Scenario descriptions and requests for EUROCONTROL input

Document information	
Project Title	EMFASE
Project Number	E.02.32
Project Manager	University of Trento
Deliverable Name	Scenario descriptions and requests for EUROCONTROL input
Deliverable ID	D2.1
Edition	00.00.07
Template Version	03.00.00
Task contributors	
Deep Blue; University of Trento; SINTEF.	

Please complete the advanced properties of the document

Abstract

D2.1 deliverable describes the application scenario selection process and details the identified application scenario from an operational and technical point of view, with particular focus on security aspects. D2.1 also lists the additional information related to this scenario that will be requested from EUROCONTROL.

Authoring & Approval

Prepared By - *Authors of the document.*		
Name & Company	Position & Title	Date
Alessandra Tedeschi, DBL	WP2 leader	25/02/2014
Luca Save, DBL	Project Member	21/02/2014
Federica Paci, UNITN	Project Member	21/02/2014
Martina De Gramatica, UNITN	Project Member	21/02/2014
Fabio Massacci, UNITN	Project Coordinator	21/02/2014

Reviewed By - *Reviewers internal to the project.*		
Name & Company	Position & Title	Date
Federica Paci, UNITN	Project Member	26/02/2014
Elisa Chiarani, UNITN	Project Member	27/02/2014

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

Approved for submission to the SJU By - *Representatives of the company involved in the project.*		
Name & Company	Position & Title	Date
Fabio Massacci	Project Coordinator	29/05/2014

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

Rational for rejection
None.

Document History

Edition	Date	Status	Author	Justification
00.00.01	30/01/2014	Document structure	A. Tedeschi	Document creation
00.00.02	21/02/2014	Document Draft	F.Paci, M. De Gramatica	Sections 3.1, 3.2
00.00.03	25/02/2014	Document final draft	A. Tedeschi, L.Save	Document final draft
00.00.04	26/02/2014	Internal Review	F. Paci	Internal review completed. Comments and suggestions
00.00.05	27/02/2014	Quality Check	E. Chiarani	Quality Check completed. Minor comments.
00.00.06	28/02/2014	Final	A.Tedeschi	Updates after Quality Check.

00.01.01	26/05/2014	Final	A. Tedeschi	Updates after EMFASE PO review.
00.01.02	29/05/2014	Final	F. Paci, F. Massacci	Quality check. Minor remarks
00.01.02	29/05/2014	Final	F. Massacci	Approval for submission

Intellectual Property Rights (foreground)

This deliverable consists of SJU foreground.

Table of Contents

List of tables

List of figures

Executive summary

The main objective of WP2 of the EMFASE project is to provide support to decision makers for selection of Risk Assessment methods for security in the ATM domain. This support will take the form of guidelines for how to select the risk assessment method best suited for the particular situation (concept under assessment and its maturity level, involved stakeholders, time and budget constraints, etc.).

WP2 empirically evaluates different risk assessment methods in terms of performance, measurable security impact, usability, and economy. The evaluation methods that will be employed in this work package can be case studies and/or controlled experiments, as prescribed by the empirical evaluation framework developed in WP1.

During these studies, different risk assessment methods will be applied on different application scenarios.

The definition of realistic application scenarios and design of concrete studies based on these scenarios is a relevant part of the objective of WP2, particularly in its early phases.

The purpose of D2.1 deliverable is to document the application scenario selection process and the interactions with relevant ATM stakeholders and security experts to carry it out.

D2.1 further details the identified application scenario form an operational and technical point of view, with particular focus on security aspects and presents the Reference Material prepared for the experiments' conduction.

D2.1 also lists the additional information related to this scenario that will be requested from EUROCONTROL, for example relevant scientific papers and/or reports, SESAR documentation, earlier risk assessments, and historical data on security incidents.

1 Introduction

1.1 Purpose of the document

The main objective of WP2 of the EMFASE project is to provide methodological and practical support to decision makers for selection of Risk Assessment methods for security in the ATM domain.

This support will take the form of guidelines for how to select the risk assessment method best suited for a particular situation, e.g., concept under assessment and its maturity level, involved stakeholders, time and budget constraints, level of expertise of the Risk Assessment facilitator, etc..

In order to develop the empirical evaluation framework and draw the guidelines, WP2 empirically classifies, evaluates and compares different Risk Assessment methods in terms of performance, measurable security impact, usability, and economy. The evaluation methods that will be employed in this work package can be case studies and/or controlled experiments, as prescribed by the empirical evaluation framework developed in WP1.
During these studies, different Risk Assessment methods will be applied on different application scenarios.
The definition of realistic application scenarios and the design of concrete studies based on these scenarios is a relevant part of the objective of WP2, particularly in its early phases.

The purpose of D2.1 deliverable is to document the application scenario selection process and the interactions with relevant ATM stakeholders and security experts to carry it out.
D2.1 further details the identified application scenario from an operational and technical point of view, with particular focus on security aspects.

D2.1 also lists the additional information related to this scenario that will be requested from EUROCONTROL, for example relevant scientific papers and/or reports, SESAR documentation, earlier risk assessments, and historical data on security incidents.
Finally, D2.1 presents the Reference Material prepared for the evaluation experiments with students, ATM professionals and Security Experts.
All the participants involved in experiments will sign a non-disclosure agreement. Participants will receive just hardcopies of the Reference Material that will be returned to EMFASE partners after the end of the experiment itself.

D2.1 is mainly an internal working document that facilitates the exchange of operational and technical information among EMFASE partners in order to build a common view on the scenarios for the evaluation experiments. It simply documents the scenario definition and selection process carried out during the first 6 months of EMFASE project and serves as a basis for future work in WP2.

More specifically, the document is structured as follows. Section 2 presents the Scenario definition process by detailing candidate scenarios and their peculiarities, listing relevant selection criteria used by EMFASE partners in the choice of a suitable scenario and describing the overall selection process and the final selection of the Remote and Virtual Tower scenario. Section 3 contains a detailed operational and technical description of the Remote and Virtual Tower Scenario. In Section 4 we present the Reference Material for the evaluation experiments depending on their duration and on the stakeholders involved, examples of the (so far) produced Reference Material are contained in Annexes to D1.2. Finally, in Section 5 we list the additional information requested from EUROCONTROL and SESAR JU, before we present our Conclusions in Section 6.

1.2 Intended readership

As stated in Section 1.1, D2.1 is mainly and internal working document for EMFASE. Thus, intended readers of this document are primarily the EMFASE project partners and the EUROCONTROL Project Officers that have to agree on a common terminology and on a shared view about the operational scenarios that are the basis of the evaluation experiments. Other potential readers are other SESAR partners interested in the EMFASE project that want to better understand the scenario selection process and the experiment preliminary design, e.g., P16.02 and P16.06.02 partners, as well as P06.09.03 partners.

1.3 Inputs from other projects

This deliverable uses in particular inputs from SESAR project 06.09.03 and P12.04.07, since the Remote and Virtual Tower is the selected scenario described in detail in Section 3.

SESAR Projects SWP 06.06 – Airport CDM, P07.03.02 – Integrated Network CDM, P05.06.01 and 05.06.05 i-4D and P05.06.04 – Extended AMAN also provide relevant input in the high-level description of the non-selected application scenarios.

1.4 Glossary of terms

Term	Definition
Remote Tower	ATSU that remotely provides ATS through the use of direct visual capture and visual reproduction e.g. through the use of cameras.
Visual Reproduction	HMI that reproduces the Out-of-The-Window view of ATCO/AFISO by collecting visual airport sensor data (from cameras and/or other sensors) and presenting them to the ATCO/AFISO in order to provide situational awareness.
Remote Tower Module (RTM)	Complete module including both the CWP(s) and the Visual Reproduction display screens.
Remote Tower Centre (RTC)	Building where ATS are provided to one or more airports. It usually includes several RTMs

1.5 Acronyms and Terminology

Term	Definition
AMAN	Arrival Manager
ATM	Air Traffic Management
ATSU	Air Traffic Service Unit
CDM	Collaborative Decision Making
E-ATMS	European Air Traffic Management System
i4D	Initial 4 Dimensions (Trajectory Management)
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.

