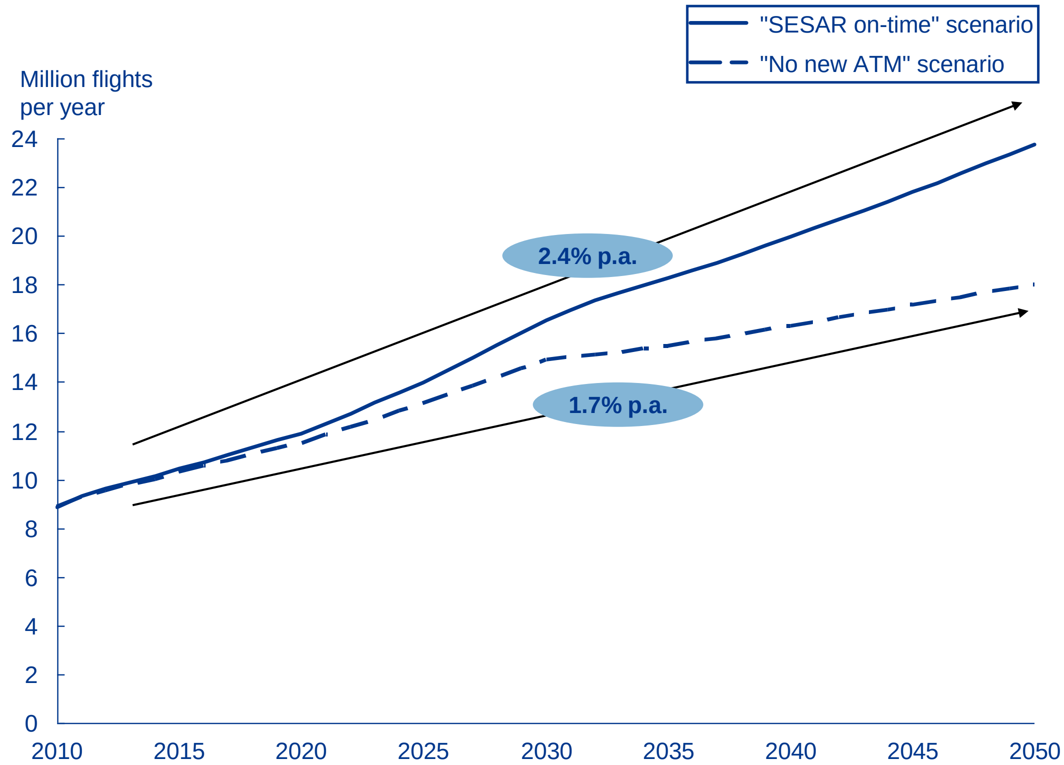


Figure 3 shows the air traffic forecast curves for the on-time implementation of SESAR and without the SESAR implementation scenarios, developed further in the next section. For the period of 2010-2050, this represent an average yearly growth rate of 2.4% and 1.7%, respectively.

4. MACROSCOPIC IMPACT FOR EUROPE IN THE PERIOD 2013-2030

4.1. Benefits of the on-time implementation of SESAR

Analyses show that SESAR deployment would make a substantial contribution to the European economy, society, and environment for Europe over the period 2013-2030.

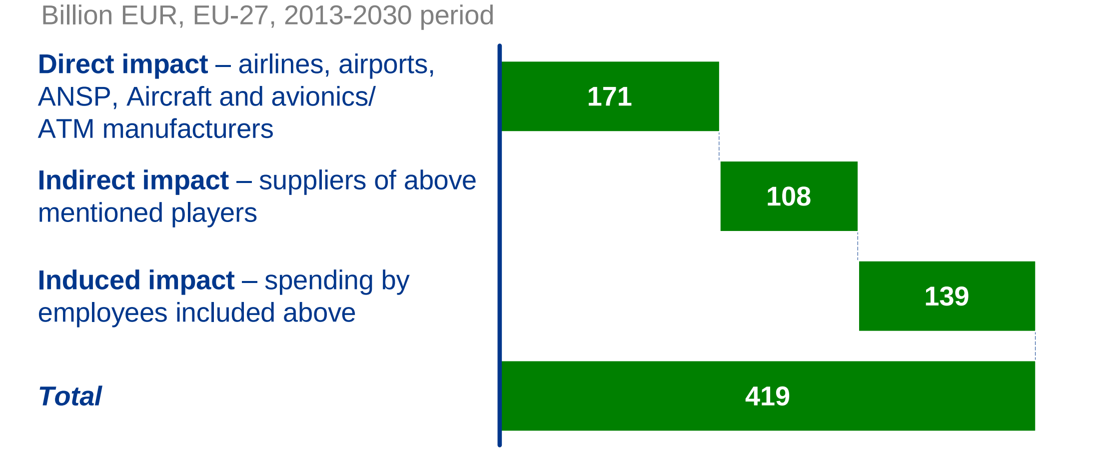
The on-time implementation of SESAR, compared with a scenario in which ATM is not modernised, would have a positive impact on GDP estimated at € 419 bn. This represents 0.16% of combined EU27 GDP over the considered period. SESAR would contribute by an additional 0.02 percentage point to EU27 annual GDP growth, with 328 000 new jobs and 50 million tons of CO_2 emissions saved.

4.1.1 Impact on GDP

The impact that SESAR would have on GDP is worth looking at in greater detail. As stated above, the total contribution to GDP of the on-time implementation of SESAR, including all direct, indirect and induced effects, would amount to € 419 bn over the period 2013-2030 or a 0.02 percentage point increase in GDP annual growth. If an evaluation period of 25 years for SESAR were to be considered, the total combined, undiscounted impact on GDP would be € 1 190 bn.

