E.02.02-D11-NEWO Final Report

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Abstract

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

Authoring & Approval

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[1] EUROCONTROL Contract reference 10-220719-C7, Part II General Conditions, Article II.8.

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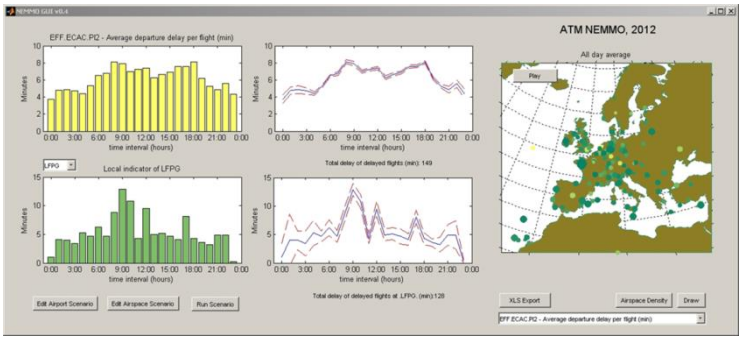
Publishable Summary

The SESAR WP-E project NEWO (emerging NEtwork-Wide Effects of inventive Operational approaches in ATM) has explored **network-wide performance** and **delay propagation phenomena** in the air transport network linked to **specific prioritisation rules applied to departure flights** at airports. NEWO has used modelling and simulation techniques by means of an innovative tool conceived for analysing multi-component systems with complex interactions. The tool used, **ATM-NEMMO**, exploits a mesoscopic approach where probabilistic methods account for air transport network microscopic details without losing the macroscopic and strategic view of the system.

NEWO has been a challenging project addressing the following original research questions:

- **Assessment of the impact on network global performance of new local operational approaches** for dealing with departure capacity shortfalls in ATM.
- **Exploration of the potential of the innovative modelling and simulation** technique used.

A straightforward approach has been the best framework for delivering concrete answers and conclusions. NEWO captured out-of-the-box ideas for managing complex networks by means of a dedicated workshop and later on translated them into specific modelling scenarios for studying the network response. To this aim, the ATM-NEMMO model used is a **mesoscopic approach** based on dynamic graphs, analytical equations and stochastic parameters, for simulating the air transport network.. The model network is composed of heterogeneous nodes (saturated airspace areas and airports) linked by air routes aggregations. The project has exploited a state-of-the-art tool and methodology for **modelling complexity** integrating:



i - Capture of ATM-NEMMO Graphical User Interface

- Dynamic graphs, generated from traffic data input, where *structure is not fixed*, and network structure and the dynamic rules are inter-related;
- Incorporation of "noise" in the behaviour of elements (non-determinism), as a way for *modelling uncertainty*;
- Links between elements than go beyond the network topology, allowing to simulate the propagation of noise through the system and reproducing actual delay propagation phenomena and *emergent behaviour generation*;
- Flexibility for implementation of *diverse behavioural rules and innovative network management strategies.*

The study of the **impact on network global performance of new local operational approaches** has produced the following results and conclusions through four different Modelling Scenarios.

IMPACT OF THE PRIORITIZATION CRITERIA ON THE NETWORK STABILITY (SCENARIO 1)

It comprehended the simulation of the selected prioritisation criteria individually to analyse their effectiveness in terms of network efficiency in comparison to the baseline First Come

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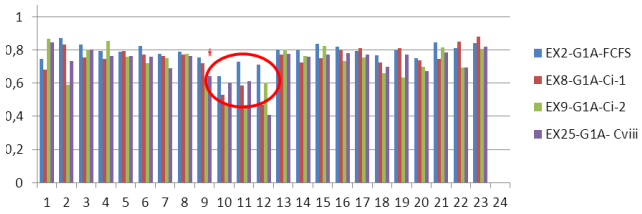
First Serve (FCFS) situation. To ensure representativeness of results, different exercises were conducted combining each prioritization criteria together with the current traffic and the presence or not of the unexpected events or external disturbances. The **list of criteria** studied included:

- Priority for flights to airports with higher/lower number of outgoing flights;
- Priority for flights to more/less congested airports;
- Priority for hub&spoke airlines;
- Priority for flights with more subsequent flight legs;
- Priority for last flight of the day;
- Priority for flights with greater/smaller turnaround buffer time at next airport;
- Priority for flights to more central destination;
- Priority on random basis;
- Priority for flights connecting different communities (FABs).