2 Scenario Definition

One of the main results of the EMFASE project will be the definition and initial application of an Integrated Evaluation Framework for Risk Assessment Methodologies that will allow to classify, empirically assess and compare different Risk Assessment Methodologies for the Air Traffic Management domain.

The Integrated Evaluation Framework includes among its evaluation methods Case Studies and Controlled Experiments, during which the Risk Assessment Methodologies are analysed through their direct application to specific scenarios.
Case Studies are conducted by observing professional practitioners apply selected security risk assessment activities, while in Controlled Experiments, operational experts, ATM and Security professionals and/or students will be subjected to tasks related to security risk assessment practices in a controlled setting.

The complexity, level of realism and duration of the experiments may vary, depending on involved users availability and expertise, ranging from 2 days to 2 whole weeks.
For both typologies of evaluation methods, it is crucial to identify SESAR-relevant realistic application scenarios for which Security Risk Assessment is a central element.

During the EMFASE first period, from September 2013 to February 2014, the EMFASE consortium members carefully selected the application scenario that will serve as a basis to organize and conduct the evaluation experiments, collected all the relative documents and materials, by involving also SESAR experts to gather detailed information, and finally prepared the Reference Material for the Controlled Experiment sessions with students and Case Studies with operational experts and professionals, see Figure 1.

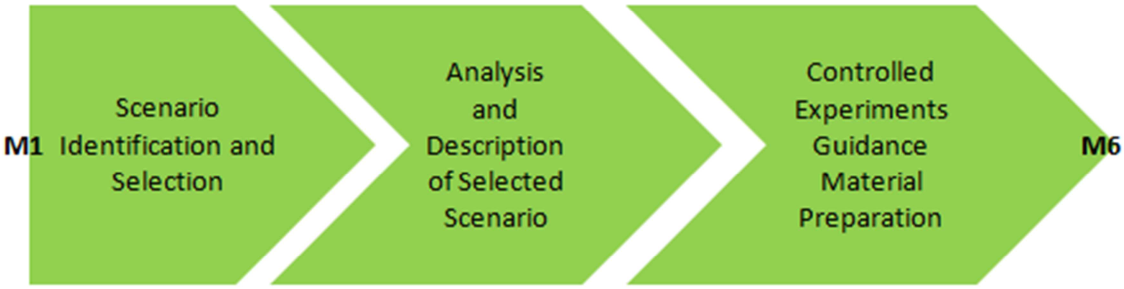

Figure 1: WP2 Activities in the period M1-M6.

Initially, a first set of 4 scenarios have been identified. They will be described in further details in next Section.

2.1 Potential Scenarios Identification

Already in the EMFASE proposal two operational scenarios were identified, i.e., the Remote and Virtual Tower (RVT) and the Airport Collaborative Decision Making (A-CDM). Other relevant scenarios were identified with the support of WP16.6.2 partners and consist in the Initial 4D Trajectory Management (i-4D) and Extended AMAN (E-AMAN) scenarios, for which SESAR partners already carried out preliminary Risk Assessments with the SecRAM methodology.

In the following a very brief description of the 4 candidate scenarios from an operational and technical perspective is provided. Security relevant issues have been highlighted.

2.1.1 The Remote and Virtual Tower

The Remote and Virtual Tower (RVT; SESAR P06.09.03, P12.04.07), is one of the new operational concepts proposed by SESAR. In this operational concept a set of 360° cameras, sensors and surveillance radars located at the aerodrome or in more aerodromes will allow Air Traffic Control (ATC) and Aerodrome Flight Information Services (AFIS) to be provided from remotely located centres. The main change with respect to current operations is that ATC and/or AFIS Operators will no longer be located at the aerodrome. They will be re-located to a Remotely Operated Tower Centre (ROTC).

A ROTC will contain several remote tower modules, similar to sector positions in an ACC. Each tower module will be remotely connected to (at least) one airport and consist of one or several Controller Working Positions (CWP), depending on the size of the connected airport. The ATC Operator will be able to perform all ATC tasks from this CWP. One ATC / AFIS Operator will be able to control more than one airport, provided that there is no concurrent aerodrome activity (arrival or departures) in the different airports.

The visual surveillance will be provided by a reproduction of the Out of The Window (OTW) view, by using visual information capture and/or other sensors such as cameras with a 360-degree view, which will be able to zoom 36 times closer than current binoculars in all weather conditions. The visual reproduction can be overlaid with information from additional sources if available, for example, surface movement radar, surveillance radar, ADS-B, multilateration or other positioning and surveillance implementations providing the positions of moving object within the airport movement area and vicinity. The collected data, either from a single source or combined, is reproduced for the ATC / AFIS Operator on data/monitor screens, projectors or similar technical solutions. The use of technologies will also enhance the visual reproduction in all visibility conditions.

The ROT concept will encompass data availability and protection issues affecting airport safety, as well as physical security issues, like the on-site protection of the remotely located cameras, sensors and surveillance radars in the aerodrome, to be analyzed during the EMFASE risk assessment.

2.1.2 The Airport Collaborative Decision Making

The Airport Collaborative Decision Making (A-CDM) concept is mainly studied into SESAR SWP 06.06 – Airport CDM and more in general include in P 07.03.02 – Integrated Network CDM.

The A-CDM integrates processes and systems aiming at improving the overall efficiency of operations at European airports. Particularly focusing on the aircraft turn-round and pre-departure sequencing process. This in turn allows the ATM Network to run more fluently. A-CDM is about different stakeholders – airport operators, airlines, GA aircraft operators, ground handlers, Air Traffic Services units (e.g., towers, Area Control Centers) and the Network Manager – working together more efficiently and transparently in how they collaborate and share data. It allows better decision making, based on more accurate and timely information, with all airport actors having the same operational picture.

The benefits are visible at a network level, with more accurate take-off information feeding into the air traffic flow and capacity management system run by SESAR Network Management. The network will be able to use the available capacity more efficiently. More effective use of slots results in reduced delays, improved predictability of events during a flight and optimised use of resources at airports.

Airport Collaborative Decision-Making (A-CDM) in Adverse Conditions helps airports minimise the impact of bad weather on operations by disseminating relevant information in anticipation of disruptions and allowing a rapid recovery after disruptions. Changes in airport capacity are communicated in real time to the Network Operations Centre at EUROCONTROL headquarters with up-to-date Estimated Take-Off Times (ETOT). This enables the development of strategies to help deal with the situation as it evolves.

All the main actors of Air Traffic Control (different ATS units, e.g. towers and ACCs), Airlines and other Aircraft Operators (e.g., military and General Aviation stakeholders) and Airports Management organisations (handling, catering services, airlines, security and health authorities etc.) should be progressively become part of the local and then of the global network exchanging information in real time.

Main security issues will be the guarantee of availability, integrity and reliability as well as confidentiality properties in the management and sharing of this amount of sensible data.

2.1.3 Initial 4D Trajectory Management

The Initial 4D Trajectory Management (i-4D) concept has been developed in SESAR WP05.06.01 as a key feature associated with the first step towards the SESAR target concept named “Time-Based Operations”. The objective of this first step is to synchronize trajectory information between Air Traffic Services, i.e., Controllers and their supporting automation and Aircrafts, i.e., Flight Crews and their supporting avionics, so that the arrival sequence can be optimized. The shared common view of the trajectory is translated into an agreed 3D route and a time constraint (CTA).

The implementation of the i-4D concept is distributed over aircraft avionics systems and ATM automation systems across navigation and communication domains as follows.