Closer analysis of the figures demonstrates a breakdown in which **the direct contribution is the largest**. Direct benefits account for € 171 bn in direct effects on GDP, whereas a further € 108 bn of indirect effects and € 139 bn of induced effects (i.e. 41%, 26% and 33% respectively of the total) complement the overall value of SESAR, as illustrated in ***Figure 4*** below.

Figure 4 – GDP impact - SESAR on-time scenario



In addition to its direct impact, the SESAR programme would have a positive **indirect** effect on the European industries that supply avionics and aircraft manufacturers, civil airspace users, airports and ANSPs. For example, each additional aircraft manufactured creates value not only for the aircraft manufacturer itself, but also for its equipment suppliers and service-providers. According to the model, this indirect effect would represent € 108 bn of additional contribution to GDP for the period 2013-2030.

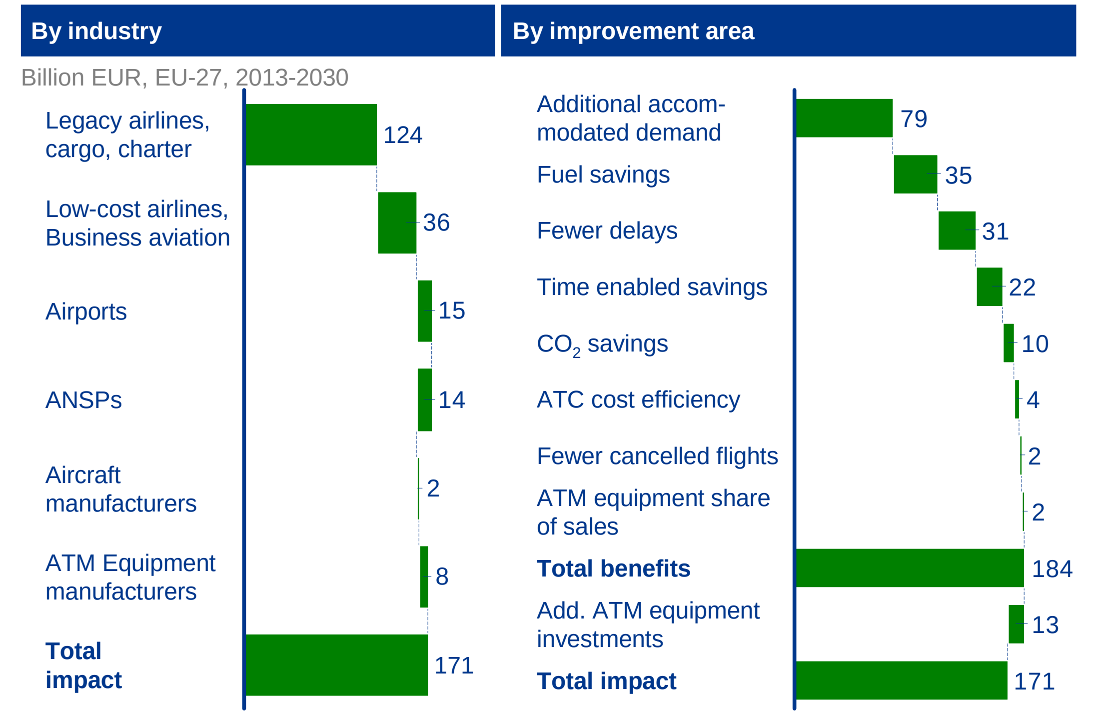
SESAR would also have an **induced economic impact** through increased spending by employees who are directly or indirectly affected by SESAR deployment. To illustrate this point, for example, additional employees would be employed by civil airspace users to cater for the greater volume of traffic made possible by SESAR. When those employees receive their pay, they are likely to spend part of their earnings on eating out or shopping or entertainment, thus creating additional value in those other sectors, which in turn benefits the people who work in them. These **induced effects** represent in our model an additional € 139 bn for the period 2013-2030.

Looking more closely at **direct benefits** on a EU27 level, undiscounted benefits are expected to reach € 171 bn additional contribution to GDP (equivalent to 0.16% of combined EU GDP) for EU27 countries over the period 2013-2030, i.e. the ramp-up timeframe for SESAR, extended by 5 years.

When the impact on economies worldwide is considered, the direct effect on GDP increases still further, represented by non-EU civil airspace users enjoying the benefits of flying in EU airspace, civil airspace users and airports enjoying benefits in non-EU SES countries, and because of non-EU industry supplying aircraft and ATM equipment to the EU. Of these effects, only the first one has been quantified, creating a direct GDP boost of € 27 bn.

The overall economic benefit of the improvements made possible by SESAR varies significantly. It also benefits all of the various parties in the air transportation industry differently. The main benefits by industry and improvement areas are displayed in ***Figure 5***.

Figure 5 – Breakdown of the direct GDP benefit - SESAR on-time scenario



The increase in accommodated demand for flights represents the biggest share of benefits, with 43% of the total. This effect impacts all parties involved in the air transportation value chain. Based on the European ATM Master Plan – Definition Phase, by 2030, SESAR deployment is expected to enable 1.6 million additional flights compared to a situation without SESAR. Most of these benefits would go to the civil airspace users and more specifically to airlines operating in congested areas where the additional traffic capacity enabled by SESAR is leveraged most intensively.

Second in the order of direct benefits created by SESAR is the reduction in fuel consumption. This represents 19% of the total and would be of sole benefit to civil airspace users, assuming savings are not passed on to travellers through fares reductions. Hopefully, benefits from cheaper flights would be shared among civil airspace users and travelling public alike.

