



ACCHANGE:Final Project Report

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Abstract

The final project report of the ACCHANGE project provides a publishable summary of the results. In addition it lists all deliverables, dissemination activities, eligible costs, deviations, bills and lessons learned.

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Publishable Summary

The number of passengers and flights in Europe has dramatically increased since the 1970s. This increase created capacity problems in the air and at the airports, causing delays and associated costs for airlines and passengers. Initiatives such as the Single European Sky (SES) were taken by the European Commission (supported by Eurocontrol) to deal with this problem. However, to date the results of implementing the SES initiatives have so far not met expectations.

The current deployment of SESAR is focussed on centrally steered and synchronised implementation. ACCHANGE, on the other hand, proposes a behavioural solution for the introduction of the new technologies. It looks for other incentive structures and pathways to change Air Traffic Control (ATC) provision. The main research questions were:

- What has led to the current inefficiencies in air navigation provision? Is central implementation the way forward? What financial regulation schemes for ANSPs are best suited in creating the right incentives?
- Can change come from within the sector? What is the right environment to enable bottom-up change and generate a successful introduction of new Air Traffic Management (ATM) technologies?
- What are the costs and benefits of different introduction scenarios and how does this relate to the fully coordinated adoption assumed in several macro-economic assessments of SESAR?

To this end a number of economic models have been developed and applied to simulate the effects of policy changes. All Deliverables can be found on <http://tmleuven.be/project/acchange/index.htm>

The study started with an analysis of the present developments in ATC and in the aviation sector in Europe (in Deliverable 2). These developments were compared to evolutions in other sectors. We first looked at models of liberalisation of national monopolies in network sectors such as the electricity transmission, rail and telecommunication. Next, we considered the implementation of new technologies in other (network) sectors such as the automotive industry, electric vehicles, tablets, bike components, etc (Deliverable 1). These cases were selected with the following questions in mind:

- How important was deregulation (liberalisation) in the process of introducing new technologies and services?
- How was the request for absolute safe operation taken into account when rail infrastructure and electricity transmission were privatised and/or liberalised?
- How were concerns for loss of employment dealt with? How did the European Commission convince the Member States to follow this liberalisation process?
- What are the incentives to develop and introduce new technologies?
- Why would firms standardize new products or not?
- Why will some new products dominate the market?
- What role did Government intervention play in the introduction of new technologies?

Our analysis focused on institutions, cost efficiency, technological innovation and regulation; and on factors hindering the change with ATC, such as “home bias” (protection of sovereignty and national interests), the “status quo bias” (labour union resistance to change), “regulatory contradiction” (price cap regulation is not necessarily compatible with the adoption of new technologies if the associated costs are not sufficiently compensated), and “coordination complications” (the incentive mechanism is further complicated by the existence of multiple stakeholders which all need to invest in the initiatives in a coordinated fashion and the imbalance in the distribution of costs and benefits across stakeholders). Based on this analysis, a first set of scenarios was developed (Deliverable 3). We developed four different models to analyse the market for ATC provision in Europe and the potential paths for change (the scenarios): a network congestion game, a labour union model, a public utility efficiency model and a simple economic network model (Deliverable 4).

The first model focusses on estimating the effects of given scenarios. The other models focus more on explaining the present inefficiencies in ATC provision.

The network congestion game is a two stage model, developed to test multiple scenarios. In the first stage, en-route and airport ATC providers set peak and off-peak charges and in the second stage, airlines select flight paths given their schedule and the charges from the first stage. Consequently, per scenario, the impacts on the users (different types of airlines) and on ATC providers is estimated taking into account the possible rerouting behaviour of airlines. The scenarios analysed in the network congestion game include (i) the impact of privatization and deregulation; (ii) defragmentation of the set of current providers; (iii) introduction of technology via the PCP and SESAR Step 1 projects; and (iv) the regional forerunner approach in which the en-route and airport ATC providers and a specific airline together cooperate. This model highlights the fact that horizontal integration across ATC providers would appear to be problematic with respect to incentives. Regional forerunners would appear to be the approach that should be encouraged. Vertical integration between companies may succeed in accelerating change as long as the ATC companies are permitted to charge for improved quality, such as reduced congestion. The model also shows that there is insufficient competition across flight paths in different regions to permit the removal of economic regulation. Consequently, ATC competition is only likely to arise when providers are in a position to compete over services over the same set of flight paths for example through virtual centres or time-limited auctioning of service provision. Finally, the modelling suggests that it is unlikely that SESAR Step 1 will be implemented without financial encouragement in the ATC sector. A separate hybrid peak/off peak price cap may be sufficient to encourage adoption if investments in SESAR are limited to standardized technologies.