Onboard the aircraft the following avionics systems are contributing to the i-4D Trajectory computation, monitoring and updating:

• The cockpit display systems which ensures that relevant data related to the engagement and monitoring of the i-4D operation onboard are displayed to the flight crew;

• The Flight Management System which ensure that the predictions computed onboard and the system performance in navigation and guidance are consistent with the i-4D requirements;

• The communication system which role is to manage the Automatic Dependent Surveillance-Contract (ADS-C) and Controller-Pilot Data Link Communication (CPDLC) applications and ensure that datalink service is available and correctly managed with the ground.

On the ATM side, the i-4D enabling technologies are:

• The arrival manager (AMAN) for the destination airport, which role is to build the arrival sequence so as to keep the i-4D flights as stable as possible, is updated to provide the CTA and interact with the other ATC system for ground-ground coordination;

• The other ATC systems to support the distribution of the relevant AMAN CTA messages across systems and with the aircraft;

• The communication system which role is to manage the ADS-C and CPDLC applications and ensure that the trajectory information received from the aircraft is dispatched to improve ground trajectory prediction (TP) tool and other ATC tools like queue management and conflict detection;

• The data-link service providers (ARINC/SITA), which network is used to exchange the information between aircraft ATSU and the ground ATSU.

Confidentiality, Availability and Integrity aspects, as well as Authenticity of data sharing are very important for the i-4D scenario. Also Access Control aspects are included. In this scenario ensuring security directly affects the safety of the flight.

2.1.4 Extended Arrival Manager

Arrival Manager (AMAN) systems have been developed and deployed in Europe, and elsewhere, over the course of many years. They are primarily designed to provide automated sequencing support for the ATCOs handling traffic arriving to an airport, continuously calculating arrival sequences and times for flights, taking into account the locally defined landing rate, the required spacing for flights arriving to the runway and other criteria. AMANs are also used as “metering” tools, assisting in regulating the flow of traffic into the TMAs surrounding busy airports. Helping to make best use of the available capacity at an airport combined with a more efficient, and predictable, arrival management process can assist in reducing low-level holding and tactical intervention by the ATCO, leading to lower fuel consumption, less noise and pollution. AMAN presents to the Sequence Manager all necessary information and advisories, allowing him/her to decide on the landing sequence, in coordination with the involved ATCOs. It provides advisories to the sequence manager to develop an optimal sequence of aircraft for landing

The extension of the AMAN Horizon is split into two options, both studied in SESAR P05.06.05; the first option is a simple extension of the AMAN horizon from the current 100-120nm to 180-200nm. This is expected to result in improved arrival flight trajectories for airspace users with efficiency and environmental benefits. The traffic presentation at terminal area entry is greatly improved with the bulk of traffic sequencing being conducted in the en-route and descent phases. This will result in more efficient terminal area operations with greatly reduced low altitude path stretching for sequence building purposes.

Techniques including simple advice to controllers such as Time to Lose or Gain and speed advice and also advanced techniques in which the flight crew is instructed to use on-board avionics to achieve a Controlled Time of Arrival (CTA) over a metering fix. The needs of the Initial 4D (i4D) concept employing CTA have a significant impact on AMAN functionality and whilst many aspects of this concept are addressed in the OSED, further output of the i4D project is still required.

The other complementary option is Long Range Arrival Management which may be appropriate at specific locations and at specific times of the day. In this option the AMAN horizon is extended to 400-500nm with the objective of pre-sequencing traffic prior to arrival at the 120nm extended AMAN horizon and allowing as much delay as practicable to be absorbed at higher altitudes. In extending the AMAN horizon many more airports fall within the area of influence of AMAN.

Relevant Security aspects of this scenario are mainly data availability and integrity, while for some concern this scenario can be considered as a 'particular case' or sub-scenario of the previous one.

2.2 Scenario Selection Criteria

There are many different aspects and characteristics that can be considered when selecting relevant operational scenarios to which apply Risk Assessment Methodologies.

Scenarios have to be clear and immediate enough to be understandable also for non-specialists. They have to present outstanding innovation in the ATM domain that may capture the interests of students, security experts and ATM professionals. They have to be 'modular' to be decomposed in sub-scenarios and/or be presented at different level of description and detailing.
The most important criteria, of course, are related to scientific aspects: the scenarios should address relevant security aspects that could (and should) be detected through Risk Assessment.
According to the SESAR Transversal Areas (TA) Assessment process, all the TAs (Security, Human Performance, Safety, Environment and Cost Benefit Analysis) should provide Cases collecting evidences and arguments, that will be integrated in a final Business Case [1][2] . The Business Case describes the business rationale for undertaking a group of projects/activities in SESAR and serves as a basis for decision makers to decide whether funding should be provided and/or whether an investment should proceed.
EMFASE want to concur to the TA Assessment process and select Security Risk Assessment methods that are enabling and supporting it.
Thus EMFASE proposes to take into consideration the links among Security and other KPAs and to assess to which extent different Risk Assessment methodologies support the capture, modeling and analysis of such links, contributing to the building of a proper Security Case that will easily inform an integrated Business Case without redundancies nor simplifications.
Potential aspects under analyses could be, e.g., to which extent organizational and human vulnerabilities of the socio-technical system under analysis are caught? Are also procedural and training countermeasures taken into account/suggested? How is the impact on other KPA assessed and evaluated in the risk estimation? Are the security countermeasures/controls prioritized in terms of their costs and actual feasibility?. In order to answer to interdisciplinary questions like the ones reported above, selected scenarios should also present other ATM – relevant areas , such as Safety, Human Performance and Business aspects.

In the evaluation and selection of operational scenarios, we do not consider just high level and scientific criteria like the ones mentioned above, but we took also into account management and operational criteria, discussed with EMFASE POs and SESAR stakeholders.
Management Criteria include contextual and practical aspects that may affect proper scenario definition with respect to information gathering, as well as material and document collection, they include access to public documentation and scientific papers related to the scenarios, the actual

availability of SESAR experts on the subject (inside or outside the consortium), availability of already carried out Risk Assessment for the considered scenario to be used as baseline and comparison for our studies.
Operational Criteria include all the aspects that may be relevant and benefit not only SESAR, but the overall ATM domain in a short-medium term timeframe.

In the following we provide a more detailed list of all the criteria considered by EMFASE partners during the scenario selection process.

General Criteria

General Criteria include high-level and general aspects that should influence the choice of the scenario:

- Clarity and understandability

- Innovation degree

- Applicability to other domains

- Modularity

Management Criteria

Management Criteria include contextual and practical aspects that may affect proper scenario definition with respect to information gathering, as well as material and document collection:

- Access to SESAR documents or public documentation related to the scenario

- Possible interaction with SESAR experts

- Risk Assessment already carried out and available to be used as baseline

- Internal knowledge/expertise in the Consortium

Operational Criteria

Operational Criteria include all the aspects of the scenario under analysis that may be important for the overall ATM domain in a short-medium term period:

- Relevance for other SESAR and ATM-related projects

- Selected concept implementation schedule in the SESAR operational Steps

- Maturity Level of the ConOps presented in the scenario under selection

- Impact on other KPAs: Safety, Human Performance, Efficiency and Business aspects

Scientific Criteria

Scientific Criteria mainly include scenario's characteristics and security aspects enriching the Security Risk Assessment process and challenging the Risk Assessment Methodologies under analysis:

- Inclusion of both physical and logical security aspects

- Coverage of Information Security Properties:

    - Confidentiality, Integrity, Availability,
    - Authenticity, Accountability, Non-repudiation and Reliability

- Scenario complexity:

- Relevance of aspects such as procedural, human and organizational issues,
- Communications and operations management,
- Information systems acquisition, infrastructure development and maintenance

- Relevance of resilience aspects:

- Incident management,
- Business continuity management,
- Contingency and emergency situations.

