Final Project Report

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Abstract

The Human Performance (HP) assessment process serves to ensure that HP is taken into account in the SESAR operational and technical projects. 16.06.05 has provided the vehicle to deliver the HP assessment process into the SESAR Programme and ensure that projects take account of the human element of the air and ground system development environment. The HP reference material provides guidance for projects that are in phase V1 (Scope), V2 (Feasibility) or V3 (Pre-industrial development & integration).

This Final Project Report that has been produced in the frame of the 16.06.05 project closure and contains the main deliverables and achievements of the Project as well as the contribution of 16.06.05 to the Master Plan, standardisation and eventual deployment of SESAR solutions

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Intellectual Property Rights (foreground)

This deliverable consists of SJU foreground.

Acronyms

Acronym	Definition
ATM	Air Traffic Management
ANSP	Air Navigation Service Provider
AU	Airspace User
ECAC	European Civil Aviation Conference
EOCVM	European Operational Concept Validation Methodology
HP	Human Performance
HPRM	Human Performance Reference Material
SELAT	Selection Assessment Tool
TACAT	Training and Competence Assessment Tool
TA	Transversal Area

1 Project Overview

The purpose of 16.06.05 was to ensure that the SESAR work programme took sufficient account of the limitations and strengths of the human actors operating within the ATM, both on the ground and in the air. As described in the masterplan, the human will remain central to the concept of ATM now and in the foreseeable future. It is vital therefore that the ATM system is designed taking account of human strengths and weaknesses and that the tasks and roles that are embedded with the operation of new concepts can be delivered by the people we expect to use the system. These two approaches formed the fundamental basis of Project 16.06.05. The project approaches can be summarised as ensuring that:

- The end users/actors who will be impacted in their operational roles and responsibilities by the implementation of the SESAR Target concept, will contribute to the SESAR expected ATM performance benefits, mainly through the improvement of the system efficiency and of the safety levels; and
- Their roles, tasks and responsibilities in the new ATM system introduced by SESAR will remain within the scope of human capabilities and limitations characteristics.

The purpose of the HP assessment process was to ensure that HP aspects related to SESAR technical and operational developments are systematically identified and managed. To achieve this, the HP assessment process:

- Described, in a series of arguments and associated necessary evidence to satisfy the arguments how airborne and ground ATM actors will contribute to the expected SESAR expected performance benefits. The Argument structure formed the central core of the Human Performance reference material and made it clear to projects what was expected to delivered, and how to derive the appropriate evidence that sufficient account had been taken of the human element within system design.

- Described the arguments and necessary evidence that showed the roles, responsibilities and tasks of airborne and ground ATM actors as developed in SESAR were within the scope of human capabilities and limitations. This basic and fundamental supposition drove the requirement that all solutions must, by the end of their design phase show that they can be operated by the people intended to operate them;

- Defined the process to ensure HP proactively contributed to building the operational concept and system architecture and described how results from HP activities should be used in the development process, with the aim of improving the concept and technology;

- Defined the HP transition criteria for progression from one phase of design to the next phase. This made it clear to projects the work that was expected to have been delivered at each V phase. This clear translation of expected evidence makes transitioning between V phases clear for projects;

- Had a clear link with validation by (a) providing an input to the validation planning process and (b) using the results of the validation activities in support of the HP arguments. This ensured that the validation strategy for projects embedded the need to consider the HP process;

- Was aligned with the other Transversal Area (TA) assessment processes, such as safety and business case, (a) it used a shared description of the reference, the solution and the assumptions and, (b) it identified overlaps and synergies between HP and other TAs;

- Defined the interactions and synergies with the other TA assessment processes, in particular, the safety assessment process;

- Provided data that can feed the SESAR Business Case, primarily with a view to understanding the training impact of each SESAR solution and how these costs would impact across ECAC and also more recently with workload and cost effectiveness assessment.