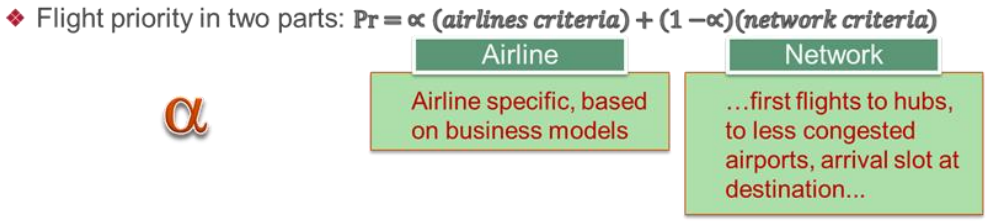
After analysing efficiency, capacity and predictability network and local indicators, the results displayed that **none of the selected prioritization criteria improves the situation at global level with respect to the FCFS basis** under any of the Generic scenarios. The propagation of delays, appearance of overloads at airports not directly impacted by external disturbances and other undesirable network effects were not better absorbed when applying the specific criteria instead of FCFS. In few cases slight improvements were detected at airport level in specific timeframes. This opened the door for further research to **analyse if any of the criteria could improve problematic hours at local level**, which would require the local switch on/off of criteria at specific times and the study of which timeframe is the most efficient in terms of reducing undesirable effects.



ii - Example of Graphical Results for Percentage of Flights Departing On Time

RELATION BETWEEN NETWORK STABILITY AND EQUITY (SCENARIO2)

This scenario was designed to investigate how giving priority to airlines interests provides the best impact in terms of network stability. An algorithm was created to assign priority to each flight by summing up points related to airline driven criteria and points grouped around network general concerns. Both parts of the equation where given relative weight according to the value of the parameter alfa.



iii - Flight Priority Algorithm for Analysis of Airlines Driven Criteria

In this scenario, the simulations clearly showed that the best network performance results were obtained with alfa closer to one, meaning that **what is good for airlines might be also good for the network**, since airline performance relies on network performance. It must be highlighted that the scenario design lacked direct input from airlines, and therefore although the results were promising, better targeted scenarios should be studied. It was also

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concluded the need for further exploring if what is good for one particular airline or for a set of airlines operating at the airport where a local problem arise, might also be good for the whole network, and might, in the end, penalise other airlines.

AIRLINES INTERESTS AS A BLACK BOX (SCENARIO 3)

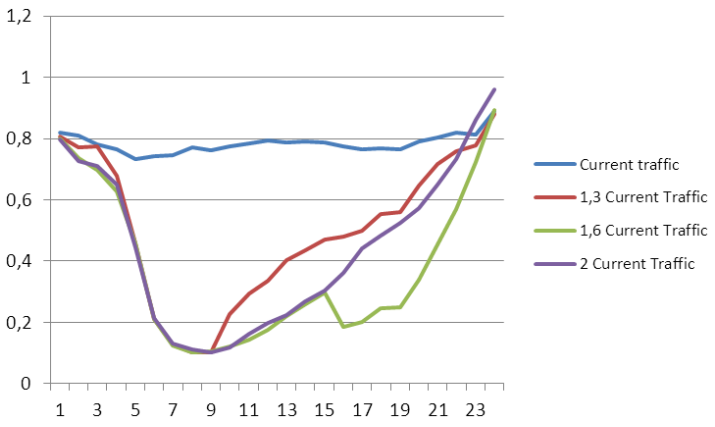
With the aim of translating the "airline" part of the equation mentioned in the previous Scenario into numerical values, it was used a random function instead of a detailed list of priority criteria and punctuations, assuming that airline business is a black box for the network manager.