The above list of Criteria have been iteratively used during the Scenario selection process leading to the definition of the Remote and Virtual Tower scenario as reference scenario for the EMFASE evaluation experiments.

2.3 Scenario Selection Process

The EMFASE consortium members carried out two main iterations in order to select a proper application scenario for the EMFASE evaluation, as described in Figure 2.

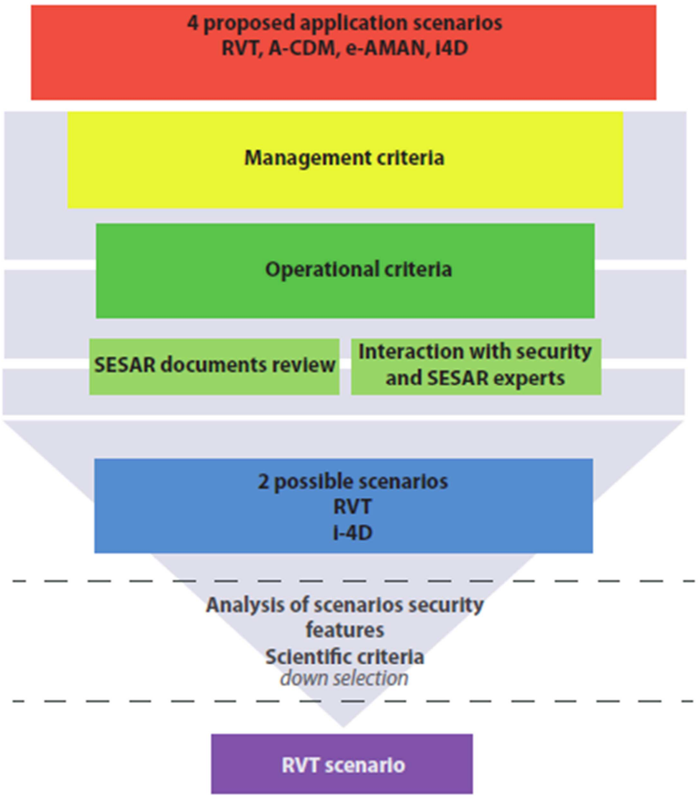

Figure 2: EMFASE scenario selection process.

Firstly, 4 scenarios were proposed by consortium partners. To this aim, a State of the Art and Literature review has been carried out by taking into account ACARE and SESAR public documents [1][4][5]. A brainstorming with ATM experts has been proposed to evaluate potential scenarios with respect to the General Criteria identified in previous Section. The 4 selected scenarios are described in Section 2.1.

Then, a first selection iteration was carried out to define, evaluate and review the 4 scenarios and to start the collection of information and more detailed inputs. During this phase a detailed review of available SESAR documents has been conducted, and further interactions with ATM and security experts to evaluate the relevance for SESAR and the maturity level of the scenarios has been carried out. Management and Operational Criteria were applied to down-select 2 scenarios, namely the Remote and Virtual Tower and the i-4D Trajectory Management scenarios. In particular, the presence of already conducted Risk Assessments with relevant results and detailed analyses has been one very important selection criteria.

Finally, an analysis of the coverage of the security issues present in the scenarios has been carried out and the Remote and Virtual Tower Scenario has been selected as the most promising scenario to which apply Security Risk Assessment methodologies for their evaluation in EMFASE.

The 4 proposed scenarios have been iteratively evaluated by consortium members and security experts against the above criteria. Since we have identified 16 main criteria grouped in 4 main categories, the results of the evaluation have been reported on a 0-4 scale for each category (i.e., Management Criteria, Operational Criteria, Scientific Criteria) by assigning a point for each fulfilled criteria. In Table 1, results of the assessment are summarized.

Table 1: Scenario Prioritization and Evaluation with respect to the Selection Criteria.

Scenario	General Criteria	Management Criteria	Operational Criteria	Scientific Criteria
Remote and Virtual Tower	3	4	4	4
Airport Collaborative Decision Making	3	2	4	3
Initial 4D Trajectory Management	3	3	4	3
Extended Arrival Manager	3	3	2	3

The Extended Arrival Manager Scenario and the Initial 4D Trajectory Scenario (discussed together since the former could be considered as an initial step of the latter) cover just information security aspects, with very few physical security issues. The Airport Collaborative decision Making has a lower innovation degree, being already operational in some European Airports. Moreover, there were not available previously carried out Risk Assessments within SESAR projects.

Thus, as showed in Table 1 , the Remote and Virtual Tower scenario presents the highest scores, since it provides an example of an operational concept with an high innovation degree and an already high maturity-level, big industrial relevance and a well defined schedule within SESAR Steps.

Moreover, the Remote and Virtual Tower scenario poses interesting security problems covering both physical and logical security. Information security properties are all covered as well. Safety, Human Performance and Economical aspects are also relevant and could be analysed during EMFASE experiments.

Finally a Risk assessment has already been conducted by SESAR WP16 partners and may eventually be used as baseline.

The Remote and Virtual Tower Scenario will be described in details in next Section.

3 Remote and Virtual Tower Scenario Description

As stated in Section 2.1, the objective of the Remote Tower is to provide the ATS (Air Traffic Service) for more than one airport by a single operator (ATCO or/and AFISO), from a remote location, meaning not from the individual control towers located in the airport. The full range of ATS should be offered in such a way that the airspace users are not negatively impacted, (and would possibly benefit), compared to the local provision of ATS.

The remote provision of ATS is expected to be applied to low density airports (where low density is determined as being mostly single operations, rarely exceeding two simultaneous movements of aircrafts) as well as to medium density airports (where more than two simultaneous movements can be expected). In the long-term period the concept may also be applied for larger airports or small airports with occasionally more traffic density.

3.1 Current Operating Method

The ATCO is responsible for assuring safe operations and provision of air traffic control services for the airport manoeuvring area and the vicinity of the airport. This includes responsibility for clearance delivery, ground control, management of inbound and outbound flow and flight data processing.

With a local, physical presence at the airport, the ATCO has the ability to perform local physical tasks such as direct runway inspections, checking local weather stations or basic maintenance if required. In addition, some task sharing can exist where the ATCO or AFISO performs additional local tasks. Other local officers (such as rescue officers) can in turn perform some of those tasks.

Regulation states that an airport control Tower has to fulfil two main operational requirements, in order for an air traffic controller to be able to properly control aircraft operating on and in the vicinity of the airport. Those requirements are:

- The tower must permit the controller to visually survey the portions of the airport over which he exercises control and its vicinities;
- The tower must be equipped to permit the controller to rapidly and reliably communicate with the aircrafts he is concerned with.

The most significant factors contributing to adequate visual surveillance are the siting of the tower and the height of the control tower cab. The optimum tower site will normally be as close as possible to the centre of the manoeuvring part of the airport, provided that at the intended height, the tower structure itself does not become an obstruction or hazard to flights.

The ATCO uses several means and systems to provide the services, but a major information source is the visual “out-the-window” (OTW) view. The OTW view is from a single viewpoint, typically high above the ground from the centre of the airport. Airport sound (e.g. engine noise, birdsong, wind noises) are directly available through ambient noise. Other functions/systems that are needed to provide the service are for example:

- Voice communications;
- Flight Plan and ATS message handling;
- Manoeuvring of airport lights, navigation aids, instrumental landing system, alarm and other airport systems;
- Binoculars, Signal Light Gun;
- Paper Strips.

Additional tools providing information gathered through specific sensors (e.g. ground radar information, meteo radar and meteo sensor information, ADS-B data, etc.) can be used to facilitate surveillance, subject to coverage.