The reduction in delays and related costs, such as compensation to passengers for flight cancellations, represents 17% of total effect and would again benefit civil airspace users only.

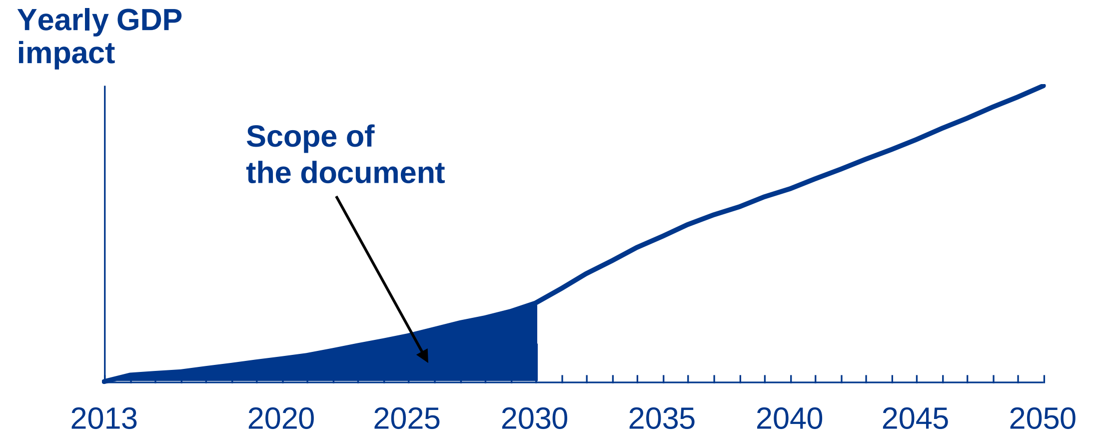
Time-related savings, i.e. the savings created by shorter flight times defined in the ATM Master plan – Definition Phase, would contribute a further 12%, for civil airspace users only.

CO_2 emissions saving account for 5% of SESAR total impact.

The remaining impact would come from a combination of other costs and benefits.

The period 2013-2030, consistent with the on-time deployment of SESAR, was considered though benefits go beyond this period as conceptually illustrated on ***Figure 6***.

Figure 6 – EU GDP impact beyond 2030 – "SESAR on-time" scenario



4.1.2. Impact on employment

SESAR is expected to create, on average, 328 000 additional jobs in Europe over the period 2013-2030. Based on the current industry structure, the translation of economic impact into job creation represents a total of 42 000 new direct employment opportunities in the air transport sector.

The majority of these new opportunities would result from the increased level of activity in the air transport sector and its related industries. However, civil airspace users would be the major beneficiaries, with 84% of the direct beneficial impact on employment.

It is also worth noting that while the increase in ATC efficiency and automation at ANSPs might originally have been considered as a threat to employment for air traffic controllers, the additional flights enabled by SESAR counterbalance this effect. Early calculations show that in the long term, the overall impact on ANSP employment would remain approximately neutral.

Similar to the indirect and induced effects on GDP, SESAR would also create indirect and induced employment, amounting to 116 000 indirect and 170 000 induced additional jobs for the period 2013-2030.

4.1.3. Impact on the environment

Overall, the positive environmental effects of SESAR will more than compensate the negative effects of additional flights in 2013-2030, thus allowing for a 'neutral' growth of the air traffic (no the "new ATM" scenario), and the economic growth associated with it. More specifically:

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Noise is defined and quantified in SESAR through the nuisance and health costs to individuals. These costs are assumed to decrease by 10% per flight with SESAR due to shorter and more efficient operations.

Air pollution, through the emission of particulate matter (PM), Nitrous Oxides (NOx), Sulphur Dioxide (SO_2) and Volatile Organic Compounds (VOC) affecting health and buildings/materials, causing crop losses and generating additional costs with further damages to the ecosystem (biosphere, soil, water), is reduced. This cost is assumed to **fall by 10% as the result of SESAR** due to lower emissions. This, in turn, **more than offsets the cost of additional flights** made possible by SESAR in 2013-2030.

Climate change costs from the effect of greenhouses gases (esp. CO_2, NOx, in the case of airplanes), at the origin of rising sea levels, increased energy use, negative impact on agriculture, water supplies, health, ecosystems and biodiversity, would fall by 10% per flight due to the reduction in fuel consumption. Negative impact from additional flights enabled by SESAR would, in consequence, be more than offset in the 2013-2030 period, thereby contributing to the EC's decarbonisation targets, as well as IATA's goal of being carbon neutral. During this period, the CO_2 emissions saved represent approximately 50 million tons, the equivalent of the annual emissions of a city of 5 million people.

The cost of **upstream and downstream processes** is the indirect effect from changes in the transport market due to the production of energy (pre-combustion), vehicles (maintenance and disposal), as well as infrastructure construction, maintenance and disposal. For air transport, this would mean a better utilisation of infrastructure, as well as a 10% reduction in the use of resources made possible by more efficient flight operations. This in turn helps offset the cost of additional flights enabled by SESAR.

4.1.4. Impact on mobility, safety, security on society as a whole

The impact on **mobility** represents the cost of unnecessary time spent travelling for business and leisure air travellers. Travel duration is also influenced by the reliability of operations currently negatively affected by high traffic densities. SESAR would shorten flight-times by an average 9 minutes through more efficient flight trajectories and routes. Delays would also be reduced by 50%[15]. One may well ask what the benefit of saving 9 minutes per flight might amount to. Using the internalization factor of € 24 per hour as recommended by the EC[16], 9 minutes saving per flight represents a catalytic boost to the EU economy of more than €100 bn. As stated previously, please note however that the catalytic effects were not added to the total benefits

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[15] Definition phase projections

Safety represents the direct and indirect cost of an accident (material costs, medical costs, production losses, suffering caused by fatalities). As introduced in the ATM Masterplan, SESAR aims to achieve a tenfold increase in safety.