Similarly to what was obtained in Scenario 2, giving **less weight to network-driven prioritisation criteria** provided **better network performance**. Even though this was not expected, the results were oriented to this direction for all cases. Again there were very different performance responses between time intervals, suggesting that, for optimising the network management, the **application of criteria should be restricted to specific airports at specific timeframes**.

NETWORK CRITICAL LOAD ANALYSIS (SCENARIO 4)

In the last scenario, an innovative analysis was conducted to observe the performance of some prioritisation criteria under heavily congested circumstances. The network critical load, defined as the traffic density beyond which jamming or overload appears at the nodes, was used as an indicator of the influence of network routing rules on behaviour.

The results obtained showed a situation that became unstable in the central hours of the day. Again, all the indicators turned to worse for the selected 'most promising criteria' under study with regard to FCFS basis, showing high delay queues and calling for flight regulation in most cases.



iv – Example of Percentage of Flights Departing On Time for FCFS

But the research work did not end there. After concluding that FCFS basis prevails over each and every of the criteria analysed during the different scenarios, an additional Literature Review work was performed with the aim of identifying any new lines of investigation on flight prioritization. It was then when the Best Equipped Best Served (BEBS) and the Most Capable Best Equipped Best Served (MC (BE) BS) were identified as the most promising prioritization criteria able to be faced to FCBS. The work then focused on defining different approaches for modelling **Most Capable Best Served criterion**, taking into account both traffic data and tool limitations. The MCBS criterion was modelled and some specific simulation exercises were launched.

According to the results, the application of departure precedence to capable flights does not represent an improvement to the situation at a global level. From a second read of the data, the four chosen exercises only represent a gap from 10% to 35% of capable flights, so the main conclusion extracted from the simulation is that giving priority to a percentage of flights labelled as Capable up to 35% of the total sample, does not represent an improvement to the global situation. The conclusion for higher percentages of capable flights should be confirmed in further simulations. From a "capable" airline point of view, the conclusion

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extracted from the simulation could be interpreted the other way around: To **give precedence to capable flights, which means an advantage at local level for the airline, has not harmful effect for the global network behaviour**, this could be an argument for justify an investment in more advanced equipage. Taking advantage of these simulations, other aspects like identifying certain airports as most suitable for capable flights or calculating the indicators per airline, could be explored.

As for the potential of the innovative modelling and simulation technique used, the mesoscopic approach has proved to be perfectly suitable for obtaining straightforward performance results. The flexibility of the tool for representing the concepts captured at the first stages of the project, and even for preparing ad-hoc simulations with ideas arisen in the course of the research, has been key for success. The project has allowed deepening into the understanding of the potential of the innovative modelling technique used and, in particular, the potential of the ATM-NEMMO tool.

FINAL CONCLUSIONS

A more accurate awareness of the tool exploitation possibilities, together with the simulation results, paves the way for enlarging the scope of the NEWO research in lines such as:

- Define specific **indicators** oriented to measure **benefits for airlines**;
- Expand the analysis of how **giving priority to airlines interests** can provide a **better 'network picture'**;
- Define **more milestones at airports**, integrating as much as possible the Airport – Collaborative Decision Making (A-CDM) concept in the model;
- Deepen in the analysis of the network response, mainly in terms of robustness and resilience, to different **congestion scenarios** and of the **network critical load**;
- Simulate **longer periods of time** (2 or 3 days operation) to analyse if network effects are softened or propagated delays absorbed, when sufficient time has elapsed since the occurrence of an external disturbance;
- Study how the **temporary application of specific and local operational approaches** can provide optimum network performance.
- For MCBS, the prioritisation of capable flights has not an adverse effect over the global behaviour of the network and could be an argument for convincing airlines to invest in advanced equipage. This should be further assessed.

