Final Project Report

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Abstract

This project supported the development of the Tower Advanced Controller Working Position (A-CWP) in which the new functionalities developed by other SESAR Airport related projects to support the Air Traffic Controllers (ATC) were integrated into a unique and configurable Control Working Position.

The A-CWP took into account the different procedures and ATC roles operating into a Tower.

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Acronyms

Acronym	Definition
ATC	Air Traffic Control
ATCO	Air Traffic Controller in Operation
ATM	Air Traffic Management
AMAN	Arrival Manager
A-SMGCS	Advanced- Surface Movement Guidance and Control System
A-CWP	Advanced Integrated Control Working Position
CWP	Control Working Position
D-TAXI	Digital-TAXI
DMAN	Departure Manager
E-OCVM	European-Operational Concept Validation Methodology
ETF	European Transport workers' Federation
HMI	Human-Machine Interface
IATA	International Air Traffic Association
ITWP	Advance Integrated Tower Working Position
OI	Operational Improvement
OSED	Operational Service & Environment Description
PPs	Primary Projects
RTS	Real Time Simulation
SES	Single European Sky
SPR	Safety and Performance Requirements
VALP	Validation Plan
VALR	Validation Report

1 Project Overview

This project came up with the definition of a Tower Advanced CWP (A-CWP) that handles the integration of the airport air side systems into a homogeneous system.

This will facilitate the work of the controllers and also the improvement of the consistency of the information used by them in the different airports.

1.1 Project progress and contribution to the Master Plan

The objectives set by Single European Sky (SES) initiative supported the clear need for improving capacity, safety, predictability and situational awareness in the whole Air Traffic System. This was leading to introduce newer functionalities in the systems providing even more information to the controller.

Nevertheless the controller was nowadays surrounded by a number of individual systems all having their own interface, without any common information management. Consequently the new functionalities and tools were previously developed in isolation and independently throughout Europe. The consequences were that the current airport controller operations can be extremely different depending on the country, the type of airport or even the controller role. This is a show-stopper in order to reach the SES objectives which will result in an improvement in the European Air Traffic Management.

P06.09.02 was the project which supported the development of the Tower Advanced Controller Working Position (A-CWP) in which the new functionalities developed by other SESAR Airport related projects to support the Air Traffic Controllers (ATC) were integrated into a unique and configurable Control Working Position.

The work performed into P06.09.02 project has always targeted the need of harmonization and integration in a Tower A-CWP of the new functionalities defined for the improvement of the ATC operations in the airport.

To achieve these objectives, partners involved in the project included a mixture of Operational, Technical, Human Factors, Safety experts and Staff Associations (IATA, ETF), with experience enough in the Airport side so as to help to evolve the A-CWP.

The baseline of this project was the work done in the ITWP project (Integrated Tower Working Position) launched in 2006 and led by EUROCONTROL. In fact the requirements specification was used as starting point ([4] [5]) and most of the V2 validation exercises were supported by the ITWP prototype. Furthermore ITWP was the reason because the initial maturity level of the solution addressed in this project was V2.

During these 6 years of work, this project in collaboration with the rest of the operational projects working on new developments impacting directly the Tower CWP HMI, worked together to set the common requirements for the A-CWP HMI.

To do this, a repetitive process was followed in close cooperation and coordination among operational and technical projects related to Airport Operations: Firstly, the requirements generated from other Airport related projects addressing single functionalities impacting HMI CWP were identified. Afterwards, the project partners assessed these requirements from a holistic point of view, compiling them as a complete set of requirements related to CWP HMI and identifying inconsistencies and gaps. The inconsistencies were addressed peer-to-peer with each particular project agreeing on the definition of those requirements under discussion and the gaps were filled in creating new requirements.

Once the operational requirements were defined, they were evaluated through different validation exercises. This task was done not only in coordination with other projects in charge of the definition of

the operational requirements but in close cooperation with the technical project in charge of the prototypes development.