Security: SESAR simplifies the EU-wide and cross-civilian/military operational coordination and with the exchange of air traffic information through SWIM could support national security tasks.

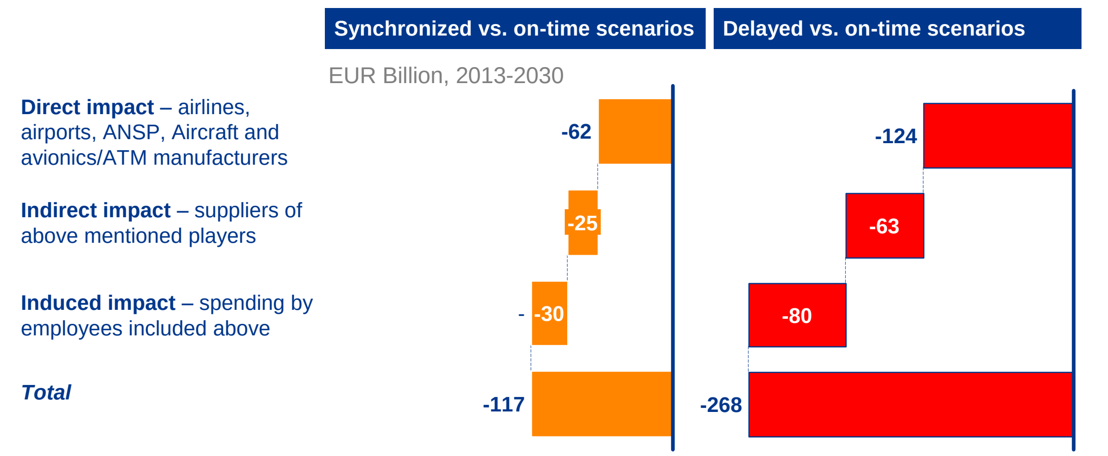
4.2. Benefits put at risk in case of delay or desynchronisation

Any negative deviations from an effective and timely implementation, as defined in the European ATM Master Plan, would put significant SESAR-related benefits at risk.

Delaying the implementation of SESAR by 10 years would cost about €124 bn to direct GDP, representing 72% of the overall direct value. When indirect and induced benefits are included, the negative impact rises to € 268 bn (or 0.10% of combined GDP). In terms of employment, this would represent a reduction in job creation of 189 000 jobs. And environmentally, the savings of 55 million tons of CO_2 would be at risk.

Desynchronised implementation was also considered. In this case, not all of the parties involved invest in SESAR simultaneously, for instance in case of geographic differences or air/ground de-synchronisation. The network-based nature of SESAR means that this type of de-synchronisation would lead to a situation in which some players have already invested in the new system, but none can benefit from it. In this situation, and assuming a de-synchronisation period of 5 years, the benefits of SESAR would be reduced by € 62 bn compared to the "SESAR on time" scenario (or € 117 bn including indirect/induced effects); the creation of 72 000 new jobs and savings of 35 million tons of CO_2 would also be at risk (cf. ***Figure 7***).

Figure 7 – Benefits at risk from a delayed or desynchronized SESAR implementation

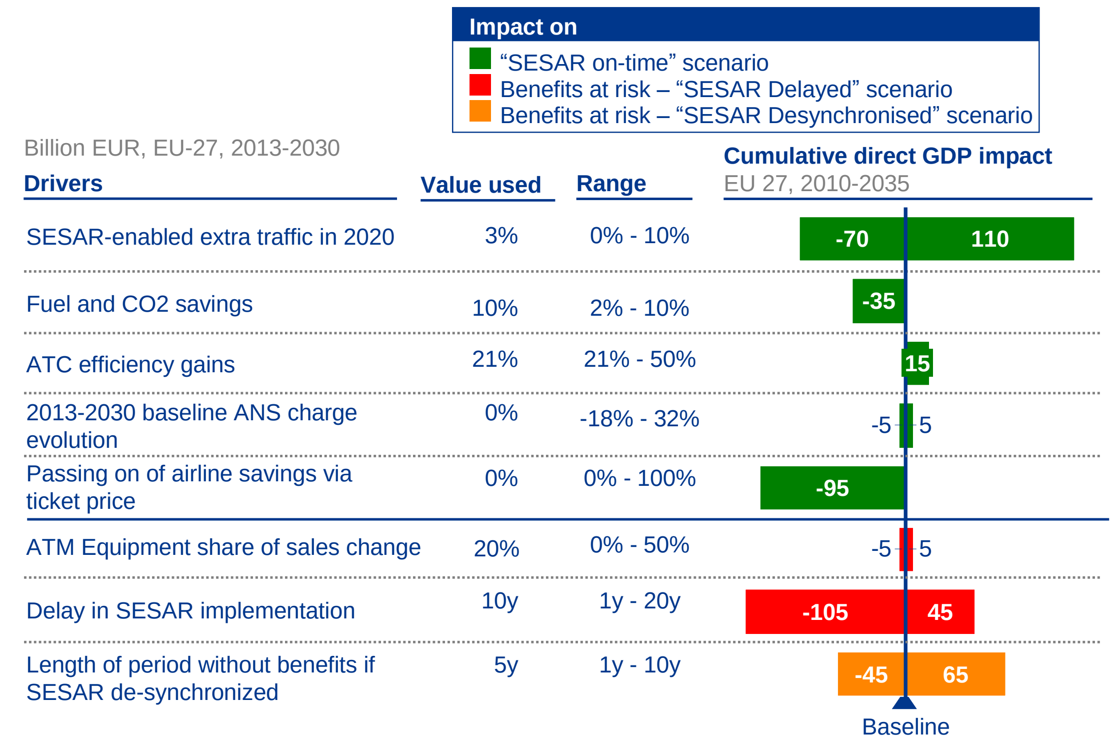


In addition to having an impact inside Europe, any delay or de-synchronisation in the adoption and implementation of SESAR would also mean a negative effect on European companies and organisations operating outside Europe.