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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

The intended audience for this document are EUROCONTROL Project Officer and the SJU-WPE Programme Manager, as managers monitoring and controlling the Project performance, using the lessons learnt at Project level for feedback to the SJU WPE programme. The overview of technical results included in this document might be also of interest to them for possible exploitation within SESAR and WPE, and for undertaking the dissemination activities that fall under their responsibility.

Other Project stakeholders (members of SJU WPE, complexity science researchers, ATM experts, etc.) with a technical interest in the Project's results should be directed to more technical oriented documents, as, for instance, deliverable D5.1 Final Report on Conclusions and Recommendations [2].

1.3 Inputs from other projects

This section identifies previous work on, with a special emphasis on what is reused from other projects.

The innovative nature of NEWO project has made impractical to find previous work to be directly reusable. Having said this, it is possible to consider as an indirect input to the Project the results of previous studies that have used the same simulation tool than NEWO, i.e. ATM-NEMMO simulation model. In particular, the **previous exploitation of ATM-NEMMO in NeCO 2030 project** [3] produced highly valuable lessons learnt. NeCo 2030 showed the way to better exploit ATM-NEMMO for simulating the air transport network from a mesoscopic point of view in a reasonable time, and, being a project performed by Isdefe, also increased the knowledge of the technical team in terms of design of modelling scenarios and representation of operational particularities.

Also tangentially, the Project has been fed with outcomes from **SESAR Project 7.6.4 "User Driven Prioritisation Process (UDPP)"**. The UDPP project is devoted to design a feasible UDPP process coping both with airlines business requirements and ATM constraints and assess its impact on performance with an emphasis on operational and access & equity KPAs. The UDPP project started in April 2011, and in December 2011, a workshop [4] was held in SESAR JU premises with the participation of Airspace Users. As part of the workshop a brainstorming session was celebrated to review situations were a capacity drop

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has caused problems and the subsequent process to tackle them was not satisfactory. As a result, the workshop participants identified common prioritisation strategies applied as a response to capacity drops and their relation with equity, principles and rules, as key factor for developing a successful prioritisation process. The results of the UDPP workshop were carefully analysed during the performance of NEWO WP2, and its outcomes in terms of strategies and, mainly, Airspace Users views, were merged with the outcomes from NEWO own prioritisation workshop [6][7].

Finally, and in the same line as above, the **NEXTGEN study about Flight Prioritization** [5] identifies a prioritization concept list, including existing mechanisms as well as future strategies. The proposed strategies were also taken into account as complementary results to the NEWO first workshop, and considered for the design of the NEWO operational scenarios. The transitional preference and Best-Performing Best-Served concepts [6] were of particular interest due to their relevance for the NEWO technical approach.

1.4 Glossary of terms

Term	Definition
A-CDM	Airport - Collaborative Decision Making
ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
ATM	Air Traffic Management
ATM-NEMMO	ATM Network Macro MOdel
BEBS	Best Equipped Best Served
CDM	Collaborative Decision Making
ECAC	European Civil Aviation Conference
ERC	EUROCONTROL
ERHQ	EUROCONTROL Headquarters
FAB	Functional Airspace Block
FCFS	First Come First Served
FDW	Final Dissemination Workshop
GUI	Graphical User Interface
IFISC	Institute for Cross-Disciplinary Physics and Complex Systems
KOM	Kick Off Meeting
KPA	Key Performance Area

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Term	Definition
KPI	Key Performance Indicator
MCBS	Most Capable Best Served
NEWO	emerging NEtwork-Wide Effects of inventive Operational approaches in ATM
SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency
TBC	To Be Completed
UDPP	User Driven Prioritisation Process
WP	Work Package
WP E	SESAR Programme WP-E "Long Term and Innovative Research"

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2 Technical Project Deliverables