In the second model, a union bargaining model, we analyse the behaviour of an ANSP as the result of bargaining process between a national regulator and the ATC union, where the union strives for higher wages and protection of its members. The result of the model highlights that, if unions have power, wages and/or employment will be higher than efficient and shows under what conditions the imposition of price-caps may fail. It also shows that ANSPs will be averse to technology standardisation and that the availability of virtual centres may be very important, even if never used.

The third model – a public utility model with asymmetric information, includes a national ATC regulator which pursues several objectives including incentivising the management of the ANSP to become more efficient. The model also incorporates multiple objectives for ANSP management to represent the variety of ownership forms of European ANSPs and the various degrees of representation in the board by stakeholders such as airline and airport representatives. We found that change from cost-plus regulation towards price-cap regulation can lead to an efficiency improvement. This is the case if the price-cap is effective and the ANSP acts as private profit-maximising firms, rather than as government controlled entities that fulfil a public duty. The price-cap on the other hand also provides incentives to cut back on quality of service if this is not appropriately monitored. The traffic risk element of RP1 was introduced to prevent ANPs from financial problems when traffic increase falls below forecasts. Although it was not the main goal, this type of regulation might also provide ANSPs with an incentive to attract more flights to their charging zone and keep (part of) the profits. We showed that this traffic risk element is however not very effective in controlling the quality of service as the demand tends to react minimally to changes in ATM charges. On the other hand, including explicit financial incentives for reaching certain quality performance targets (as envisaged in RP2) is probably a more effective regulatory mechanism. We further find that capacity-enhancing technology adoption follows a similar incentive patterns. Under a pure price-cap, ANSPs have very limited incentives to invest. This can be remedied by recovering investment costs or, even better, by rewarding the ANSPs for the expected reduction in delays obtained. This way, benefits from better airspace management are more equitably divided over various airspace actors.

The final network-based model draws the labour union and efficiency aspects together. Within this model it is also shown that vertical cooperation seems the way forward as it will provide incentives for higher cost-efficiency and more technology adoption of capacity-enhanced technology options. It also shows that the effectiveness of this “regional forerunner” model depends on the underlying model for wage determination and parameters such as risk aversion, profitability of ATM operations, profitability of airport operations and the effectiveness of the price-cap regulation.

The focus of the models discussed is on providing insights into the main mechanisms and drivers of the results obtained. In order to keep the ideas and modelling traceable this does mean the use of stylised models, simplifying assumptions and lack of operational detail. The models are hence not meant and not be seen as an exact replication of reality. In some cases data was missing and assumptions were used which might have influenced some of the results, although this would play mainly on the absolute level and not when focussing purely on the mechanisms described. A logical first strand of further research would hence be the advanced development of the models including the focus on maintaining quality goals/KPIs/Safety levels/..., the inputs used and an empirical testing of the models.

The main added value of the four theoretical models developed within this research project lies in the fact that they comprehensively demonstrate that price regulation and charging regimes will continue to be a cornerstone for change but that they are insufficient as a tool to encourage change. Their scope could be extended beyond cost-efficiency targets only and include also monetary compensation for targets in other key performance areas (delays, technology adoption, environmental targets and safety). Price regulation would then take the form of a hybrid price-cap¹. Alternative triggers for change stemming from the aviation market and the airport sector, as analysed in the network models, are shown to be too weak due to the low demand elasticities. ACCHANGE arrives at the conclusion that it is necessary to change the institutional and regulatory mechanisms in order to encourage both greater cost-efficiency and accelerated technological adoption simultaneously.

The study also suggests that introducing some competitive elements can help in driving bottom-up change. This is another approach, compared to the usual collaborative approaches for ATC sector development, which have been used in the past years. In this context, the “regional forerunner” vertical cooperation seems to be the way forward as it would introduce more competition and provide incentives for higher cost-efficiency and more adoption of capacity-enhancing technology options.