4.3 Sensitivity analysis

When examining the many areas of uncertainty relevant both to deploying SESAR and potential changes in the sector, a broad range of sensitivities were considered for the major economic impacts taking as reference case the on-time implementation of SESAR which according to the European ATM Master Plan is the scenario that provides the highest economic benefits to the EU. The overall impact varies significantly: as a result of the analysis carried out, the impact of SESAR was found to be highly sensitive to the extra traffic to be accommodated, as well as the potential reduction in airfares as a market reaction to airline cost-savings. If SESAR were not to lead to any additional air traffic, up to 40% of the direct impact on GDP would be at risk. Considering a reduction in the price of airfares, 0% to 40% of total impact on GDP could be at risk depending on price sensitivity assumptions and size of the reduction.

Figure 8 – Sensitivity analysis for key drivers



SESAR-enabled additional traffic in 2020: A change in the numbers and volume of air traffic, whether due to economic developments, decreases/increases in fuel or airfares, taxation or other policy measures, affects the level of benefits that predominantly civil airspace users and airports derive from a greater or lower accommodation of additional flights. This means that the direct impact could vary between € 101 bn and

€ 281 bn (for 10% SESAR-enabled additional accommodated traffic by 2020).

Passing on airline savings via airfares: so far, it has been assumed that civil airspace users would retain the SESAR-enabled cost savings in the form of increased profits. However, in line with historical trends, if the civil airspace users were to pass on part or all of the cost-savings to consumers, airfares would be reduced on average by € 5 in the period 2013 to 2030. This would have a negative impact on the direct contribution to GDP of € 95 bn brought about by SESAR. This negative direct effect would be partially offset by increased demand for air travel as a consequence of lower fares. This increased demand would in turn generate higher revenues, employment, and profits throughout the value chain, thereby increasing the direct, indirect and induced impact on GDP. The total impact of SESAR on GDP would fall by only 40% in the case of the full redistribution of cost-savings and a conservative price elasticity of -0.5. When considering higher price elasticity of around -1, the negative direct and positive indirect and induced effects cancel each other out, leaving the total impact on GDP more or less unchanged.

Delay: In the event of the delayed or de-synchronised implementation of SESAR, the period during which no benefits can be obtained from SESAR is by far the main driver for the total benefits of SESAR. As a base case for a 'delay' scenario, a gap of 10 years was considered, in line with historical ATM technology deployments. If this delay were to be reduced to 1 year, the overall negative effect of the delay on direct GDP would be reduced by € 105 bn to € 66 bn. In the opposite case, a delay of 20 years would increase the direct negative effect of the delay to € 171 bn.

Fuel and CO_2 savings: In case of a reduced savings of fuel and CO_2 emissions, the calculated impact on GDP would be € 35 bn which corresponds to a reduction of SESAR impact on GDP of 20%.

Other sensitivities tested include ATC efficiency gains (21% to 50%), non-SESAR ATC efficiency gains (-18% to 32%) and changes in the share of sales for avionics manufacturers (0% to 50%). None of these changed the total direct impact of SESAR on GDP by more than 20%.

5. CONCLUSIONS

This report has identified that the timely and effective implementation of SESAR according to the EU ATM Master Plan would have a **significant positive impact on Europe**. It would also be a broad contributor to future prosperity and employment, as well as to support carbon-neutral growth compared to a situation without new ATM systems and improve the travel conditions of the public.

Other real and important benefits, such as supporting innovation and increasing European aviation industry competitiveness via the research, development and deployment of SESAR, weren't considered as part of this study.

However, **the benefits of SESAR are extremely sensitive to its implementation timeline and coordination**. The full impact can only be achieved if the timely and coordinated implementation of SESAR can be ensured. For Europe to be able to enjoy the multiple benefits that SESAR would bring, the required upgrades to technical standards need to be implemented / deployed on schedule and all public and private stakeholders to work in partnership to enable the orderly and efficient rollout of SESAR at an EU level.

The risk of a de-synchronised or delayed deployment is real. As the benefits of SESAR will only materialise if a large majority of the involved stakeholders implement the technology, there is the risk of a perceived advantage for stakeholders to move last to implement SESAR (i.e. 'last mover advantage').

The EC seems to have recognised the need to act, as already expressed in the Transport White Paper: "*Action cannot be delayed. Infrastructure takes many years to plan, build and equip […] – the choices we make today will determine transport in 2050. We need to act on a European level to ensure the transformation of transport is defined together with our partners rather than determined elsewhere in the world*."

To improve the impact of SESAR and optimise its delivery, a range of actions could be taken. In addition to legal requirements, the EU has at least two levers to mitigate the risks caused by implementation delays and de-synchronisation. First, the establishment of a clear, Europe-wide governance for the deployment of SESAR, allowing for central coordination. Second, the definition of public funding – incentive mechanisms to push for early adoption, both in the air and on the ground.

Overall, as the EU-wide implementation of the first SESAR capabilities is planned for 2013, this emphasises the importance and urgency of having appropriate policy decisions taken at a Council Level regarding effective governance and funding for the deployment phase of SESAR.

