Final Project Report

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Abstract

The purpose of this is to guide the SESAR primary projects in assessing the impact of any automated planning tools on the flexibility of the aviation system, with a focus on the flexibility to introduce changes after the planning cycle is complete. In other words, it should help to assess whether the planning capabilities that automated decision support tools offer will limit flexibility in the execution phase if those plans need to change. Analysing such planning/flexibility trade-offs involved modelling the future ATM operations envisioned in SESAR, instantiating those models in a set of scenarios, discussing all the materials with experts, and then building a list of important issues from those discussions. We then abstracted out of those issues a general checklist for avoiding such trade-offs.

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This deliverable consists of SJU foreground.

1 Final Project Report

1.1 Project introduction

The purpose of this project was to provide guidance for relevant SESAR primary projects (WP 4-15) in assessing potentially negative impacts of automated flight-planning (and related) tools on the flexibility of the aviation system, with a focus on the flexibility of human operators to introduce changes after the planning cycle is complete. In other words, the results were meant to help other projects ensure that the advanced planning support tools they build do not constrain flexibility in the execution phase if those plans need to change.

Planning here refers to the sequencing of ground and air traffic that occurs on and before the day of operations (DoO), and which constrains the degrees of freedom that pilots and controllers have to modify and negotiate flights. The focus is on those activities supported or replaced by tools being developed in SESAR. Put another way, *planning* is the set of automation-assisted activities that lock the system into a certain state on the DoO. *Flexibility*, in turn, refers to the system's ability to be reconfigured when such plans are disrupted. Many factors affect system flexibility, but the focus in this project is on the human factor – in particular, the ability of pilots and controllers to make efficient, informed, and thorough decisions regarding system changes within the constraints of the previously planned state. Planning/flexibility *trade-offs* can occur when increases in the precision of planning – a goal of using automation – reduce system flexibility.

The consequences of such trade-offs can range from degraded system efficiency at one end of the scale to loss of life at the other end. Hence, it is important for the primary projects developing the SESAR operational concept to be aware of the problem itself, of means for identifying and anticipating potential trade-offs, and of general strategies for building and using their tools in a way that reduces that potential.

1.2 Project contribution to ATM Master Plan's deployment roadmap

Like most of the projects in 16.05, P16.05.02 was not intended to make a direct contribution to the ATM Master Plan. As stated earlier, its goals were to (1) identify potential issues in the SESAR CONOPS regarding any negative effects of automated planning and related tools on human actors in the system, and (2) develop guidelines for the makers of those tools that promote awareness of such issues and provide connections to HP tools for addressing them. Hence, the results of this project are meant to influence the design and validation of those support tools in primary projects (WP 4-15) engaged in E-OVCM phases V1 to V3, with no direct contribution to deployment.

1.3 Project achievements

1.3.1 Results

The project produced a checklist to direct the attention of relevant primary projects toward potential flexibility tradeoffs that some automated tools might introduce. Developing the checklist started by modelling the general entities/roles, technologies, procedures, and interactions involved in planning-related activities envisioned in the SESAR programme. Those models were then instantiated in a set of scenarios describing the given activities in non-normal situations. Two workshops were held to discuss both the models and the scenarios with controllers and pilots, which both resulted in a list of issues relevant to planning/flexibility trade-offs. From those issues, we abstracted the final checklist. A summary of the checklist is below:

1. **Understand the planning environment**

   Understand the composition of the different environments in which planning occurs, including the actors, actor task, actor information requirements, and especially the timeframe for tactical interventions.

2. **Capture both formal and informal planning processes**

   When defining the scope of planning systems, consider not only the normal daily operations performed in accordance with formal procedures, but also the frequent actions that occur outside those procedures.

3. **Consider the planning processes in non-normal situations**

   For planning systems that span different planning environments, consider how the different time constraints within those environments affects the impact and handling of events that occur outside normal operating conditions.

4. **Make automated systems understandable and transparent**

   Ensure that human operators can access and understand the rationale behind the outputs of automated components in a planning system, so that they can develop trust in the system's capabilities.

5. **Ensure planning flexibility throughout the process**

   Make the planning process flexible enough to accommodate last-minute flight changes without producing long delays.

The checklist was linked via references to the Human Performance Reference Material of project 16.06.05 ("Human Performance Support and Coordination Function").

1.3.2 R&D questions addressed

This project addressed two questions:

1. How might automated tools for scheduling and sequencing air traffic hinder the flexibility of humans in the system when responding to system perturbations?

2. How can that information be used to raise awareness of the relevant human factors issues in groups developing such automated systems?

Answering the first question resulted in a list of eight issues describing general situations in which automated planning tools potentially compromise system flexibility. That list formed the basis of the answer to the second question, which resulted in a checklist of five high-level, human-factors guidelines that development projects should consider when building automated planning systems and similar tools. Note that the final format of the guidelines was a compromise between three factors: The goal was to provide usable material while also satisfying both the specifications for HP material set by 16.04.01 and 16.04.02, and the SJU directive that the guidelines provide guidance only (i.e., leaving any actual design solutions in the hands of the development teams).

1.3.3 Contribution to ATM performance targets

This project was not intended to make a direct contribution to the ATM performance targets, but rather an indirect one by helping other projects to do so. In particular, proper access to and use of the results of 16.05.02 by relevant primary projects should help those projects to ensure that the SESAR programme meets the SES Performance Scheme's *safety* and *capacity* KPAs, both of which depend on an aviation system flexible enough to handle unexpected events with minimal disruption.

1.4 Key Deliverables

Del. code	Del. Name	Description	Assessment Decision
D 04	Final Version of Guidelines/ Checklist	This document provides a checklist to help the SESAR primary projects recognize and avoid potential reductions in system flexibility that may result from automated-planning tools they develop. The goal is to guide the primary projects in assessing the impact of intended automated planning capabilities on the flexibility of the system as a whole, as well as on the flexibility to introduce changes after the planning cycle. The checklist was the culmination of the previous two tasks in the project, which involved activity modeling and scenario definition.	No Reservation

1.5 Project contribution to new Standards and Norms

As with deployment, this section is not applicable to 16.05.02 because the project makes no direct contribution to standards. Rather, it provides guidance for other projects, some of which may contribute directly to standardization.

1.6 Recommendations for use of project results

The checklist is meant to be used by human-factors specialists in conjunction with the HP assessment process for projects in phases V1 to V3.

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