Some of these exercises addressed V2 (supported by prototypes developed into the project) and other ones were focused on V3 phase (supported by prototypes developed into technical project). The V2 exercises were focused on the analysis of the impact of the integration of new functionalities on the CWP but with no integration with other systems, (very focused on HMI). The rest of the exercises addressed late V3 through integrated exercises in which all the functions and their systems were inter-connected. In fact, two of the exercises were carried out configuring some SWIM services.

The main objective was assessing whether the level of integration of the new functions into the CWP was adequate and usable for controllers. These exercises were Real Time Simulations, (and one Shadow Mode) in which Air Traffic Controllers into Operation evaluated the new functions integrated into a common A-CWP. The airside was simulated with pseudo-pilots. Due to the nature of the project, only qualitative results were provided. They have been provided through de-briefing and standardised questionnaires addressing several indicators such as situational awareness or workload.

The requirements were assessed in different airport environments in line with the four prototypes developed to support the validation activities in several Airport environments: Charles de Gaulle (CDG) – Paris, Fuhlsbüttel (HAM) – Hamburg, International Riga Airport (RIX) – Riga, Adolfo Suárez-Barajas (MAD) – Madrid, El Prat (BCN) - Barcelona, Malpensa (MXP) – Milano. Besides two validation exercises performed into the project (in Hamburg Airport) have tested the use of initial SWIM services. At the end of each cycle, the requirements (both operational and technical) were re-assessed and updated creating new versions of the operational requirements. This process was repeated per each Validation cycle which means that at least one validation exercise was performed every year.

Due to its transversal nature to other airport related projects, this project was considered as enabler for the other operational improvements linked to the airport-related projects. Thus the previous Operational Improvement was deleted and this project has defined the links to several enablers related to the Control Working Position as shown in the following table:

Code	Name	Project contribution	Maturity at project start	Maturity at project end
AERODROME-ATC-50	Advanced Controller Working Position	Support to Integrated validation activities providing the appropriate HMI in the A-CWP the HMI of new advanced tools defined in SESAR 1 such as routing, Safety nets, D-TAXI or Airfield Ground Lighting.	TRL3	TRL6
AERODROME-ATC-38	Airport data recording and Analysis System	Identification of operational requirements description related to the HMI of the A-CWP of the Operational Supervisor. Those requirements are also linked to the new functions impacting on the role.	TRL3	TRL3
AERODROME-ATC-49	Development of advanced CWP to support enhanced A-CDM and the integration of new	Support to Integrated validation activities providing the appropriate HMI in the A-CWP the HMI of new advanced tools	TRL3	TRL5

	aerodrome system components/tools(e.g. coupled AMAN/DMAN)	defined in SESAR 1 such Coupled AMAN-DMAN		

As "enabler", the project contributed providing operational requirements and supporting validation activities to the following solutions that should reach V3: #02 "Airport Safety Nets for controllers", #14 "Departure Management integrating Surface Management constraints", #22 "Automated Assistance to Controller for Surface Movement Planning and Routing", #23 "D-TAXI service for CPDLC application", #46 "Initial SWIM".

For the solutions #01 Runway Status Lights, #15 Integrated and throughput-optimised sequence of arrivals and departures, #21 Airport Operations Plan and AOP-NOP Seamless Integration, #35 MET Information Exchange, #47 Guidance Assistance through Airfield Ground Lighting, #48 Virtual Block Control in LVPs, #53 Pre-departure sequencing supported by route planning, #54 Flow-based integration of arrival and departure management, #55 Precision approaches using GBAS Category II/III, the contribution has been through the collection of operational requirements impacting on the A-CWP HMI. However, these solutions have not been assessed within this project, targeting specifically the impact of the integration of those solutions on the A-CWP HMI.

After the different V2 and V3 validation activities, no blocking point related to the integration of the functions into the CWP was raised up. Therefore the maturity level of the AERODROME-ATC-50 and AERODROME-ATC-49 was the same as the solutions supported by these enablers.