APPENDICES

APPENDIX A: DETAILED METHODOLOGY

The macroeconomic impact of SESAR in terms of GDP and job creation at an EU level was assessed, based on an economic model. This model takes three types of effects into consideration:

1. **"Direct":** impact on ATM equipment and aircraft manufacturers, civil airspace users, airports and air navigation service-providers. For each of them, the model estimates the value enabled by SESAR from additional flights, fewer cancellations and delays, improved ATC cost-efficiency, reduced fuel consumption and CO_2 emissions, time-savings, increased investment and share of sales by the ATM equipment industry
2. **"Indirect":** impact on the multi-tiered suppliers of the direct players involved (ATM equipment and aircraft manufacturers, civil airspace users, airports and ANSPs). The model assesses the impact using multipliers from input-output economic tables.
3. **"Induced":** impact through increased spending by employees who are directly or indirectly impacted by SESAR. As with "Indirect" impact, the model assesses the impact using multipliers.

Based on the discussions conducted during the workshops, four hypothetical scenarios for the implementation of SESAR in Europe were developed to provide an understanding of the macroeconomic impact of the various assumptions:

- **Scenario A: "No new ATM"**. This "business-as-usual" scenario serves as a base case and assumes that in terms of the Single European Sky, only incremental changes will be implemented to build on existing systems. This scenario assumes that there is no paradigm shift in the way the ATM system operates. As a result, the amount of demand not accommodated under "No new ATM" would grow over the coming years to 1.6 million flights by 2030.
- **Scenario B: "SESAR on time"**. This scenario assumes that the performance targets described in the ATM Master Plan and investments with them are ramped up according to plan over the period from 2013 to 2025. The difference between Scenarios A and B highlights the full benefits of deploying SESAR as planned.
- **Scenario C: "SESAR de-synchronised"**. This scenario assumes the de-synchronised (i.e. piecemeal) implementation and adoption of SESAR by key protagonists. This would lead to an extended investment period between 2013 and 2030, with the benefits only starting to materialise after 5 years (i.e. at the earliest by 2018). The benefits would only ramp up to their full potential by 2030, at the same speed as in Scenario B. The de-synchronised implementation of SESAR might occur because there is insufficient coordination between different airspace users or between air and ground investments (either ground systems have been implemented,

but avionics have not yet been installed in aircraft, or vice versa, thus hampering use of the benefits as a complete system). This has occurred historically in the deployment of some other ATM technologies.

- **Scenario D: "SESAR delayed"**. This scenario assumes a 10-year delay in the implementation of SESAR, i.e. that investments and benefits are gradually ramped up over the period 2023 to 2035. This could occur due to a longer-than-anticipated R&D programme (technical difficulties, lack of funding) and/or slow adoption (uncertainty about standards, cumbersome governance, lack of central leadership).

The most relevant comparisons of scenarios are the impact of the on-time implementation of SESAR (vs. no implementation), as well as the value put at risk in the event of de-synchronisation or delays.

The model and the four scenarios were presented and discussed in a series of bilateral discussions, as well as at two workshops with technical experts from key protagonists, representatives from industry associations, OECD and EU institutions. Feedback was collected and taken into account to refine the model and some of the assumptions made. In total, more than 20 representatives from public institutions and the aviation industry provided feedback.

In this study, effects were assessed both quantitatively and qualitatively. For GDP and jobs, direct, indirect and induced benefits were considered. Direct benefits were calculated bottom-up for civil airspace users, airports, ANSPs, and aircraft and ATM equipment manufacturers, using parameters specific for the industries considered. The indirect and induced effects were assessed using multipliers from input-output economic tables.

A.1. Drivers of the direct effect of SESAR

SESAR direct effect has been computed along 9 levers:

i. **Additional accommodated demand:** According to ATM Master Plan, SESAR would increase runway capacity by up to 33 per cent, depending on airport configuration, weather conditions and congestion levels (cf. ***figure 9***). On average for Europe, SESAR would enable a 20% increase by 2020. SESAR also relieves any ATM en-route capacity constraints. By 2030, this could result in up to 2.6% more flights being accommodated, without negatively impacting delays or safety. For civil airspace users, ANSPs, airports and manufacturers, this increased capacity would also represent an increase in activity level. For travellers, it means increased mobility with a wider choice of routes and/or schedules becoming available.

Figure 9 – Runway capacity gains – 2020 performance targets

KPA	Key Performance Indicator (KPI)	Baseline		2020 Target	
		Year	Value	Absolute	Relative
Capacity	Annual IFR flights in Europe	2005	9.2 M	16 M	+ 73%
	Daily IFR flights in Europe	2005	29,000	50,000	+ 73%
	Best In Class (BIC) declared airport capacity in VMC (1 RWY), mov/hr	2008	50	60	+20%
	BIC declared airport capacity in VMC (2 parallel dependent RWYs), mov/hr	2008	90	90	+0%
	BIC declared airport capacity in VMC (2 parallel independent RWYs), mov/hr	2008	90	120	+ 33%
	BIC declared airport capacity in IMC (1 RWY), mov/hr	2008	25	48	+90%
	BIC declared airport capacity in IMC (2 parallel dependent RWYs), mov/hr	2008	45	72	+60%
	BIC declared airport capacity in IMC (2 parallel independent RWYs), mov/hr	2008	45	96	+110%

Source: SESAR Master Plan D5

ii. **Time-enabled savings (for civil airspace users):** SESAR is expected to reduce the average flight time by 10% as a result of ATM routing improvements. This would cut airline operating costs (e.g., maintenance, long-term workforce planning), potentially allowing additional flights to be accommodated and reducing passenger flight times by an average of 9 minutes per flight.

