



## 16.05.01 Final Project Report

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### Task contributors

AENA, AIRBUS, DFS, ENAV, EUROCONTROL, NATMIG, THALES

### **Abstract**

This document is the last deliverable for SESAR P16.05.01. It provides a brief summary of the outcomes achieved during its execution phase. The project aimed at identifying the most relevant automation issues that could potentially become show-stoppers for part of the SESAR ATM Target Concept and at developing guidelines to address these issues, based on known good HF practices.

## Authoring & Approval

Prepared By - <i>Authors of the document.</i>		
Name & Company	Position & Title	Date
[REDACTED]	[REDACTED]	20/03/2013

Reviewed By – <i>Reviewers internal to the project.</i>		
Name & Company	Position & Title	Date
[REDACTED] (AENA)	[REDACTED]	16/04/2013
[REDACTED] (AIRBUS)	[REDACTED]	16/04/2013
[REDACTED] (DFS)	[REDACTED]	16/04/2013
[REDACTED] (ENAV)	[REDACTED]	16/04/2013
[REDACTED] (Deep Blue on behalf of ENAV )	[REDACTED]	16/04/2013
[REDACTED] (EUROCONTROL)	[REDACTED]	16/04/2013
[REDACTED] (NATMIG-NORACON)	[REDACTED]	16/04/2013
[REDACTED] (THALES)	[REDACTED]	16/04/2013

Reviewed By - <i>Other SESAR projects, Airspace Users, staff association, military, Industrial Support, other organisations.</i>		
Name & Company	Position & Title	Date
<Name / Company>	<Position / Title>	<DD/MM/YYYY>

Approved for submission to the SJU By - <i>Representatives of the company involved in the project.</i>		
Name & Company	Position & Title	Date
[REDACTED] (AENA)	[REDACTED]	22/04/2013
[REDACTED] (AIRBUS)	[REDACTED]	22/04/2013
[REDACTED] (DFS)	[REDACTED]	22/04/2013
[REDACTED] (ENAV)	[REDACTED]	22/04/2013
[REDACTED] (EUROCONTROL)	[REDACTED]	22/04/2013
[REDACTED] (NATMIG-NORACON)	[REDACTED]	22/04/2013
[REDACTED] (THALES)	[REDACTED]	22/04/2013

Rejected By - <i>Representatives of the company involved in the project.</i>		
Name & Company	Position & Title	Date
<Name / Company>	<Position / Title>	<DD/MM/YYYY>

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None.

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## Intellectual Property Rights (foreground)

This deliverable consists of SJU foreground.

## Table of Contents

<b>PUBLISHABLE SUMMARY .....</b>	<b>6</b>
<b>1 INTRODUCTION.....</b>	<b>8</b>
1.1 PURPOSE OF THE DOCUMENT.....	8
1.2 INTENDED READERSHIP.....	8
1.3 INPUTS FROM OTHER PROJECTS.....	8
1.4 GLOSSARY OF TERMS .....	9
<b>2 PROJECT CONTRIBUTIONS.....</b>	<b>10</b>
2.1 PROGRESS MADE TOWARD THE ATM MASTER PLAN.....	10
2.2 CONTRIBUTIONS TO THE ROADMAP FOR DEPLOYMENT ACTIVITIES.....	10
2.3 CONTRIBUTION TO STANDARDIZATION.....	10
<b>3 PROJECT LESSONS LEARNT .....</b>	<b>11</b>
<b>4 PROJECT ACHIEVEMENTS.....</b>	<b>12</b>
4.1.1 <i>Project deliverables</i> .....	12
<b>5 TOTAL ELIGIBLE COSTS.....</b>	<b>1</b>
<b>6 REFERENCES.....</b>	<b>2</b>

## List of tables

Table 1 - Project lessons learnt .....	11
Table 2 - List of Project Deliverables .....	13

## List of figures

No figure found.

## Publishable summary

Automation is expected to play a critical role in the proposed change of the European ATM system. In the context of SESAR it may enhance several 'Key Performance Areas', including safety, security, capacity, efficiency, and cost-effectiveness. Automation is expected to support human actors in the ATM system both by taking full advantage of technical solutions and by enhancing human performance.