Hence, a second strand of possible further research could focus on the different possibilities to introduce more competition within the ATM world. These possible venues range from creating more efficient ATM business models to more drastic solutions such as changing the structure of ATC provision itself. As far as creating more efficient ATM business models - by introducing market forces at different levels that would reduce fragmentation - it would be worthwhile to investigate the effects of for example, organizing ANSPs as share based companies with equity that can be traded, allowing for change in ownership or cross-ownership; the tendering and contracting out of services to other ANSPs, to groupings of ANSPs and the ATM manufacturing industry; or the auctioning of ATC-provision. A more drastic approach would be to change the entire structure by focussing on flight-centered ATC. However, this change of structure leads to the following set of questions: What regulatory conditions should be in place to make this market function? What ‘markets’ should be there and what characteristics should they have? Another, more drastic, solution worthwhile exploring could be the stronger regulation of union powers and the structured establishment of merging processes. This could lead to a more US-orientated approach, where the unions have limited union powers and service provision is organized and operated as one entity. This strategy is worthwhile exploring (economies of scale, standardization of equipment), but also has its pitfalls (uptake of new technologies, cost-efficiency). The end point as well as the process could be examined.

¹ Today the regulatory framework for incentives and penalties is set by Regulations 390/2013 (laying down a performance scheme) and 391/2013 (laying down a common charging scheme). A hybrid price-cap would capture both elements (pricing and performance targets) into one scheme.

1 Introduction

1.1 Purpose of the document

The purpose of this document is to:

- Summarise the technical results and conclusions of the project (Publishable Summary);
- Provide a complete overview of all deliverables;
- Provide a complete overview of all dissemination activities (past and in progress). Where appropriate, provide feedback from presentations. Describe exploitation plans.
- Provide a complete overview of the billing status, eligible costs, planned and actual effort (incl. an explanation of the discrepancies).
- Analyse the lessons learnt at project level.

1.2 Intended readership

This document is mainly targeting SJU and Eurocontrol as, apart from a summary of the main results and conclusions, the content focusses on technicalities such as dissemination activities and an overview of the billing status and costs. However, others, such as those directly connected to the operation of the air traffic control system, including ATC providers and software producers, those involved in the regulation of air traffic control both at the member state level and at the European level including the European Commission, SJU, Eurocontrol and EASA, customers of air traffic control services including airports and airlines, and finally, academics and advisors interested in analysing such markets, might also be interested in the summary and the lessons learnt.

1.3 Inputs from other projects

No input was used from other SESAR –E projects

1.4 Glossary of terms

n/a

2 Technical Project Deliverables

Number	Title	Short Description	Approval status
D5	Conclusions and Caveats	This Deliverable summarizes the results of the previous deliverables. Resulting from this it provides some further policy conclusions and areas for further research	Approved
D4.2	Quantitative and qualitative assessment of scenarios for ATM development	This deliverable describes the development of four economic models (network congestion game, labour union model, a public utility efficiency model and an economic network model) that were used to analyse the effects of different scenarios.	Approved
D4.1	Quantitative and qualitative assessment of scenarios for ATM development – Interim Report	The goal of this interim report was to have a conceptual model. It discusses the first versions of the public utility efficiency model and the network congestion model, including the first numerical analyses using mock data.	Approved
D3	Selection of scenarios	In this deliverable we develop a number of ambitious but realistic scenarios for the European air navigation sector. These allow us to operationalize and analyse future developments for this sector and highlight the importance of enabling framework conditions. The deliverable discusses the scenario building blocks and makes a first proposition on which scenarios to develop.	Approved
D2	Air transport sector specifications	Deliverable 2 focuses on airport and airline deregulation and liberalization and draws potential lessons with regard to the air traffic control sector.	Approved
D1	Taking stock of parallel experiences	The first deliverable focusses on the experiences in other sectors regarding liberalisation of other national monopolies and implementation of new technologies to draw lessons for the change process of ATM. This is done using a framework of general economic concepts.	Approved

Table 1 - List of Project Deliverables

3 Dissemination Activities

3.1 Presentations/publications at ATM conferences/journals

Presentations

Sesar Innovation Days 2013, 27-29/11/2013, Stockholm, Eef Delhay, poster session explaining the goal of the project and the first results of D1.