3.2 Current Problems

Here a brief discussion of common problems which usually arise during current operations:

- Cost

The focus is set on reducing the cost of providing ATS without reducing the level of safety. The provision of a transparent cost-regime makes it possible for the customer to see the costs passed on to them. The current costs associated with the provision of ATS are high and need to be reduced, particularly at low to medium density airports. The high costs are then passed onto the customer through increased airport/landing fees, which in turn result in higher airfares and lowers the propensity of customers to remain users of airports. It is necessary to maintain commercial air traffic services at small/medium density airports, as many of these routes act as public service routes for isolated communities. If the ATS costs are not lowered and reasonable business margins cannot be made, many low and medium density airports will find it hard to financially survive without subsidies.

A main proportion of the ATS costs are associated with the building, maintenance and upkeep of the physical ATS facilities and the costs of personnel to provide the ATS.

The maintenance and upkeep of old Tower facilities can be inefficient and expensive, with lots of old Tower equipment and infrastructure to maintain. Unique competences are required for maintenance and components can be difficult and expensive to repair when they fail. Building new towers is very expensive, compared to “ordinary” buildings on an airport.

- No standardisation

The systems, equipment, operating methods and procedures are currently variable according to airport. There is a lack of standardisation and this has an impact on cost (equipment, systems) and controller training (methods, equipment and procedures).

- Lack of space

There is often a lack of space to install new equipment and an overall lack of appreciation and application of Human Performance elements in relation to CWPs and the set-up of required equipment. The variability and subsequent controller training issues (in combination with geographical considerations) mean that many controllers will only be valid/ rated for their local airport.

Several reasons press to consider the Remote Tower a suitable and beneficial solution for the above mentioned issues. Other expected benefits will be cost effectiveness. ATS facilities will be cheaper to maintain, able to operate for longer periods and enable lower staffing costs (through centralised resource pools) and training/re-training costs, by large scale effects. It will also significantly reduce the requirement to operate and maintain actual control tower buildings and infrastructure, leading to further cost savings, as well as eliminating the need to build replacement towers.

The expected benefits of the remote provision of ATS during contingency operations at airports are increased safety, security, improved service continuity and a reduction in overhead costs; minimising the losses and costs that would occur in the event of a major outage if no mitigating measures would have been adopted. Minimising economic losses includes losses of revenues, for example airport taxes and charges, operating costs such as staff and compensation, reduced losses for the customers of airspace users and reduced costs for the local, regional or European economy.

3.3 New SESAR Operating Method

In the Remote Tower Operational Concept, the full range of ATS will be provided remotely by an ATCO. The airspace users must be provided with the same level of services as if the ATS were provided locally.

The main change is that the ATCO will no longer be located at the airport. They will be re-located to a Remote Tower Centre (RTC).

The visual surveillance will be provided by a reproduction of the OTW view, by using visual information capture and/or other sensors. The visual reproduction can be overlain with information from additional sources when available, for example, surface movement radar, surveillance radar, ADS-B (Automatic Dependent Surveillance-Broadcast), multi-lateration or other positioning and surveillance implementations providing the positions of moving objects within the airport movement area and vicinity. The collected data, either from a single source or combined, is reproduced for the ATCO on data/monitor screens, projectors or similar technical solutions.

The provision of ATS from a local tower building (as in today's current operations) has some constraints at certain airports due to the single operational viewpoint from a central, high up perspective and is subjected to prevailing weather conditions (e.g. clear, foggy). This can create some minor limitations in capability, which is accepted in 'traditional' air traffic control. With the use of reproduced visual views, these limitations can potentially be eliminated. Visual information capture and reproduction can still be done in order to replicate the operational viewpoint obtained from a traditional tower view and this may ease the transition from current operations to remote operations and also provide some common reference points. Alternatively, several operational viewpoints may be based on information captured from a range of different positions, not necessarily limited to the original tower position. This may provide an enhanced situational awareness and/or a progressive operational viewpoint. In all cases, the visual reproduction shall enable visual surveillance of the airport surface and surrounding area.

The use of technologies to enhance the visual reproduction in all visibility conditions may be introduced. The full set of Advanced Visual Features (AVFs) will be gradually introduced into the concept as they are defined and developed. The AVFs will be tools to improve situational awareness and eventually aid in providing improved use of visual separations applied by ATCOs. To further improve the situational awareness the airport audible background sounds can be captured and relayed in the RTM. Moreover benefits in terms of workload might be gained through other enhancements integrated into the visual representation. For example, the ATCO head-down time may be reduced by integrating certain information into the panorama view. Thus radar data, weather information, the PTZ camera view etc. could be moved from the ATCO work desk onto the panorama representation screen.

Through the use of enhanced technology and digital information, a wider range of information will be available and possible to share with other stakeholders, airport users and other ATS. The concept will also introduce the ability to record visual information; this will create enhanced and unique opportunities to support incident/accident investigators when working at airports.

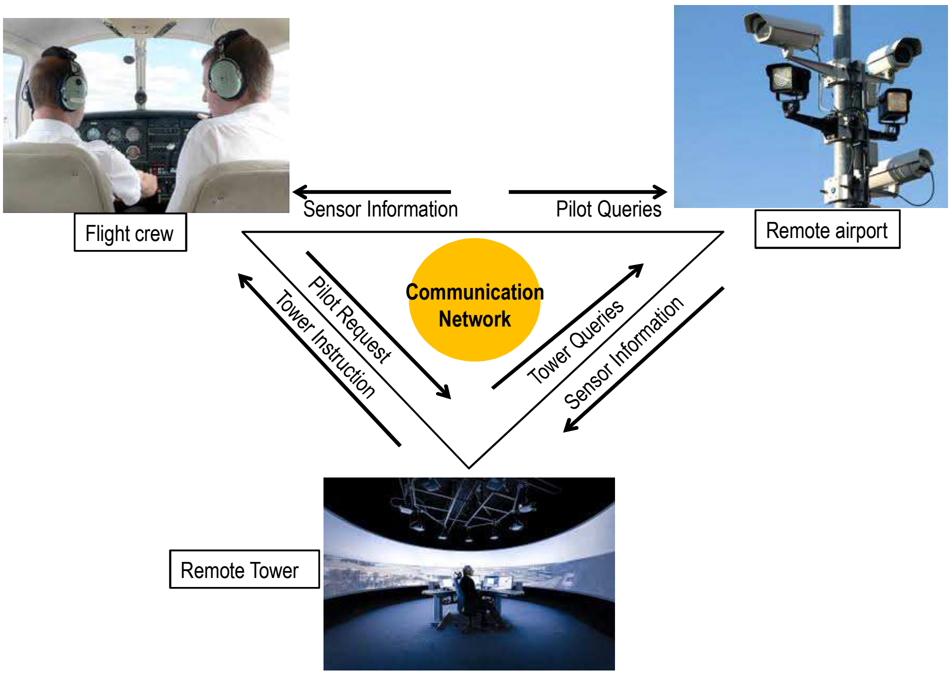

Figure 3: Remote Tower concept: domains overview

It is foreseen that the concept will have minimal or zero negative impact on the Instrument Flight Rules (IFR) traffic.

The ATCO will not have the ability to perform any tasks that are external to the control facility e.g. physical runway inspection. Therefore the role of the ATCO as seen under current operations will change, with the focus being almost solely on pure ATS tasks with secondary non ATS tasks performed by non ATS personnel local to the airport.

Although it is not necessary, it will be possible to remove the local control tower as it will no longer be used for the provision of air traffic services. The infrastructure (service, maintenance etc.) that goes along with maintaining such a building will also become redundant. Instead, a local installation consisting of systems/sensors will be maintained by central maintenance teams. The remote facility will also require maintenance, but it is expected that a more 'traditional' building using common systems and components will lead to a reduction in overall maintenance costs. If single airports share RTC's with other airports then overall building costs will also reduce as they become shared.

3.3.1 Remote and Virtual Tower Applications

Three different applications are foreseen for the Remote and Virtual Tower.