The use and deployment of the HPRM has improved significantly since the start of the programme. Initially, only projects that had within them HP experts deployed the assessment process. Thus the remote tower project was one of the few projects that successfully embedded a HP assessment process during the early part of SESAR. As this phase of SESAR closes, not only are individual project continuing to deploy a HP assessment process, but also entire work packages are centrally creating HP capabilities. Network (WP7) and Airports (WP6) have an established HP capability that ensures a full coverage of their sub projects.

It might be estimated that at the beginning of the SESAR (R1) approximately 10% of projects were deploying suitable HP assessment processes. By the end of SESAR (R5) it can be seen that nearer 80% of projects are deploying a suitable HP assessment process.

The changes that lead to the increasing successful deployment of the HPRM can be put down to three parallel, separate behaviours:

- A full engagement with the system engineering review cycle by 16.06.05 where project shortcomings were identified and reflect to projects at several stages within the project lifecycle.
- A recognition by technical and operational projects that to successfully transition through the SE review cycle a HP assessment is a necessary criteria
- A shift in the tactic of 16.06.05 from a passive project review role to actively engaging with operational and technical projects to ensure sufficient awareness of the HP assessment process. This occasionally provided the opportunity for 16.06.05 to directly provide the HP assessment necessary successfully transition the system engineering review.

1.1 Project progress and contribution to the Master Plan

Despite the fact that the HP assessment processes may be conducted in any phase of design, at the start of the work programme it was clear that there was little uptake of the HP assessment process before late design, i.e. It was very difficult to identify evidence that HP assessments were conducted during the project review process of early part of the project. Many projects were under the apprehension that by specifying the requirement to measure workload during a validation exercise the responsibility to assess HP had been discharged.

During subsequent phases of the programme, it was clear that projects were understanding more fully the requirements upon them to perform a HP assessment, and further what the ideal content of that assessment should be. The project review process, conducted in June 2016, has shown a significant improvement in the uptake and deployment of the HPRM and associated HP assessment techniques within and outside the validation process.

Implementing the European ATM Master Plan will only be successful if there is a detailed understanding of the impact that the human actors have on the successful operation of the System. The human element of the overall ATM system remains the most critical source of its performance, safety and resilience.

To support Human System Integration, technology has to be designed to incorporate the knowledge and understanding of how human and system actors' work together, and to explicitly incorporate the requirements that enable all functions to work collaboratively in managing performance. In the SESAR programme this is supported by a systematic analysis and management of Human Factor aspects of the design and validation of future operations.

The Human Performance Assessment Approach is described in the Human Performance Reference Material - HPRM is based directly on the EOCVM. Specifically, the output of the HP process has a direct impact on the following documents:

- HP should be represented in all project documents that present the ambitions of the project in terms of the human element of the Solution being proposed. Further, the same documentation should provide a complete set of requirements for the human should generated during the HP assessment process and that directly impact on the system design.
- The Validation Plan is a fundamental document that describes how the assessment of operation and technical projects will be undertaken. The validation plan contains a place holder for a HP assessment annexe, and therefore a HP assessment is a required inclusion that describes what is to be measured during validation and establishes a like originally derived from the argument structure and validation objectives.
- The Validation Plan and Report are the formal deliverables from the validation process. The validation plan and report, respectively, define and substantiate the means by which the assumptions made by the Solution covering the human component and the requirements placed upon 'it' are successfully and safely delivered.
- The description of the physical system in technical requirements, and based on comparison with the HP argument structure, it should be clear how system requirements have addressed the requirements of the arguments.

In order to ensure that the commitments made in the master plan are delivered 16.06.05 has committed to activities that have recognised the real progress made by SESAR projects in incorporating the HP approach into their methods of working. Most notably Project 16.06.05 has engaged fully with the SESAR project review process. This has allowed 16.06.05 to do three things:

(a) Monitor the ongoing and increasing uptake of the HPRM within the validation process

(b) Provide feedback to the SJU on the extent to which Projects make use of the approach developed promoted 16.06.05

(c) Provide feedback to the projects on the extent to which their deployment of an HP assessment process accords with the requirements of HP assessment process.