Number	Title	Short Description	Approval status
D02	Conceptual Framework	It contains the definition of the concepts and terms that will be mentioned along the project lifecycle including a brief description of the problem statement, the project approach and the baseline for modelling.	Approved
D03	Workshop on Innovative Operational Approaches	The actual project first workshop focussed on collecting ideas/ views for innovative prioritisation strategies to be studied in the project.	Approved
D04	Analysis of Outcomes and Report on Innovative Operational Approaches	It collects the results and conclusions derived from the project's first workshop. The report highlights the set of preliminary Innovative Operational Approaches that will become the baseline for the following steps: building the simulation scenarios and analysing promising approaches.	Approved
D06	Modelling Scenarios and Experiments Plan	The NEWO project modelling approach is reviewed and the modelling scenarios are described in detail. For each simulation scenario a set of exercises is described in line with the research focus areas defined as result of workshop activities, questionnaires and literature review.	Approved
D07	Simulation Results and Analysis	This document presents the simulation results of the four sets of exercises conducted under the modelling scenarios described in previous deliverable, and provides a detailed analysis in terms of the impact of the prioritization criteria on the network stability.	Submitted
D08	Final Dissemination Workshop "Innovative Flight Prioritisation Strategies in Air Transport"	The actual project's Final Dissemination Workshop (FDW), presenting to the community the main project results and gathering feedback on simulation outcomes and preliminary conclusions.	Submitted
D09	Dissemination, Communication and Knowledge Management Report	This deliverable provides all scientific publications that NEWO produced, e.g. conference articles.	
D10	Final Report on Conclusions and Strategic Recommendations	It collects the conclusions and strategic recommendations coming from the analysis of the simulation results, literature review and the discussions that took place during the project's Final Dissemination Workshop (FDW).	Submitted

Table 1 - List of Project Deliverables

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3 Dissemination Activities

3.1 Presentations/publications at ATM conferences/journals

The dissemination activities under this section have been to date:

- **Brochure** for the SJU ComplexWorld network first Annual Conference (6th July 2011, Seville, Spain), with description of the project strategy, main objectives and means of establishing technical communication links with NEWO team. Main ***feedback*** from the meetings with target scientists was the support to the project coming from relevant research institutes, such as Institute for Cross-Disciplinary Physics and Complex Systems (IFISC), in terms of future sharing of research outcomes and participation in NEWO workshops.
- **Presentation** at the First SESAR Innovations Days (29th November 2011, Toulouse, France) of the **paper** "*Dynamic Approaches from Complexity to Manage the Air Transport Network*" [9], describing the modelling framework chosen, as well as the current regulatory framework in air transport and some preliminary ideas for prioritisation coming from complexity related literature and applications in other complex networks. Main ***feedback*** was enthusiastic about the project innovative approach and the modelling mesoscopic conception. Aside of new followers for the NEWO LinkedIn group, the feedback was particularised in an informal commitment with SJU WPE ELSA project for holding a dedicated meeting to explore synergies between both projects and for early sharing of projects outcomes in support of that.
- **Poster** for the Second SESAR Innovations Days (27th November 2012, Braunschweig, Germany), highlighting the main innovative features of the NEWO scope and depicting prioritisation criteria under study, simulation scenarios and preliminary outcomes. Main ***feedback*** was also interest in following the project progress and scientific results and in taking part in NEWO final event where results are described and feedback gathered.

Another paper is being prepared gathering final results and conclusions for presentation at the Third SESAR Innovations Days, notwithstanding that the research outcomes are also presented to other target conferences or scientific and technical publications.

3.2 Presentations/publications at other conferences/journals

The dissemination activities under this section have been to date:

- **Presentation** at the 4th International Conference on Experiments/Process/System Modelling/Simulation/Optimization (4th IC-EpsMsO) (7th July 2011, Athens, Greece) of the **paper** "*Emerging behaviours and propagation patterns in air transport networks*" [8], which outlines the modelling approach chosen in NEWO and introduces the research questions addressed by the project. Main ***feedback*** came from diverse engineers and scientists working in the fields of applied mathematics, dynamical systems, energy networks and transportation systems, who showed interest in taking part in the 1st project workshop and to keep track of the project performance.
- **Poster** for the European Conference on Complex Systems 2012 (ECCS'12) (7th September 2012, Brussels, Belgium), describing the application in NEWO of complex system approaches to manage current and future air transport network and the outcomes obtained to the date. Main ***feedback*** from researchers studying complex

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networks in transportation systems was interest in taking part in the project, so they were directed to NEWO final workshop brochure and encouraged to take part in the final project workshop.