Two of them are for small aerodromes with low traffic and the RVT as a *replacement* to the local tower:

a. Remote Provision of ATS to a Single Aerodrome

b. Remote Provision of ATS to Multiple Aerodromes

The third one will be implemented for medium to large aerodromes with high traffic, with the RVT in *addition* to the local tower:

c. Remote provision of ATS to aerodromes in Contingency Situations.

Here a brief summary of the foreseen development in SESAR.

The remote provision of ATS for a single aerodrome falls under SESAR Operational Step 1 (ATM Service Level 2). This operational service is already quite mature, having been developed initially in the ROT and ART projects. It is expected that the initial technical and operational capability of remote provision of ATS for a single aerodrome will be available from 2013.

The remote provision of ATS for a multiple aerodrome and the Contingency RVT fall under SESAR Operational Step 2 (ATM Service Level 3). It is expected that the initial technical and operational capability of remote provision of ATS for a multiple aerodrome and Contingency RVT will be available from 2017.

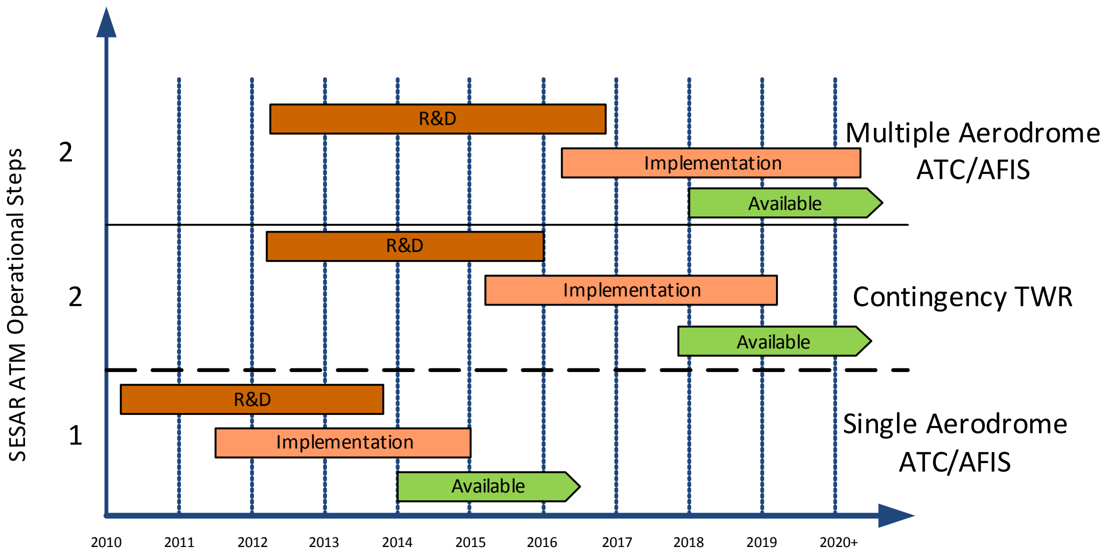

Figure 4 - SESAR ATM Operational Step Timeline

3.4 RVT Technical Implementation

The Remote and Virtual Tower objective is to provide the air traffic services already provided by local aerodrome control Towers from a remote location. The main difference between Remote and a Virtual Tower is the technical solution used to implement the Outside The Window (OTW) vision service and related functions and services, while other ATS services could be more similar in both implementations.

The distinction between remote and virtual tower can be found in P06.09.03 OSED [6], glossary of terms:

- In the **Remote Tower**, the OTW vision is remotely provided through the use of direct visual capture and visual reproduction through the use of cameras.

- In the **Virtual Tower** the OTW vision is remotely provided through the use of computer generated images of the aerodrome, aircraft and vehicles, and through the use of terrain mapping and computer modelling to represent aerodromes. The virtual tower requires that the remote airport has radars, ground sensors and/or an A-SMGCS system to provide the Virtual Tower with data (system tracks) describing type and kinematics of all mobiles in the aerodrome.

Both Remote and Virtual Tower share the concept that ATS services are provided using a **Remote Tower Facility** (RTF), which includes the operator workstation(s), ATC systems and display screens. The building where one or more RTF are housed is defined as **Remote Tower Centre** (RTC).

Most of ATS function/services implemented by the Integrated CWP are the same for both Remote and Virtual Tower:

Local control systems at the airport (such as ground lights and navigational aids) are adapted for remote control.

Radar, A-SMGCS and surveillance data and weather information will be gathered and displayed at the Remote Tower Centre. Technical implementation of these functions may vary, but generally it does not depend on type of the tower (Remote/Virtual). The multi sensor surveillance data, optional in the Remote the Remote Tower, are among the main requirements for the Virtual Tower.

3.4.1 Remote tower

The Remote Tower includes controller working positions for remote airport control. They incorporate all necessary control systems, live video presentation and additional remote tower specific systems.

The OTW vision in Remote Tower is based on live video image captured at the remote airport and sent to the remote tower centre. The live video image will provide the ATCO/AFISO with an out-the-window view similar to an actual ATS tower.

A set of fixed cameras on the dismissed local tower (or other airport structure/building) in the remotely controlled airport send to the RTC live images of the airport and it surrounding as viewed by a local ATCO/AFISO. Each camera could be a multi spectral camera (B&W/RGB/IR) or a set of dedicated single spectral cameras to enhance the vision in cases of low visibility operations. A secondary set of cameras could provide an alternative point of view.

One or more remotely controlled (by ATCO/AFISO) electro-optical system implements the “binocular” function to have more detailed vision.

A multi display system or a circular video wall reproduces the OTW vision of the remotely controlled aerodrome. Ground radar, ground sensors data, A-SMGCS data received from remote controlled airport are presented on the CWP display.

The ATCO could select a subset of data presented on CWP and display them on a graphic overlay on OTW representation implementing a head up display function. Data recording function will provide video and voice communication recording and playback. Sounds and noises of remotely controlled airport are delivered in RTC.

3.4.2 Virtual tower

The Virtual Tower includes controller working positions for remote airport control. They incorporate all necessary control systems, OTW vision is remotely provided through the use of computer generated images of the aerodrome, aircraft and vehicles, and additional remote tower specific systems.
The 3D model of the remote aerodrome is generated through the use of terrain mapping and computer modelling. System tracks gathered from remote airport are represented in a 3D real time animation on the digital 3D model of remote airport. The digital animation will provide the ATCO with a virtual out-the-window view.

System tracks are multi sensor tracks received by Virtual Tower as A-SMGCS real time messages. The track fusion of radars tracks and other surveillance sensors of remotely controlled airport generate the A-SMGCS system tracks.

Radar and A-SMGCS system tracks received from remote controlled airport shall presented on CWP display.
A mobiles database contains a complete set of known aircraft, ground mobiles as truck, buses and cars. Tracks matching with database entities are visualized with their attributes (e.g. aircraft model with proper airline skin)
Time of day, data about daylight/night/dawn/dusk and meteo in remote controlled aerodrome generate the environmental data for 3D airport model, enabling the simulation of day and night, sun position, rain or fog. ATCO could switch on/off the visualization of environmental data in 3D representation.

The ATCO could select an entity on CWP display, the corresponding entity on the virtual OTW is highlighted and a graphic overlay will display a subset of the entity data.

- Data recording function will provide system tracks recording and playback.
- Radio communication recording function to record/reply radio.
- Sounds and noises of remotely controlled airport are delivered in RTC

Figure 5 provides an overview of the functional blocks composing the Remote Tower architecture as reported in [7], as well as the other components of the overall system, i.e., e-network, airport premises, aircraft, other ATC units. Figure 6 illustrates the symbols to denote the different architectural components.