What has been clear from the project review process is that the uptake and use of the HPRM has been steadily increasing over the lifespan of the Transversal Areas. Thus during early project reviews at the beginning of the project review process in 2011 there was very little of the formal application of the HPRM. Subsequently, in the 2016 review, it is clear that more of the projects are applying the process, and applying it successfully. This is a significant achievement for both the projects and 16.06.05.

1.2 Project achievements

The 16.06.05 project has delivered and promoted the HPRM into the SESAR project and aided Operational Focus Areas with the deployment of their approach to integrating HP into the project lifecycle.

The following may be listed as achievements of the project:

- HPRM is the standard defining HP assessment in SESAR.

The HPRM has been developed with industry, ATM and airframe manufacturers, and it has been reviewed and accepted by staff associations. The mechanism by which the HPRM uptake can be gauged is the process associated with the System Engineering Review. Initially, at Release 2 there was little uptake of the HPRM as an assessment methodology, project preferring to rely on the measurement of situational awareness and workload to during validation exercise to define their approach to HF. However for Release 4 there was a significantly larger deployment of the HPRM and generally all projects make reference to the HPRM and deploy it appropriately for their projects.

The HPRM has been shown to be the method by which the full range of a HP assessment is deployed into the SESAR programme. A series of clear indicators are available from the SESAR programme that show the extent to which the HP Assessment Process, and the activities of 16.06.05 have contributed to the success of the programme. These include:

- Contribution to the Master Plan
- Support from the Staff Associations and Airspace Users
- Training cost assessment framework & database
- Adoption of the HPRM for work outside SESAR
- Request for HPRM by non SESAR ECAC members
- Request for the HPRM from non ECAC ANSPs

Each of these achievements is described in more detail below.

- Contribution to the Master Plan

The 16.06.05 team, has promoted the relationship with the master plan, and in the latest version of the master plan clearly embodies a text that describes the importance and relevance of the consideration of human strengths and weaknesses within the scope of the programme. By engaging fully with the staff associations, and the master plan, the goal of ensuring suitable consideration of the Human component of the system is recorded in black and white.

This incorporation and recognition of the importance of the human system relationship and its formalisation in the master plan is a significant achievement.

- Support from the Staff Associations and Airspace Users

16.06.05 has recognised the importance of working with staff associations and airspace user and actively pursued relationships with:

  - IATA (International Air Transport Association)
  - ELFAA (European Low Fairs Airlines Association)
  - ITF (International Transport Federation)
  - ETF (European Transport Federation)
  - ECA (European Cockpit Association)
  - IFATCA (International Federation of Air Traffic Control Associations)

They have provided active review and contribution to a series of project activities and the relationships established in 16.06.05 have been further exploited by 16.06.01. 16.06.05 has also benefited from the active role of the staff associations and airspace users in supporting the inclusion of HP in the master plan.

- Training cost assessment framework & database

The continued reliance on the human as a key actor, required for the implementation and successful operation of the majority of SESAR concepts means that in addition to looking for performance enhancement, SESAR partners should also be aware of the training burden associated with different operational improvements.

16.06.05 has developed a cost assessment framework within which data, can be applied within a tool that allows the cost of implementing different elements of SESAR projects to be estimated. The cost benefit framework has allowed a close working relationship to be established with 16.06.06 for the integration of human costs into overall SESAR CBA process. Within the business case, the cost benefit assessment process has used this deliverable as a contributing element.

- Adoption of the HPRM for work outside SESAR

Organisations that are part of 16.06.05 are also applying the HPRM outside SESAR projects; i:e for projects within their own organisations but not part of the SESAR program.

  - EUROCONTROL for example is deploying the HPRM in support of the network manager
  - Airbus is also applying the process to in house projects.
  - Elements of the HPRM to contribute to the European GDP study developed internally by and for IATA

- Request for HPRM by non SESAR ECAC members

Skyguide has taken the HPRM and applied it to their early lifecycle projects. Skyguide wanted to compare the use of the HPRM for SESAR with the Eurocontrol HF Case process. The outcomes of the application are currently being explored. The skyguide HF team offered to host and subsequently attended 16.06.05 Face to Face meeting in Geneva.