3.3 Demonstrations

During the NEWO final dissemination workshop (23rd July 2013, Madrid, Spain), a short demonstration of the ATM-NEMMO simulation tool (used as modelling tool in NEWO) was performed. The aim was to provide a hint of the Graphical User Interface (GUI), the configuration options and the computational speed to the workshop attendees. The demonstration went rapidly through the initiation console, the traffic selection, scenario definition and execution options. It was also shown the graphical presentation of the simulation results obtained directly from the tool and the simulation data dumping to MS Excel files for data exploitation and statistical analysis.

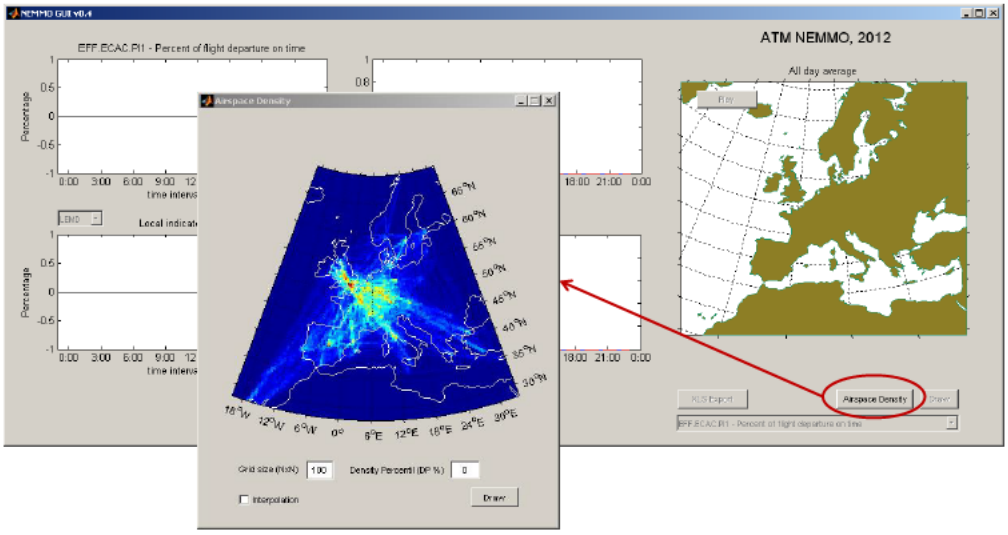

Figure 1 – ATM-NEMMO Demonstration: Initial GUI and Airspace Density Module

Although the short time slot available for the tool demonstration during the workshop, the attendees' ***feedback*** was very positive. Several questions arisen regarding the possibilities of the tool in terms of type of traffic samples that can be input (type of flight data, specific Times (milestones), routing rules used, etc.) Some suggestions were also proposed by the participants, such as considering new milestones at airports (including engines switch on/off), evolving the tool to model flight routes, or studying the possibility to integrate the Airport Collaborative Decision Making (A-CDM) concept in the model.

3.4 Exploitation plans

Describe, per project participant, how the results or lessons learnt from this project will benefit the company or the research community in the future.