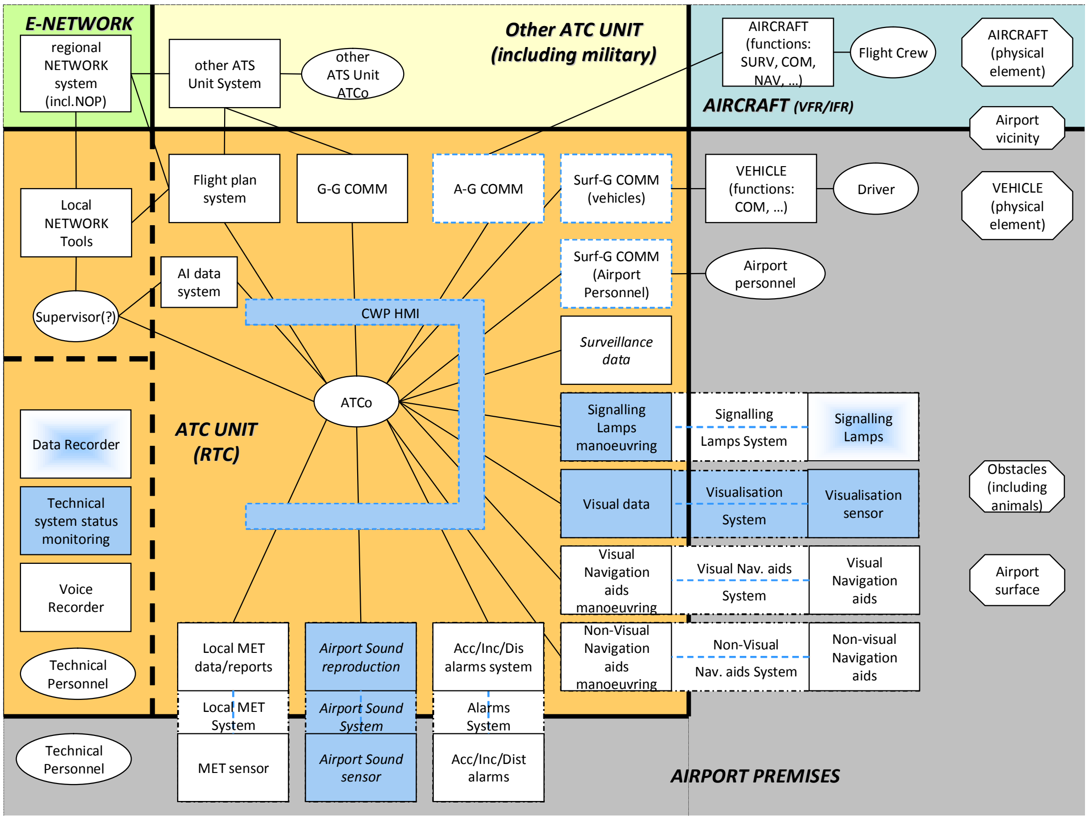

Figure 5: Functional block model Remote Tower

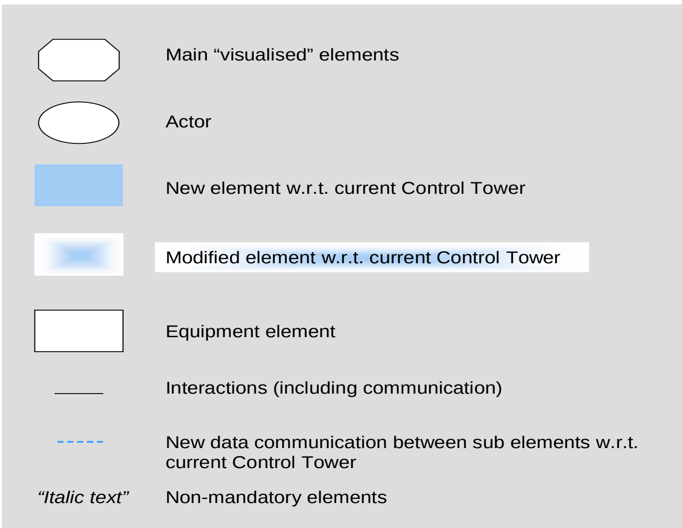

Figure 6: Elements - Functional block model Remote Tower

The table below describes more in details the RVT functional blocks and their users and the service provided.

Table 2: Functional Blocks and Services provided.

Element Type	Ground Elements	Description
Services	Local Network	Provides relevant information and tools for supporting the

	Tools	Supervisor's tasks as managing the airport re-staffing resources
	AI data system	Provides Aeronautical Information to the ATCO to be used by supervisor and/or ATCO as necessary
	Flight plan system	Provides flight plan information to the ATCO for the aircraft flying/operating in the area of responsibility of the ATCO in form of paper strips or eventually electronic strips
	Surveillance Data System	When available, it provides "real-time" surveillance data for the (equipped) aircraft flying/operating in a delimited area of responsibility of the ATCO
	Signalling Lamps System	Allows the ATCO to remotely manoeuvre the Signaling Lamps located in the airport premises
	Visualisation System	Provides "real-time" images of the airport, the airport traffic, as well as any obstacle[1] in this area. A specific function allows a binocular view of particular element/objects
	Visual Nav. aids System	Allows the ATCO to remotely manoeuvre the different "lighting" systems to support aircraft in "finding their way" to the airport, on the vicinity of the runway and on the airport surface
	Non-Visual Nav. Aids System	Allows the ATCO to remotely manoeuvre the different "non-lighting" systems to support aircraft in "finding their way" to the airport/runway
	Accident, incident and distress alarms	Allows the ATCO to monitor and trigger accident, incident and distress alarms as applicable to the airport
	Airport Sound System	When available, it provides "real-time" noise from the airport (aircraft engines, wind sound, …)
	CWP HMI	Allows to ATCO to get information from all previous systems and to interact with them as necessary (to have a deeper insight about the systems connected with the CWP HMI)
	Local MET system	Provides to ATCO the relevant weather information on the airport (temperature, pressure/QNH, snow on the runway, wind direction/strength, …)
Communication lines	G-G COMM	Allows voice/data communication between ATCO and "other ATS unit ATCO"
	A-G COMM	Allows voice (VHF) / data (CPDLC) communication between ATCO and Flight Crew
	Surf-G COMM (vehicles)	Allows voice communication (VHF) between ATCO and vehicles drivers on the airport surface
	Surf-G COMM (Airport personnel)	Allows voice/data communication between ATCO and airport personnel

Actors	Supervisor	The (optional) Supervisor could have main responsibility for staff/CWP allocation in an RTC with several workstations connected to several airports. He/she manages the airport/ATC unit resources/capacity in order to cope with the foreseen traffic (staffing, re-sectorisation, closure of the airport, …). During a shift, a Supervisor role can be used to manage the allocation of staff and CWP at any one time during the shift in order to provide an efficient set up at all times and guarantee a flexible system. The Supervisor role can be performed by a dedicated person, or can be handled by one of the shift staff in addition to their ATCO/AFISO role.
	ATCO	Provides ATC services by using the information provided in the CWP HMI. The TWR ATCO is responsible for assuring safe operations and provision of air traffic control services for the airport manoeuvring area and the vicinity of the airport. This includes responsibility for clearance delivery, ground control, arrival management, departure management and flight data processing.
	Technical personnel	In charge of the maintenance of the following “Technical supervision” elements
Physical elements	Data Recorder	Allows to record operational data including visualization information
	Voice Recorder	Allows to record voice communication on the applicable radio channels
	Technical System status monitoring	Allows to monitor and detect any technical failure mode / degraded mode of the system

3.5 RVT Scenario Discussion

As explained in Section 2, the Remote and Virtual Tower Scenario has been selected since it presents an innovative concept that addresses relevant Security topics and interesting links with other Key Performance Areas.