The UK CAA made a series of requests for material from 16.06.05 to support their automation working group. 16.060.05 provided the automation guidance provided by its associated research project and also the HPRM that showed how automation guidance has been incorporated into the assessment process.

- Request for the HPRM from non ECAC ANSPs

A formal request has been received from non ECAC ANSPs for the release of the HPRM. The material has been requested by:

  - Air services Australia
  - Nav Canada

In addition to these formal requests, the HPRM has been presented at the joint FAA European working group for safety known as Action Plan 15.

These significant achievements of the project have contributed to its success within the partner organisation and staff associations and airspace users.

1.3 Project Deliverables

A number of deliverables have been produced by the project. The most notable ones (aside from standard project reporting) are described below.

Title & Description
HP Assessment Process for V1 to V3 - D
The HP assessment process was originally an iteration of the Eurocontrol HP Case. It was developed to reflect the research and design environment and released as a series of document that mirrored the evolving EOCVM project environment. The final release of the HPRM provided a combined document of V1 to V3 (early to late design) and provides a mechanism for tracking the HP maturing of each project.
Quarterly Report on HP Assessments -
In supporting operational and technical projects, 16.06.05 recorded the support offered to each project and provided a quarterly report to the SJU for clarity and transparency. The quarterly reporting spreadsheet allowed issues and difficulties to be reported to the SJU. As the programme progressed, it provided a tool to track the contribution made by each project to human performance.
Interdisciplinary Training Review
Managed by DFS this sub task explored the opportunity to link low fidelity simulators for the ground and air to establish the extent to which the air side and ground side were cognisant of the limitations in the expectations each had on the other. Gaps in understanding, procedures and shared awareness were identified in the process and were subsequently debated by pilots and controllers to determine the most appropriate – shared – approach to resolving them.
SELAT & TACAT
16.06.05 has developed a tool that for each SESAR project allows an assessment to be made of whether there will be a requirement to adjust or change the selection and training requirements for Air Traffic Controllers, and also to assess whether the project has any impact on the competencies required of controllers, pilots and ATSEPs.
Report on the applicability of P16.04.01-04 outputs to meet 16.06.05 requirements
16.06.05 provided a vehicle to deploy the outcomes of the Human performance research projects deployed within 16.05.x and 16.04.x. The output of each R&D project was deployed in a test case with a real operational project to determine whether it was suitable for further deployment into the programme as a whole.
Cost Benefit Analysis Tool
A tool has been developed that allows the estimation of training costs for each SESAR project, and allows a subsequent combination of projects into similar groupings to provide an estimation of cost for deploying a 'package' of operational improvements. The cost benefit tool allows the training cost to be assessed for controllers, ATSEPS and pilots for all projects within the SESAR programme and has been used to directly support the cost benefit analysis of the programme.

1.4 Contribution to Standardisation

The HPRM offers to ATM an approach for assessing human performance across the V1 to V3 system development project lifecycle. It is the only reference material available, authored within and directly relevant to the European theatre of operations. It provides a single, unifying, approach that has been agreed ANSPs, equipment manufacturers, airframe manufacturers and staff associations and industry associations for deployment in the design phase of ATM and cockpit technologies.

The HPRM has been agreed within SESAR as 'the' HP process by

- ANSPs:
  - NATS
  - ENAV
  - DFS
  - AENA / ENAIRE
- Equipment Manufacturers
  - Thales
  - Indra
- Airframe manufacturers
  - Airbus
- Research Partners
  - Sintenf (Norway)

In addition to defining a single unifying framework for assessing HP, the processes within the HPRM have also been used to directly support standardisation activities.