The following results and lessons learnt from the project are very valuable outputs that benefit directly Isdefe or the research community:

- The **focussed literature review** performed at the initial stages of the project constitutes a structured baseline for further research, not only for topics directly related to NEWO scope, but also for more ample research topics like the relation between network topology and behaviour or the use of dynamic indicators for complex network management;

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- The **set of prioritisation strategies** gathered during the identification phase and the whole set of innovative operational approaches discussed remain as a useful repository for future projects picking up the baton of the flight prioritisation challenge;
- The **defined modelling scenarios** are other interesting product to be reused in other simulation projects. In particular, the effort made for building future scenarios and estimated traffic samples for 2020+ time-window have crystallised in a well-documented set of scenarios and simulation input samples;
- **Simulation results** are obviously an indispensable input for future studies exploring network effects associated to high-level operational strategies and, provided the assumptions and simplifications of the NEWO research, a source of preliminary conclusions. The results have provided a better perception of the way forward for studying the impact of operational changes in the network in terms of:
    - Deepening in the analysis of the network response, mainly in terms of robustness and resilience, to different congestion scenarios and of the network critical load;
    - Expanding the analysis of how giving priority to airlines interests can provide a better 'network picture';
    - Considering scenarios where operational decisions are driven not only by the level of equipage of the Airspace Users, but also of ANSPs;
    - Simulating longer periods of time (2 or 3 days operation) to analyse if network effects are softened or propagated delays absorbed, when sufficient time has elapsed since the occurrence of an external disturbance;
    - Including in the study new operational approaches and prioritisation strategies that have not been analysed yet.
- Finally, the project has allowed deepening into the **understanding of the potential of the innovative modelling technique** used and, in particular, the potential of the ATM-NEMMO tool. The main benefit is for Isdefe as owner of the tool, but the community can as well benefit from having access to the conclusions in terms of modelling approach usability. A more accurate awareness of the tool exploitation possibilities paves the way for enlarging the scope of the NEWO research in lines such as:
    - Create new parameters for modelling Airspace Users negotiation process;
    - Model and distribute the delays in the airside, with the possibility of absorbing them;
    - Define more milestones at airports, integrating as much as possible the Airport – Collaborative Decision Making (A-CDM) concept in the model;
    - Define specific indicators oriented to measure benefits for airlines;
    - Model other operational concepts that are being developed in SESAR projects.

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4 Total Eligible Costs

Date	Deliverables on Bill	Contribution for Effort	Contribution for Other Costs (specify)	Status
30/11/2011	D0.1, D1.1, D0.2	18.450,00€	1.303,58€ (Travel cost for paper presentation and congress participation at 4th IC-EPSMSO in Athens; Travel costs for participation in first annual ComplexWorld event in Seville; Lunch KOM with ERC and SJU; First year domain fee for www.newo-sju.eu (project webpage); Fee for participation in 4th IC-EPSMSO).	Paid
30/04/2012	D2.1, D0.3, D2.2, D0.4	23.962,50€	4.981,74€ (Travel cost for paper presentation and congress participation at SESAR Innovation Days in Toulouse. Lunch 1st Progress Meeting with ERC; Catering 1st NEWO Workshop; funding experts' travel costs for attendance to NEWO 1st Workshop. Fee for participation in conference Net-Works 2011).	Paid
17/09/2012	D3.1, D0.5, D0.6	18.337,50€	1.458,05€ (Travel cost for pseudo-gate meeting at ERHQ, attendance to ATACC'S 2012 at London and meeting with IFISC in Palma de Mallorca within WP4 - links with ATM community; Second year domain fee for www.newo-sju.eu (project webpage)).	Paid
xx/xx/2013	D3.2, D2.3, D5.1, D4.2, D0.7	124.125 €	2.324,09€ (Travel costs for participation in ECCS 2012 Conference in Brussels. Participation in SIDs 2012 in Braunschweig; Third year domain fee for www.newo-sju.eu (project webpage); Cost of Catering Final Workshop) Pending for billing the following travels:	Not submitted

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		- Attendance to Close-out meeting - Participation in SIDs 2013 in Stockholm	
GRAND TOTAL		Estimation 184.875,00 €	Estimation: 10.067,46€ + Pending Costs (see above)