The aim of 16.5.1 project is to identify the most relevant automation issues that could potentially become show-stoppers for part of the SESAR ATM Target Concept and to develop guidelines to address these issues, based on known good human factors (HF) practices.

The guidelines developed in the project provide criteria for designing and validating automation solutions as well as suggestions on how to tailor them to the specific context of application. Therefore the output of 16.5.1 is targeted to the 16.6.5 project which is the direct client, but it is tailored having in mind WP4-15 projects as final users.

This project provides guidance material on automation design and evaluation that HF specialist can apply to airborne and ground operational and technical projects that involve automation. However, the document is also useful for readers interested in gaining a better understanding of the value of human factors in automation design.

Guidance is proposed mainly for three human performance (HP) activities relevant to automation design:

- Identifying potential human performance automation issues that may emerge as a result of the introduction of automation support, and which are considered to be specifically relevant to the SESAR Target Concept of Operations.
- Identify the appropriate level of automation for an existing or targeted automation with the support of a new level of automation taxonomy.
- Support HP with principles to be addressed in automation design.

In addition to providing guidance on automation design, the material summarizes methods relevant for design and evaluation of HP automation support.

The material was developed within the different tasks of WP 16.5.1 as follows:

**Task 002.** Human Performance automation issues considered relevant to the SESAR target were identified by a review of the SESAR ConOps and other SESAR documents, a literature review of HF research conducted on automation in both aviation-related and non-aviation domains, and interviews with operational experts and HF experts to gather specific SESAR-related examples of the automation issues relevant to ground, air and air-ground systems.

**Task 003.** With the purpose of supporting the collection and classification of good practices for automation solutions, a common reference structure was designed. This framework is mainly composed of classification elements covering the context, the task, and the level of automation, the cooperation type between human and system, and the maturity level of the automation. To support the collection of good practices a tool was also designed. The core part of this tool is a template which integrates all the classification elements. In addition the initial list of issues developed in Task 002 was further refined.

It is worth noting that the levels of automation represent a key aspect to analyse and compare automation examples and to further derive automation design principles relevant in SESAR. In this context a specific, new level of automation taxonomy was developed to account for different cognitive functions which can be automated.

**Task 004.** Relevant examples of automation of both airborne and ground domain have been analysed and compared with a customised template covering essential questions around a successful automated function. This collection of more than 20 relevant examples of automation served as an empirical basis to derive lessons learnt. In abstraction of this empirical basis and other well-known automation examples, the automation design principles were developed. These automation design principles are put in relation with the particularly concerned automation levels. Within task 004, three different versions (first and second draft and final) of the deliverable D04 Guidelines Material for HP Automation Support were elaborated, also taking into account the feedbacks received from the Airspace Users and from 16.06.05 project in two different stages. Finally a test application was performed under the supervision of 16.06.05 and a dedicated report was then elaborated (“Task023 – Validate HP R&D Project 16.05.01 Results through Test Application”).

In general, this guidance material is supposed to influence the design and validation of automation aspects of projects going through E-OVCM phase V1 to V3. However, the earlier this material is applied in a project, the more efficient and effective it will be, because the degrees of freedom for an initial and systematic definition of the automation level will be higher in earlier stages. Depending largely upon the specific automation solution in question and the project progress, the HF specialists can assess which of the proposed guidance is the most relevant for their activity at a certain stage.

# 1 Introduction

## 1.1 Purpose of the document

The purpose of this document is, as stated in the Multilateral Framework [1], to

- Summarise the results and conclusions relating to the concerned Members' participation in the Project (publishable summary);
- Describe the contribution of the Member to the development of new Standards and Norms Proposals in the Project;
- Describe the contributions made, through the Project, to the roadmap for deployment activities;
- Explain the progress made, through the Project, towards the execution of the ATM Master Plan;
- Provide an overview of the final achievement of the Deliverables and an explanation of the discrepancies between the planned and the actual work carried out in the Project;
- Provide for each Member involved in the Project, a Project Costs Breakdown Form of the total Eligible Costs incurred by the Member during the Project, including interest accrued on the Pre-Financing payments and any other Revenue related to the Project.
- Analyse the lessons learnt at project level.