iii. **Fewer delayed flights:** With a more timely and precise information sharing capability within the air traffic system, SESAR would reduce overall delay[17]-related time losses by 50%. This would cut airline costs, mainly by reducing the compensation paid to passengers for flight cancellations, which in turn would reduce airline and airport costs and increase overall travelling convenience.

iv. **Fewer cancellations:** SESAR would reduce knock-on flight cancellations (e.g., as the result of late arrivals) and cancellations caused by service disruptions (e.g., the reduction in airport capacity in bad weather should be cut from 50% to 20%) by 50% with respect to the total number of scheduled flights..

v. **CO_2 cost-savings:** similar to *point vi*. below, the reduction in airline fuel consumption would decrease CO_2 emissions by 10%. This would lead to a direct cost reduction for civil airspace users given charges linked to CO_2 emission under the EU Emissions Trading Scheme (ETS). This would in turn also bring side-effect benefits to airports, where emissions are more concentrated and are required to comply with given emission constraints. To society in general, this represents a lower impact on the environment and would help to combat climate change.

vi. **Fuel-savings:** SESAR would enable average fuel-savings of 10% as a result of improvements to ATM practices (e.g., better routing, fewer delays).

[17] Delays refer to ATC actionable delays (which includes lower capacity in bad weather conditions)

vii. **Improved ATC cost efficiency:** SESAR would reduce the ANS charges paid on a per flight basis by civil airspace users to ANSPs by 21% as a result of an increase in air traffic and cost efficiency (e.g., an increase in ATCO productivity). This also includes the 'determined cost basis' regulation. In addition, SESAR would enhance ground operations at airports. Other non-SESAR effects, such as the implementation of Functional Airspace Blocks (FAB), would further reduce ANS charges by around 50%. However, these non-SESAR effects are not included as part of the impact assessment.

viii. **Additional investments in ATC/avionics:** SESAR would require the installation or upgrade of equipment. This has been estimated by the Definition Phase at approximately € 30 bn (€ 11 bn in civilian retrofits, € 5 bn in forward-fits, € 7 bn for the military and € 7 bn for civilian ANSPs).

ix. **Changed share of avionics sales** (not part of the ATM Master Plan)**:** As SESAR would require the development of new ATM-related standards, sales of avionics or ground equipment manufacturers would benefit from SESAR implementation. Looked from another perspective, an avionics player deciding not to invest in SESAR-related R&D/standards or facing development delays compared with other ATM standards, is likely to see its market share reduced, simply because its products will not reach the market until later. As an initial estimate, a 20% reduction in market share was considered in the event of a 10-year delay. This would also have indirect effects on the continuous improvement of European technological knowledge.

A.2. Major assumptions

The model is based on several basic assumptions:

- **Scope** this encompasses the implementation of SESAR in the SES and assesses the economic impact at an EU27 level considering which policy and legislative actions may be taken by the European Commission. Exports of EU aircraft are considered constant in all scenarios, i.e. SESAR does not have an effect on these exports.

- **Financial conventions:** all numbers are stated in purely "real" value terms, i.e. payments and benefits are not increased annually by inflation and results are presented in undiscounted and cumulative fashion between 2013 (the start of SESAR deployment) and 2030 (the final year for which a traffic forecast is available). Real value is used to encompass the real economic growth triggered by the implementation of SESAR. Also, unlike cost-benefit analysis, GDP analysis is not discounted.

- **Air traffic forecast:** traffic levels are based on Eurocontrol's STATFOR long-term forecast[18]. This includes assumptions about developments in the price of fuel and airfares, expansions to the high-speed rail network and physical airport capacity. Based on discussions with experts during the methodology workshops, this forecast has been adjusted to take account the additional capacity enabled by SESAR, as well as in-air and Traffic Management Adviser (TMA) capacity constraints. The STATFOR forecast was selected as it is widely used across Europe and provides detailed forecasts on both demand and presents the ability of airports to accommodate demand at a country level. Other forecasts show comparable growth rates, e.g. PRIMES forecast[19] predicts 2.4% annual EU traffic growth in 2013-2030, while STATFOR forecasts 2.3% annual growth for the same period.

- **Air traffic categories:** the entire traffic is grouped into two categories for which the benefits from un-accommodated demand and delays vary, depending on the type of airports typically used, and business model of flights. Group 1 encompasses legacy civil airspace users, charter and cargo flights (in total 68% of all flights), while group 2 (28%) covers low-cost civil airspace users and business aviation. For the remaining flights (2% military, 2% others[20]), the resulting economic benefits were assumed negligible compared to the total benefits, while their implementation costs were included in order to ensure EU-wide system rollout.

- **Air transport players:** the model provides a macroeconomic view of the impact of SESAR. The effect of SESAR is shown for the air transport players selected (civil airspace users, airports, ANSPs, aircraft and ATM equipment manufacturers). The impact of SESAR on other players, such as property lessors, reservation systems, freight forwarders and travel agents is covered via the indirect multipliers, as these players are either relatively small compared to the total industry, or would only experience a relatively limited impact from SESAR.