Table 2 - Overview of Billing

Company	Planned man-days	Actual man-days	Total Cost	Total Contribution	Reason for Deviation
ISDEFE	469	*Estimation:* 730 man-days	*Estimation* 246.500 €	*Estimation* 184.875 €	TBC after close-out meeting. Deviations are expected mainly because of the following reasons: • The planned costs per day per engineer are lower than the ones estimated at the beginning of the project; • The initial estimations of man-days were based on the specific number of hours per profile. As the profiles of the engineers has changed during the lifecycle, the number of actual man-days were also changing; • Actual effort/budget spent on the organisation and execution of the workshops was half the planned one, since it was possible to organise them in Madrid, Isdefe's premises, optimising the participation and minimising costs. • The project scope was enlarged with the inclusion of the Most Capable Best Equipped Best Served criteria, resulting in an increase in effort spent.
GRAND TOTAL	469	*Estimation*: 730 man-days	*Estimation* 246.500 €	*Estimation* 184.875 €	

Table 3 - Overview of Effort and Costs per project participant

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5 Project Lessons Learnt

What worked well?
The project established **clear scope and objectives** from the start, ambitious enough given the innovative nature of the project, but not too wide. This, together with planned slots for addressing topics that could arise in the course of the research, provided a good framework for delivering concrete answers and conclusions.
The **suitability of the mesoscopic modelling framework** used for analysing the multi-component air transport network and, in particular, for obtaining straightforward performance results associated to specific prioritisation rules applied to flights.
The establishment of **contact with scientists of domains out of air transport** (such as complexity, transport networks or logistics) resulted in original inputs to the project, that contributed to fulfil the objective of identifying innovative operational approaches that could be applicable to air transport. Also being able to engage them to the project field of study was very positive in terms of the quality and depth of feedback received.
The **small/ single-company team size**, not requiring great managerial workload, perfectly fitted the project size, objectives and technical challenges.
On the side of **project external supervision**, the level of control was a well-fitted combination of firmness and flexibility, allowing adaptation to the unexpected particularities that arise in innovative research projects and to better focus on delivering valuable results. **Continuous and open communication with EUROCONTROL Project Officer**, receiving real-time feedback and suggestions during the project execution, was valuable by itself, and also helped to ensure that the SJU expectations with regard to the project performance were met.
What should be improved?
The **role of SJU WPE networks**, or, in particular for the concern of NEWO, of ComplexWorld network was unclear. There are specific tasks that could be covered by the network and which will be very useful for WP-E projects and the research community in general, such as providing a framework for knowledge management and sharing, identifying and stimulating research synergies, being a channel for collaboration with other relevant research networks, etc. Besides, under-request access to the network available information proved to be not very agile.
For the particular operational focus of NEWO project, the **airlines inputs** would have been very valuable for defining strategies to manage departure queues. But the airlines are not willing to share their own strategies and in consequence, the approaches used when implementing the rules for prioritization were based on assumptions. A centralised approach to this concern shared by other SJU WPE projects could be very useful.
As for the **traffic data availability**, it is recognised that there is a lack of quality samples of European traffic, or the costs of acquiring them are too high for small projects like NEWO to contemplate this possibility. A potential solution for SJU WPE projects would be to acquire basic traffic data in a centralised manner so that acquisition costs are reduced and information is better managed.
Collecting diverse expert inputs was another source of concern, since the project did not achieve success in gathering a wide variety of views. While the availability of the scientific community for questionnaire filling in or for workshop attendance was good, it was difficult to have the **involvement of experts from industries outside air transport**. At the level of the project, it is clear that, when external participation is expected, more focus must be made from the start on publicising the project and setting strategies for making participation attractive. It would also help the support of SJU WPE managerial level on fostering exchanges of views with other industries.
The use of NEWO webpage as dissemination or communication mean was not satisfactory. Being the internet deluged with static contents, it is hardly expected that a webpage of a small project like NEWO get a lot of views. The trade-off "cost of effort"/ "usefulness" was poor. For future projects it is considered that other means of dissemination and communication (more cost-effective, collaborative and dynamic) are preferable. An

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example would be the use of LinkedIn groups.

Table 4 - Project Lessons Learnt

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