Direct support was provided to Project C.03 – Regulatory Interface - in establishing a HP process for early regulatory assessment. This was colloquially known as the ATC Licensing tool, and provided insight as to whether a project or solution would require a change of licensing. The tool was initially developed for Controller licensing, but was then extended for Pilots and ATSEPs.

Experts from DFS provided direct support to C.03 and for each operational improvement for SESAR (subsequently combined into Operational Focus Areas, and eRIA was undertaken. The findings were summarised

1.5 Project Conclusion and Recommendations

1.5.1 Conclusions

In delivering 16.06.05, the SESAR programme has been served by the deployment of a single consistent framework for assessing human performance in early design phase projects.

The following conclusions can be drawn:

- The HPRM has been developed to reflect, and is acceptable for air and ground projects in an R&D environment.

Over its six year lifecycle, the HPRM has been revised to support, initially, the immediate need of projects in V2. This immediate need was then revisited and material released to support projects in V2, finally material to support early design projects (V1) was released. The significant coordination between air and ground has produced an effective approach to integrating HP into the design process of projects.

- The early trend of a lack of uptake of the HPRM has largely been reversed in the later phases of SESAR.

Following the multi-strand approach by 16.06.05 to increasing the uptake of the HPRM as the means of assessing HP in projects, there is now significant positive evidence that projects are conducting HP assessments and are doing so using the HPRM.

- The uptake and deployment of the HPRM into projects has benefited most from direct personal contact from 16.06.05 into projects.

The coaching approach advocated by the transversal areas has had greatest impact in ensuring the HPRM is used by projects. This coaching process, delivered directly from 16.06.05 into projects has proved the most effective means of communicating with projects.

- There is a clear need for SJU to require that the HPRM is deployed within a development and deployment project activity.

Initially, projects were largely unwilling to deploy HP assessments that required further work than the traditional approach to validation. With the requirement to successfully transition the SE gate process there was added impetus for projects to deliver appropriate HP assessments. As the SJU became more rigorous in applying the SE review process, the expectations on projects became more stringent. Combined with the coaching approach from16.06.05, this more stringent approach to the SE review process has increased significantly the deployment of the HPRM across the programme. SJU is encouraged to maintain this stringent approach to project review during S2020.

1.5.2 Recommendations

The following recommendations are made for future SESAR Human Performance Assessment

- To maintain the HPRM as the approach for assessing human performance within SESAR.

The HPRM has been agreed between ground and air industries and ANSPs and air frame manufacturers, and has been approved by staff associations and airspace users. It is an agreed structure to assess and aid with the design of the human component of new systems. SJU is urged strongly to mandate the HPRM within the forthcoming S2020 programme and continue building on the success of 16.06.05.

- To provide a mechanism that affords the pro-active involvement of impacted stakeholders with an expert forum capable of advising on the proposed application of the HPRM.

Through its face to face meetings, and the coaching initiative, 16.06.05 has provided a forum where experts and professionals can come together to discuss the difficulties and opportunities of working within the project environment in SESAR. The S2020 framework does not afford a direct facsimile of this working arrangement, and the SJU is urged to explore whether a mechanism could be created to allow a similar exchange of information, within experts and between projects.

- Resources developed in SESAR 1 and referenced in the HPRM should continue to be available. Specifically the HP tool repository developed in 16.4.2.

The HPRM makes reference to a collated body of Human Performance tools, methods and approaches. It is an invaluable resource that should not be lost in SESAR 2020. The 16.04.02 HP Repository is referenced directly in the Project Handbook for SESAR 2020.

- The tight link between HP and validation is explored fully so that validation activities take full benefit of the evidence required for the validation of HP issues.

In the early parts of the work programme the need for HP was largely considered satisfied by addressing workload and situational awareness within the scope of a validation exercise. This has subsequently been addressed, but greatest benefit to SESAR 2020 could still be gained by ensuring close cooperation between the needs of the HP assessment process and the needs of the validation exercise. Close cooperation and collaboration will ensure an efficient deployment of HP methods within a validation exercise, and the gathering of suitable and complete evidence to address HP validation requirements.