## 1.2 Intended readership

The intended audience potentially interested in this deliverable is: SJU WP16 Programme Manager, other Members of the SJU, the WP16.0 Leader, the 16.06.05 and 16.05.01 Members, SESAR primary projects.

## 1.3 Inputs from other projects

The following inputs from other SESAR projects have been used for the identification of Human Performance automation issues considered relevant to the SESAR target:

### **SESAR Definition Phase:**

SESAR Consortium (2006). Human Factors Impact SESAR Definition Phase WP1.7.1/D2. Document Number DLT-0607-171-00-04.

[http://www.eurocontrol.int/humanfactors/gallery/content/public/docs/HLT-0607-171-00-04\\_T171\\_D2.pdf](http://www.eurocontrol.int/humanfactors/gallery/content/public/docs/HLT-0607-171-00-04_T171_D2.pdf)

### **WP B 04.02:**

SESAR Joint Undertaking (2010). SESAR Trajectory Management Document. WP B 04.02 Deliverable D04. Edition 00.02.01 - and Edition 00.02.03 29/03.2011.

### **WP 04.02:**

SESAR Joint Undertaking (2011). Detailed Operational Description DOD Step1- Draft1. WP 04.02 D01-02-1-2 Edition 00.00.11.

### **WP 05.02:**

SESAR Joint Undertaking (2011). Detailed Operational Description Step 1. WP 05.02 Deliverable 04. Edition 00.00.01.



**WP 06.02:**

SESAR Joint Undertaking (2011). Detailed Operational Description Step 1. WP 06.02. Edition 00.01.03.

SESAR Joint Undertaking (2011). Airport Detailed Operational Description DOD Step 2. WP 06.02. Edition 00.01.00.

In relation to the HP argument structure inputs from 16.04.01 project have been used:

**WP16.04.01:** SESAR Joint Undertaking (2011). HP assessment process for projects in V2 (Feasibility) - D04 Edition 00.01.00

In addition, previous documents produced within this project have been used as input for the final deliverable. These include:

- SESAR Joint Undertaking (2010). Identification and Integration of Automation Related Good Practices. WP 16.05.01 Project Initiation Report. Version 00.01.03.
- SESAR Joint Undertaking (2011). Identification of Issues in HP Automation Support. WP 16.05.01 Deliverable 02.
- SESAR Joint Undertaking (2011). Framework for HP Automation Related Good Practices. WP 16.05.01 Deliverable 03

## 1.4 Glossary of terms

Term	Definition
ATM	Air Traffic Management
ConOps	Concept of Operations
DOD	Detailed Operational Description
E-OCVM	European Operational Concept Validation Methodology
HF	Human Factors
HP	Human Performance
LOAT	Level Of Automation Taxonomy
MFA	Multilateral Framework Agreement
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking
V-phases	Validation phases
WP	Work Package

## 2 Project contributions

### 2.1 Progress made toward the ATM Master Plan

This section is not applicable to P16.05.01 since no direct contribution to the ATM Master Plan was given by this project. As mentioned above, the scope of the project was to identify the most relevant automation issues that could potentially become show-stoppers for part of the SESAR ATM Target Concept and to develop guidelines to address these issues.

### 2.2 Contributions to the roadmap for deployment activities

The guidance material produced in project 16.05.01 is supposed to influence the design and validation of automation aspects of primary projects (WP 4-15) going through E-OVCM phase V1 to V3. Therefore, there is no direct contribution for the deployment phase (V4).

### 2.3 Contribution to standardization

This section is not applicable to P16.05.01 because the scope of the project was to develop guidance material that provides criteria for designing and validating automation solutions as well as suggestions on how to tailor them to the specific context of application. P16.05.01 as such does not directly contribute to standardization. Nevertheless, the guidelines might be a relevant input for such a process.