- **Usage of multipliers:** There are two methods for estimating indirect and induced effects: multipliers from input-output economic tables and GCE models. We opted for the former because it provides significant benefits. Multipliers provide a standardised framework, with consistent definitions for understanding and analysing inter-industry connections through the supply chain, as well as links to categories of final demand. Multipliers also enable a comparison of the total impact of an initial change across various countries. This is greatly facilitated by the existence of an EU27 input-output table, while a GCE model would

18 Scenario C. Note that this is an explicit forecast until 2030, followed by an extrapolation until 2050.

19 Policy Option 1

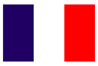
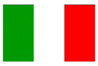
20 Classification used GAT IFR traffic as STATFOR; other include private civil aviation

require a greater amount of time to develop. Also, in the past, other studies (e.g. “Frankfurt Airport extension” or “Employment effects of the extension of renewable energy industry”) have used multipliers based over lengthy periods of time. Particular care has been taken to avoid any double-counting of indirect effects from the different air transport players directly modelled. Any shortcomings of the multipliers used have been deemed acceptable in the context of this study. Any inaccuracies introduced by the static nature of multipliers have also been deemed acceptable, given that the focus of this report lies on the direct effects of SESAR and the fact that transport-related multipliers in China, India and the US have been observed to change by 10-20% only over a number of decades. The impact on jobs should not be considered in isolation, but should be taken together with other measures, such as productivity.

APPENDIX B: OVERVIEW OF THE INDIVIDUALS REVIEWING THE METHODOLOGY

Names in *italics* are members of SESAR project 16.6.6, which focuses on collecting, modelling and summarizing information to support business case development and stakeholder buy-in.

Focus area	Body	Name
Institutions	DG MOVE	Marco De-Sciscio, Jan Szulcyk, Doris Schroecker, Katarzyna Gryc
	EUROCONTROL	*Paula Leal de Matos* Xavier Fron David Marsh, Magda Gregorova
	OECD	Stephen Perkins, Kurt Vandender, Jari Kaupilla, Norihiko Yamano, Naohiko Ijiri
	DG ECFIN (relayed on JRC experts)	Panayotis Christidis, Francoise Nemry
Civil airspace users	IATA	Selim Ach
	IACA	Guy Battistella
	ELFAA	Francis Richards
	AIRFRANCE	*Olivier Llacagne*
	Lufthansa	*Manfred Mohr*
	ebaa	*Belarmino Paradela*
Airports	ACI	Philipp Ahren
	Aena	*Lourdes García Bartolomé*
ANSPs	canso Belgocontrol	Bernard Martens
	canso Aena	Juan Macho
	NATS	*Nigel Tay*
Manufacturing inudstry	ASD AIRBUS	Daniel Janouschek
	AIRBUS	*Philippe Maligne*
	ASD THALES	Gordon Sarlet
	THALES	*Herve Goutelard, Philippe Jasselin*

Focus area	Body	Name
Country specifics and overall approach		
	Ministry of Transport	Tom Worsley, Alex Macfarlane, Stu Wain
	Ministry of Transport	Nancy Sickert
	Ministry of Transport	Philippe Ayoun
	Ministry of Transport	Olga Kazmierska
	Ministry of Transport	Helena de Lucas de Santos, Raul Medina Caballero
	Ministry of Transport	Bergamini Elisabetta

APPENDIX C: LIST OF ACRONYMS USED IN THE DOCUMENT

- A/C Aircraft
- ACI Association of Airport Operators
- AENA Aeropuertos Españoles y Navegación Aérea
- ANS Air Navigation Service
- ANSP Air Navigation Service Providers
- ASD Aerospace and Defence Companies
- ATAG Air Transport Action Group
- ATC Air Traffic Control
- ATM Air Traffic Management
- CANSO Civil Air Navigation Services Organization
- CBA Cost Benefit Analysis
- EBAA European Business Aviation Association
- EC European Commission
- ELFAA European Low Fares Airline Association
- GALILEO European Global Satellite Navigation System
- GDP Gross Domestic Product
- GHG Greenhouse Gas
- IATA International Air Transport Association
- IACA International Air Carrier Association
- JRC Joint Research Center – European Commission
- MOD Ministry of Defence
- MOF Ministry of Finance
- NATS National Air Traffic Services (UK)
- NPV Net Present Value
- OECD Organisation for Economic Co-operation and Development.
- SES Single European Sky
- SESAME now called SESAR
- SESAR Single European Sky ATM Research
- SWIM System Wide Information Management
- TMA Terminal Manoeuvre Area

APPENDIX D: PUBLIC REPORTS USED

- EUROCONTROL STATFOR LTF10
- t2_3_1_d4_airport-capacity-quantification-20071106.xls
- ACE 2008 Benchmarking Report
- 20100225 Civil Business Case v60.xls
- SESAR Master Plan D5, April 2008
- ECAC Constraints to Growth '01
- OAG flight database, 2010
- Roadmap to a Single European Transport Area
- Eurostat Labour Market Statistics 2009
- Summary Report, Operating Economy of AEA Airlines 2007
- Global insights Inflation Figures for European Countries, 2009-2039
- PRR 2009 Report
- t2_3_1_d4_airport-capacity-quantification-20071106.xls
- IATA employment database ‘09
- ICAO 1993-2007
- IATA, june 2010, average 2005-2010
- ACI Europe Economics Report 2009
- Airbus website (http://www.airbus.com/tools/airbusfor/analysts/, Feb '11; airbus.com/work/why-join-airbus/global-business/)
- EADS Financial Report 2010
- Frost & Sullivan report 2009
- ASD Fact&Figures 2009
- OECD, National Statistics Offices
- 2010 annual reports of Air France-KLM, British Airways, Lufthansa, Ryanair, Easy Jet
- GDP Real and Nominal.xls
- Standard Inputs for EUROCONTROL Cost Benefit Analyses 4.0 October 2009
- EuroControl Challenges of Growth '08
- CRCO Report 2008

- Competitiveness of the EU Aerospace Industry with focus on: Aeronautics Industry
- WATS/IATA and company annual reports
- SESAR brochures – ‘Today’s partners for Tomorrow’s aviation’