2 References

The following deliverables have been produced by 16.06.05 and have been accepted.

Code	Title
D02-001	SESAR HP Management System (HPMS) Policy and Principles
D08-002	Cross-TA Common Baseline and Assumptions
D17	Interim Performance Based Operations (Step 3) HP Cases and Contributions to Business Cases - PDR
D18	Interim Performance Based Operations (Step 3) HP Cases and Contributions to Business Cases - OAR
D27	HP Assessment Process for V1 to V3
D34	Quarterly Report on HP Assessments
D38	Quarterly Report on HP Assessments - Q1 2014
D39	Quarterly Report on HP Assessments - Q2 2014
D44	Quarterly Report on HP Assessments - Q3 2015
D56	SE Release x (x=1-5) Review 2
D73	Training Automation Assessment Guidance
D79	Final Report: Conclusions on interdisciplinary training
D92	SELAT
D05-001	HP and Cross-TA Output Communication and Outreach
D06-002	SESAR HP Reference Material
D10-001	Cross-TA Project and Package Impacts - Benefits Mechanisms
D10-002	Cross-TA Project and Package Impacts - Benefits Mechanisms
D03-001	HP and Cross-TA Assessments Management Plans
D03-002	HP and Cross-TA Assessments Management Plans
D04-001	Regulatory Interface Reviews
D06-001	SESAR HP Reference Material
D07-001	Report on the support to Projects HP Assessments
D09-001	Cross-TA Register of Data
D12	Interim Time-Based Operations (Step 1) HP Cases and Contributions to Business Cases – OAR
D13	Time-Based Operations (Step 1) HP Cases and Contributions to Business Cases – SAR
D15	Interim Trajectory-Based Operations (Step 2) HP Cases and Contributions to Business Cases - OAR
D20-001	HP and cross-TA Awareness and Training Material
D24	Final Project Report
D30	Quarterly Report on HP Assessments
D32	Quarterly Report on HP Assessments
D41	Quarterly Report on HP Assessments - Q4 2014
D42	Quarterly Report on HP Assessments - Q1 2015
D46	Quarterly Report on HP Assessments - Q1 2016
D61	SE Release 3 Review 3

Code	Title
D63	SE Release 5 Review 3
D83	Summary of additional Human Performance tools
D90	TACAT ATC
D14	Interim Trajectory-Based Operations (Step 2) HP Cases and Contributions to Business Cases - PDR
D16	Trajectory-Based Operations (Step 2) HP Cases and Contributions to Business Cases – SAR
D19	Performance Based Operations (Step 3) HP Cases and Contributions to Business Cases – SAR
D21-001	HP and cross-TA Training and Coaching
D26	SESAR HP Assessment Process 2
D31	Quarterly Report on HP Assessments
D33	Quarterly Report on HP Assessments
D36	Quarterly Report on HP Assessments - Q3 2013
D45	Quarterly Report on HP Assessments - Q4 2015
D57	SE Release 5 Review 1
D58	SE Release 2 Review 3
D60	SE Release 4 Review 1
D77	Development Phase Conclusion Report
D08-001	Cross-TA Common Baseline and Assumptions
D09-002	Cross-TA Register of Data
D11-001	Report on HP Reviews for SEMP (for Steps 1 - 2 and 3)
D22-001	Report on the applicability of P16.04.01-04 outputs to meet 16.06.05 requirements
D23-001	Report on the applicability of P16.05.01-04 outputs to meet 16.06.05 requirements
D25	SESAR HP Assessment Process 1
D35	Quarterly Report on HP Assessments - Q2 2013
D37	Quarterly Report on HP Assessments - Q4 2013
D40	Quarterly Report on HP Assessments - Q3 2014
D43	Quarterly Report on HP Assessments - Q2 2015
D59	SE Release 3 Review 2
D64	SE Release 4 Review 3
D67	SE Release 5 Review 3
D78	Test & Demonstration Report
D80	CBA_Tool
D91	TACAT ATSEP

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