Sesar Innovation Days 2014, 25-27/11/2014, Madrid, Thomas Blondiau & Eef Delhay, ACCHANGE: building economic models for understanding ATC performance [1]. Presentation focussing on the set up and main outcomes of the efficiency model (part of D4)

Sesar Innovation Days 2014, 25-27/11/2014, Madrid, Nicole Adler, Managing European Air Traffic Control Provision [2]. Presentation focussing on the set up and main outcomes of the network model (part of D4)

ATM Seminar USA – Europe 2015, 23-26/6/2015, Lisbon, Stef Proost, Amihai Glazer, Thomas Blondiau & Eef Delhay, Air traffic control regulation in a union bargaining setting. Presentation will focus on the set up and main outcomes of the bargaining model (part of D4) [5]

ATM Seminar USA – Europe 2015, 23-26/6/2015, Nicole Adler, “Accelerating Change in Air Traffic Control: a Regional Forerunner Approach”. Presentation focussing on the set up and main outcomes of the network model (part of D4) [6]

3.2 Presentations/publications at other conferences/journals

Presentations

2nd European Aviation Conference, 14-15 November 2013, Amsterdam, Nicole Adler, Accelerating change in Air Traffic Control? Presentation focussing on the set up and main outcomes of the network model (part of D4)

Air Transport Research Society Conference, 17-20/7/2014, Bordeaux, Eef Delhay, Accelerating Change by Regional Forerunners: Taking stock of parallel experiences [3]. Presentation focussing on the main outcomes of a comparison of ATM with other experiences focussing on the introduction of new technologies and on liberalisation experiences (D1). Led to an invitation to present the ACCHANGE work at the GARS workshop.

Air Transport Research Society Conference, 17-20/7/2014, Bordeaux, Nicole Adler, Accelerating change in Air Traffic Control? Presentation focussing on the set up and main outcomes of the network model (part of D4)

INFORMS, November 2014, San Francisco, Nicole Adler, Accelerating Change in Air Traffic Control Provision. Presentation focussing on the set up and main outcomes of the network model (part of D4)

GARS workshop, November 2014, “Reform of ANSPs- Experiences and next steps forward, Brussels, Eef Delhay, Accelerating Change by Regional Forerunners: Taking Stock of parallel Experiences. Presentation focussing on the main outcomes of a comparison of ATM with other experiences focussing on the introduction of new technologies and on liberalisation experiences (D1).

GARS workshop, November 2014, “Reform of ANSPs- Experiences and next steps forward, Brussels, Thomas Blondiau, ACCHANGE : building economic models for understanding ATC performance. Presentation focussing on the set up and main outcomes of the efficiency model (part of D4)

GARS workshop, November 2014, “Reform of ANSPs- Experiences and next steps forward, Brussels, Stef Proost, Air traffic control regulation in a union bargaining model setting”. Explained the first ideas and set up of using a bargaining model approach to ATC.

OPTION, April 2015, Amsterdam, Nicole Adler, “Accelerating Change in Air Traffic Control a Regional Forerunner Approach” Presentation focussing on the set up and main outcomes of the network model (part of D4)

3.3 Web presence

From 1st of May 2013 there has been a webpage (one in English and one in Dutch) discussing the ACCHANGE project on the website of Transport & Mobility Leuven:

<http://tmleuven.be/project/acchange/home.htm>

This website discusses the main set-up of the project, provides a link to the approved Deliverables, a (password-protected) link to the presentations of the two stakeholder workshops and the presentations made on the Sesar Innovation Days 2014.

3.4 Demonstrations

Two stakeholder workshops were organised.

11/02/2014: The goal of this first workshop was threefold. Firstly, the consortium wanted to inform the attendees in more detail about the first results of Deliverable 1 (taking stock of parallel experiences) and D2 (air transport specificities). Secondly, to have a discussion on the way forward: what did the stakeholders think about our approach and what would be the most promising, likely or interesting scenarios. Finally, the workshop was used to see which data was available and where. Apart from the consortium, there were 11 other participants, mostly coming from Eurocontrol. The presentations of this workshop can be found on <http://tmleuven.be/project/acchange/home.htm> (password protected).

30/01/2015: The goal of this workshop was to present the main results of the work done within the ACCHANGE project to an audience with a more “economic” background. Three models were discussed: the network congestion game, the labour union model and the public utility efficiency model. The participants mostly came from Eurocontrol. The presentations of this workshop can be found on <http://tmleuven.be/project/acchange/home.htm> (password protected).

Feedback on both workshops was in general positive. The approach was appreciated and there was an open discussion on the results. Some remarks were given on assumptions, which enabled the consortium to look into them again to make sure that they were correct. For the first workshop the feedback on the data provision was positive, but less feedback was given on the way forward.

3.5 Exploitation plans

Transport & Mobility Leuven:

Transport & Mobility Leuven gained a larger insight in the complex world of ATC. We were able to apply basic economic models, new to the ATM world, which allowed for a better understanding of some of the current problems within ATM. We also aimed to give some insights on the way forward. We learned that some current practices within the economic ATM research could be improved – for example the information available on the cost structure of ATC and the current cost-benefit (CBA) practices. Transport & Mobility Leuven would like to continue with this line of research focussing on ways to improve competition within ATC, improving knowledge on cost functions and extending the focus of current CBAs to real social CBAs.