### 3 Project lessons learnt

What worked well?
To account for different cognitive functions which can be automated a new Level Of Automation Taxonomy (LOAT) was developed and it will be most likely used both in SESAR and other external projects.
The participation of HF specialists from different countries and different subject (ground / airborne) allowed a cross-fertilization by improving the understanding of the automation design. This has led to formulate an innovative proposal in the field of ATM, such as the LOAT.
In this international context the extranet was a very useful tool for the enhancement of work practices.
Partners' involvement and competence. The project members provided adequate and expert support. This allowed also to reduce some negative effects related to the turnover or the possible disaffection caused by the small contribution.
What should be improved?
The non-sequential and not synchronized starting of the technical and operational projects did not allow a linear flow of information. Sometimes the reference input was lacking, or was not mature enough (e.g. some docs from federating projects). In some cases this has led to slow down the activity and change the schedule, as well as to review the work already done.
Although it was a critical activity, the coordination and the interchange with 16.06.05 started too late with respect to the planning of the project. So, some directions on how to prepare the HP Reference Material were received too late, when the project was already at the end.
Formal management procedures and processes resulted difficult to deal with, complex and time consuming. Although progress and steps forward were made over time, room for improvement is certainly possible in this area.

**Table 1 - Project lessons learnt**

## 4 Project achievements

### 4.1.1 Project deliverables

Del. code	Del. Name	Description	Assessment Decision	Explanations
D 02	Identification of Issues in Human Performance Automation Support	The aims of the deliverable are: - to review the issues regarding human performance in automation support identified during the SESAR Definition Phase in order to refine their description based on both literary review and consideration of the ConOps elements that will be defined in the various x.2 federating projects and in WP B4.2 during the 16.5.1 timeframe. - to identify possible additional automation issues with respect to those identified during the SESAR Definition Phase, based on both literary review and consideration of the ConOps elements that will be defined in the various x.2 federating projects and in WP B4.2 during the 16.5.1 timeframe.	No Reservation	The deliverable developed fits with the description.
D 03	Framework for HP Automation Related Good Practices	This document describes a framework that links the automation issues identified in Task 16.5.1-002 with the good practices to be identified in Task 16.5.1-004. The framework is intended to play two different roles in the project: - To provide 16.5.1 with a common reference structure to allow consistency in the collection of good practices by different project contributors. - To become part of the guidelines addressed to WP4-15 projects and help the users to orient themselves in the choice of the good practice to be considered. In order to serve the two different purposes the framework will integrate different classification elements, such as: the automation issue being addressed, the ATM roles actually involved in the automation support, the different levels at which the automation support may be given, the different ATM Services to be considered, the contextual elements to be considered in the operational environment in which the automation support is offered, etc.	No Reservation	The deliverable developed fits with the description. In addition a new Level Of Automation Taxonomy was created for the ATM field purposes.
D04	Guidelines for Addressing HP Automation Issues	This document provides guidance material on automation design and evaluation that HF specialists	No	The final deliverable developed fits with the

		<p>can apply to airborne and ground operational and technical projects involving automation. Guidance is proposed mainly for three HP activities relevant to automation design: Identifying potential human performance issues that may emerge as a result of the introduction of automation support, and which are considered to be specifically relevant to the SESAR Target Concept of Operations. Identifying the appropriate level of automation for an existing or targeted system or tool. Developing principles of automation design. In addition to providing guidance on automation design, this document summarizes methods relevant for HP automation support design and evaluation.</p>	<p>Reservation</p>	<p>description.</p> <p>A new title was proposed "Guidelines Material for HP Automation Support" with the purpose to match better with the content of the deliverable D04.</p>
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**Table 2 - List of Project Deliverables**

## 5 Total Eligible Costs

This section is based on the Project Costs Breakdown Forms of the eligible costs incurred by project Members during the project and these will be sent to the SJU separately by each member.

## 6 References

*Reference to main documentation, delete if not required*

- [1] SESAR, MFA, Multi-Lateral Framework Agreement, SESAR JU, 2.06.2009, SJU/LC/0028-CTR
- [2] SESAR Joint Undertaking (2010). Identification and Integration of Automation Related Good Practices. WP 16.05.01 Project Initiation Report. Version 00.01.03.
- [3] SESAR Joint Undertaking (2011). Identification of Issues in HP Automation Support. WP 16.05.01 Deliverable 02.
- [4] SESAR Joint Undertaking (2011). Framework for HP Automation Related Good Practices. WP 16.05.01 Deliverable 03
- [5] SESAR Joint Undertaking (2013). Guidelines Material for HP Automation Support. (ex Guidelines for Addressing HP Automation Issues). WP 16.05.01 Deliverable 04

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