Regarding the AERODROME-ATC-38, the maturity level was the same as initially (V2): This is because the project has contributed to the specification of the ATC supervisor but this role and it's a-CWP has not been addressed in any validation activity.

1.2 Project achievements

As operational project, a set of Tower CWP requirements was defined. With the development of the new functions related to Airport operators, other requirements were defined impacting the CWP. In order to avoid duplications, this project was working in getting a unique document in which all the requirements impacting the Tower CWP were included. Besides, inconsistencies and gaps were raised up and new or updated requirements were included.

It was not possible to establish a specific validation target related only to HMI. However in order to measure the impact of the integration of the new functions impacting the CWP HMI, the following indicators were assessed: Positive impact on Air Traffic Controller into Operation (ATCOs) Situational Awareness, Positive or non-negative Impact on Safety and non-negative impact on ATCO workload when integrating new functionalities impacting the A-CWP.

As mentioned in the beginning, this project has supported several solutions producing a single set of commonly agreed requirements for Tower A-CWP that will help any ANSP or Industry to develop an A-CWP, independently of the ATCO role, Tower procedure or type of Tower.

These requirements compiled the global requirements impacting a generic CWP with the current functions in place together with the requirements coming from the new advanced functionalities covered in other Airport related projects, (only those with a direct impact on the A-CWP). They were defined modularly covering several functionalities from the less complexes Towers to the most advanced ones. The following ATCO roles were assessed: Clearance delivery, Ground and Runway Controllers, Supervisor.

The requirements were assessed in several airport environments, (large, medium and small) and in different runways configuration (parallel and crossed runways).

Finally, this project has supported the technical project in the development of the technical specification ensuring the right interpretation of the operational requirements and their translation into adequate technical requirements.

1.3 Project Deliverables

The following table presents the relevant deliverables that have been produced by the project.

Reference	Title	Description
D121	OFA06.01.01 Final OSED	This document includes the operational requirements and procedures which are the common and agreed specification of the Tower A-CWP. It includes a set of requirements generated into this project in addition to other ones defined into other Airport related projects impacting the A-CWP HMI. This document does not include the results of the last validation activities during end 2015-mid 2016.
D124	OFA06.01.01 Final SPR	This document includes the Safety and Performance Requirements related to Tower A-CWP. It includes a set of requirements generated into this project in addition to other ones defined into other Airport related projects with an impacting the A-CWP HMI. This document does not include the results of the last validation activities during end 2015-mid 2016.

The project has also contributed to the planning, execution and reporting of integrated validations in another SESAR project, participating in the assessment of the objectives related to integration of the functions (Solution #14, Solution #22, Solution #23 and Solution #46), into the A-CWP HMI.I

1.4 Contribution to Standardisation

The set of requirements produced by the project helped to create a baseline and must be used as guidelines in order to develop or update the A-CWP. However no standardisation activities could be proposed since the configuration of the HMI is dependent not only on the airport type but also on operational needs (traffic, complexity, roles…). Furthermore, the A-CWP will be in a continuous development cycle in which new functions should be tested previous to any implementation to check the consistency among all integrated functions.

1.5 Project Conclusion and Recommendations

This project developed a common specification for supporting an appropriate development of a Tower A-CWP. The operational requirements were defined taking into account the controller roles and they were formulated modularly depending on the functions to be implemented. Most of the requirements were addressed in the different validation exercises but there were still some of them that either they have not reached the complete V3 maturity level or they were not assessed in any integrated validation exercise.