Core-Invest:

The ACCHANGE Project has given us insight in the behaviour of the stakeholders in the aviation industry, and more precisely on the economic behaviour of the ANSPs. There seems little spontaneous incentive to invest in innovative technology and in cost saving international initiatives. Regulation on quality and price is very important. Our company has an interest in consulting activities for the ATC industry and could use the lessons learned to better consult.

More research could be done on the incentives, spontaneous or guided by regulation to stimulate innovative and cost saving international or multinational investments. By greater understanding of and analysing the already existing international cross border collaboration initiatives, lessons could be learned how to create a more dynamic defragmented Air Traffic Control business.

HUJI:

As a group of masters, Ph.D., post docs and profs, we learned a great deal about the very complicated world of air traffic control. One student has gone on to study transport at MIT and another has begun her Ph.D. at Hebrew University on the topic of estimating capacity in air traffic control. We hope that several academic papers will result from this work that will further push the boundaries of modelling air traffic control provision and the organization of the ATC market in Europe, which is very different to that of North America. We also plan to continue research in this field with a more detailed operational game in the near future thus contributing to the field of applied game theory too.

MovingDot:

The use of economic game theory in ATC creates new insights in how to accelerate change in this business. The conclusion that under the current institutional framework horizontal cooperation through functional airspace blocks is unlikely to facilitate cooperation among ANSPs, because of a lack of financial incentives, is quite surprising. Also the insight that the introduction of SESAR technology will be difficult without financial encouragement, which means that the current price regulation for ATC needs to be altered, is interesting.

4 Total Eligible Costs

Date	Deliverables on Bill	Contribution for Effort	Contribution for Other Costs (specify)	Status
20/01/2014	D0.1, D0.2, D0.3, D1 and D2	206.411,098 euro for 350,67 days	6.371,210 euro for travel costs and subsistence allowances ADSE, Core-Invest, HUJI & TML	166.173,49 euro paid
4/07/2014	D0.4, D0.5, D3	141.380,47 euro For 184 days	8.684,50 euro for travel costs and subsistence allowances ADSE, Core-Invest, HUJI & TML	115.585,87 euro paid
4/11/2014	D0.6, D0.7, D4.1	141.247,60 euro for 327,87 days	3.888,14 euro for travel costs and subsistence allowances ADSE, Core-Invest, HUJI & TML	117.162,90 euro paid
June 2015	D0.8, D0.9, D0.10, D4.2, D5	244,424,57 euro for 479 days	8.384,27 euro for travel costs and subsistence allowances ADSE, Core-Invest, HUJI & TML	175.921,24 euro billed
GRAND TOTAL		733.463,73 euro		574.843,50 euro

Table 2 - Overview of Billing

Company	Planned man-days	Actual man-days	Total Cost	Total Contribution	Reason for Deviation
Coordinator, TML	560	562	€ 371.604,76	€ 278.703,57	more work than anticipated, especially on the data gathering
HUJI	480	511	€ 113.959,98	€ 113.959,98	more work than anticipated
Core-Invest	200	208	€ 198.526,90	€ 148.895,18	more work than anticipated
ADSE	80	73	€ 81.314,59	€ 60.985,94	hours foreseen for review, but this was less work than foreseen
GRAND TOTAL	1320	1355	€ 765.406,23	€ 602.544,66	

Table 3 -Overview of Effort and Costs per project participant

5 Project Lessons Learnt

What worked well?
Openness to new ideas drove the project further
Active support in data collection helped with the construction of the models.
Interesting interaction between ATC experts and transport economists
The opportunity for the academics to converse with ATC operators and Eurocontrol led to interesting models and also helped with the calibration of parameters
Project progress reports (although maybe less elaborated/in another form) help to keep project on time and on track.
What should be improved?
Data availability
Openness of cost benefit analyses whether generated by public or private organizations
The project should have been longer (i.e. 3 to 4 years) because it takes time to develop ideas and train Ph.D.s. Having said that, the consortium itself opted for a 24 month project, while it was a possibility to have 30 months.
More direct collaboration between the “economic” orientated projects. For example by organising a kick off meeting and a midterm meeting (midterm could be organised during the SID). Today cooperation was more informal and limited to participation in workshops/discussions at conferences.
Outside academic reviewers.

Table 4 - Project Lessons Learnt

6 References

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