The main results coming from the analysis of the results of the validation exercises are summarized below:

- Globally, the results indicated that the controllers were able to efficiently manage the traffic by using the A-CWP with all the integrated functions for all levels of traffic load (i.e, low, medium and high). That meant that the usage of advanced functions integrated into the controller HMI enabled the controllers to perform their tasks with a perceived increased situational awareness within a reasonable level of workload.
- Part of the new functions integrated (Safety net alerts, routing guidance and datalink functions) were defined to increase the safety and the situational awareness reducing or keeping the level of ATCO workload. They were integrated into four different platforms representing different implementations of an A-CWP. In general terms, the feedback about the level of integration of those functionalities was positive. However it could be improved by an increase in the size of the screen of the A-CWP. This will enlarge the presentation surface and more information could be added (for example, the Electronic Flight Strips could display more lines).
- More concretely by new function implemented and assessed: the display of the safety net alerts and the routing and guidance in the four different CWPs was considered useful and appropriately implemented. In order to keep on with the deployment of these functions, local adaptions and configurations must be done to adapt to specific environments. Regarding the datalink services, although it was considered useful, there is still room for improvements regarding HMI. For example: the datalink messages to be implemented (It is not clear that all datalink messages are useful and needed by the controllers), how the datalink actions could be performed through the track label, etc.
- The readability and meaningfulness of textual information and graphical objects into the A-CWP were overall assessed positively. The controllers (Ground, Runway and Clearance Controllers) estimated that the information available on the A-CWP was sufficient to perform their tasks. The different HMI proposals used in the prototypes/platforms were considered to be usable and intuitive and helped to build a good mental picture of the traffic as well as within an acceptable level of workload.
- The validation activities in which integrations of new functions within A-CWP are assessed have been done taking into account that ATCOs have to watch outside of the tower cap and they can not only be focused on the screen.
- Furthermore, prioritising the information is particularly important taking care of the unnecessary warnings in the position which could overwhelm the ATCO, preventing him/her from receiving critical information.
- The use of the SWIM services had a limited impact on the HMI. Only some services were configured in the platform supporting two validation exercises. The main objective of the exercise was to check that the information provided by SWIM was available and appropriate to support the controller operations. The first validation exercise concluded that the meteorological information provided by SWIM was not sufficient. The results of the second validation could not be analysed before the project closure.

These are the recommendations extracted from the experience of this project:

- A-CWP is the interface with the Air Traffic Controller in the Tower. Any future functionality to be developed will need to be integrated into it ensuring that there is benefit on Controller situational awareness, safety and performance. Consequently the evaluation of the integration of the new/updated functions into a CWP HMI must be performed and it must not be underestimated.
- The integration of the safety net alerts and the routing and guidance services is ready to move to the next phase. However local adaptations must be done.
- The datalink services and the integration of Coupled AMAN/ DMAN must be further assessed looking at the results of the validation activities performed up to this moment (the results of the latest validation activities must be checked to confirm this conclusion).
- There are still requirements which have not completed the V3 maturity level. For those, it is recommended to address them in future validation activities.

- Furthermore the Supervisor role which was addressed into the operational requirements could not be assessed in any validation exercise. Therefore it is recommended to assess this role in future validation activities.
- There are still some open actions in terms of the consolidation of the operational requirements impacting HMI: once the solutions projects have updated their requirements, a consistency check must be done with all their new/updated requirements (only those impacting the HMI of the A-CWP). Furthermore, the latest validation activities will provide feedback about the HMI of the A-CWP (i.e. about the requirements defined by this project and not by the solution projects), so these results must be assessed and consequently new or updated requirements could be produced. With the results of undertaking these open actions, a new version of the deliverables of this project should be created.
- Finally in terms of the execution of validation activities, the learning curve of the controllers when they are facing new functions should be carefully considered. This means that training must be carefully planned. The lack of training had a high impact on the execution of the validation exercises when the controllers usually considered the first runs as though they were on training sessions. This has been confirmed in the results of the validation exercises and it has been mentioned during the debriefing sessions. Alternatively, the results of the first sessions might be weighted adequately to avoid jeopardising the results.
- Regarding the enablers, it is recommended to change the approach for the definition of enablers related to the A-CWP. They should not be split by the different functions to be integrated but they should allow the differentiation between mature integrated functions in SESAR 1 and the other aspects to be further assessed in future R&D validation activities.

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