That will allow EMFASE partners to use it as a paradigmatic example to carry out the Security Risk Assessment during the experiments and evaluation exercises.

Namely, the ROT concept will encompass:

- data continuous availability and integrity to ensure safety during landing/departure and taxing,
- data protection to ensure confidentiality and avoid malicious exploitation of traffic data,
- physical security issues, like the on-site protection of the remotely located cameras, sensors and surveillance radars in the aerodrome,

- etc.

Moreover, the ROT concepts affects also other relevant Key Performance Areas, as showed in table below:

Table 3: ROT KPA- Benefits and Constraints.

Key Performance Areas		Expected Benefit	Main Constraint
Societal Outcome	Safety		X
	Security		X
	Environmental Sustainability		
Operational Performance	Cost Effectiveness	X	
	Capacity		X
	Efficiency	X	
	Flexibility		X
	Predictability		
Performance Enablers	Access and Equity		X
	Participation		
	Interoperability		

The ROT concept is aimed at providing benefits in two main areas – Cost Effectiveness and Efficiency. In addition, it is necessary for the concept to maintain performance at least as good as current operations in other Key Performance Areas (KPA). Therefore a positive contribution is expected in:

- Cost Effectiveness – This is the main benefit delivered by the ROT concept. The benefit is expected through provision of air traffic services from remote facilities. For single aerodromes these facilities will be cheaper to maintain, able to operate for longer periods and enable lower staffing costs (through centralised training and resource pools). For multiple aerodrome additional cost effectiveness benefits can be achieved through the ability to control a greater number of aerodromes with fewer individual facilities and controllers.

- Efficiency – The ROT concept provides efficiency benefits in three main areas. The first is the cost effectiveness benefits described above, centred around using assets and resources more efficiently thus leading to a more cost effective service. The second is the ability to exploit the use of technology in the provision of the services. Digital enhancements can be used to maintain throughput in low visibility conditions, thus making a more efficient use of available capacity. Finally, the application of the ROT technology in a contingency environment should allow throughput to be maintained when the local control facility is out of service.

The following KPA must not be negatively impacted, and preferably improved, through the introduction of the ROT concept:

- Safety – Safety is the number one concern for air traffic. The provision of air traffic services (facilities and staff) from a remote location should provide the same, or greater if possible, levels of safety as if the services were provided locally. The use of the digital visual technologies used in the ROT concepts may provide some safety enhancements in low visibility.
- Security – The ROT concept will encompass data availability and protection issues, as well as physical security issues, the overall security level should remain the same as in current operations.
- Capacity – Capacity should not be reduced through the removal of local facilities, or through the sharing of resources across multiple aerodromes. It may even be increased through the use of digital enhancements in low visibility or by the ROT in contingency situations.
- Flexibility – The implementation of the ROT concept, especially the Multiple Aerodrome applications must not affect the ability to provide a flexible service to the airspace users. It may even be increased through a greater possibility to extend opening hours when through remote operations.
- Acceptability – to assess the acceptability of the Remote and Virtual Tower concept to the operators and customers.
- Access and Equity – As above, the implementation of the ROT concept, and the Multiple Aerodrome applications in particular, must not affect the levels of access each type of airspace user has to the aerodrome. Moreover , ROT concept for small airports can guarantee Access to Business and General Aviation airspace users.

It is really important to understand how the different KPA are linked and how one KPA can influence the others. The impact of increasing one KPA can affect positively or negatively another KPA and the Security Risk Assessment methods considered in EMFASE may support or not this kind of ‘transversal’ analyses and considerations.

4 Reference Material for Evaluation Experiments

In this Section we will provide examples of the Reference Material developed for the first Evaluation Experiments with students, ATM professionals and Security Experts.

The Reference Material is prepared in two different versions that depend on experiment duration, i.e., long-running experiments lasting 1-2 weeks versus short experiments lasting about 2 days.
The Reference Material includes, for both versions, a Power Point introductory presentation about the Air Traffic Management Domain and the Remote and Virtual Tower ConOp and a document providing a detailed operational and technical description of the Remote and Virtual Tower scenario.
The Power Point presentation and the document may vary in length and level of description depending on the experiment typology.
They would be further customised with respect to experiment size (number of participant), experiment scope (research question(s), Risk Assessment Methodology(ies) under evaluation, etc.), experiment target (type of participants, e.g., ATM professionals, Security Experts, students, etc.)

Since Reference Material may contain sensible information, all the participants involved in experiments will sign a non-disclosure agreement. Participants will receive just hardcopies of the Reference Material that will be returned to EMFASE partners after the end of the experiment itself.

4.1 Material for long-running experiments

For long Evaluation Experiments, lasting approximately 1 or 2 weeks, general presentation about the ATM domain and the current ATC, introducing the Remote and Virtual Tower scenario and its security issues have been prepared.

A 20-25-pages document summarizing the operational context, as well as the Remote and Virtual Tower technical description has been provided to participants.

Examples of reference material for long-running experiments are provided in the Appendix.

4.2 Material for short experiments

For long Evaluation Experiments, lasting approximately 2 days an high-level presentation about the ATM domain and the current ATC, introducing the Remote and Virtual Tower scenario and its security issues have been prepared.

A 15-pages document summarizing the operational context, as well as the Remote and Virtual Tower technical description has been provided to participants.

Examples of reference material for short experiments are provided in the Appendix.

5 Requests to SESAR and EUROCONTROL

In order to successfully carry out EMFASE project activities, consortium members are requesting access to additional information about the selected scenario and support of operational experts, to guarantee an adequate representation of the real operational conditions in the case studies and to support the empirical evaluation of the Security Risk Assessment methodologies through validation exercises.

In order to better specify the Remote and Virtual Tower Scenario, EMFASE partners officially request access to P06.09.03 and P12.04.07 deliverables and to the Remote and Virtual Tower Risk Assessment carried out by WP16.6 partners.

Regarding the interaction with operational experts, two different kind of contributions are required:
1) Contribution of Remote and Virtual Tower experts for:

- Review and detail the case studies
- Support the preparation of additional Reference Material for Evaluation Experiments
- Give introductory presentation about the Remote and Virtual Tower during Evaluation Experiments

2) Contribution of SESAR security experts for:

- Providing Tutorials about SecRAM Security Risk Assessment Methodology during Evaluation Experiments
- Involvement in the evaluation activities of risk assessment methods (interviews, focus groups, direct application of the selected methodologies to case studies, expert judgments, etc.)
- Participation to the EMFASE Validation Workshop(s).

Some of the above requests have already been submitted to SESAR JU for approval and have already been partially satisfied, while others emerged during D2.1 writing and should be discussed with our SESAR Project Officer and formally accepted.

6 Conclusions

In this deliverable we presented the selected scenario to which apply Risk Assessment Methodologies for their comparison and empirical evaluation in the ATM domain.

Following the iterative selection process presented in Section 2, we identified the Remote and Virtual Tower Scenario as the best candidate and provided its operational and technical description in Section 3. In Section 4 we described the Reference Material that should be used during Evaluation Experiments. Example of the Reference Material prepared for first experiments is given in EMFASE Appendixes.

D2.1 is mainly a working document, that will be used by project partner as a basis for building up the Evaluation Experiments and to communicate explicitly EMFASE needs to EUROCONTROL and SESAR (as stated in Section 5).

During the course of the project we will determine whether further application scenarios should be investigated as well, and whether additional ‘ad-hoc’ Reference Material should be prepared for future Evaluation Experiments. This will depend on our findings and research results, as well as any further project need that we may identify.

The next step of the work of EMFASE WP2 is to prepare, organize, conduct and report results of a set of Evaluation Experiments of different sizes and with different stakeholders.

On one hand, this work will contribute to develop the WP1 empirical evaluation framework. The framework will elaborate and extend the initial criteria documented in this deliverable, based on existing practices, comparison of state of the art risk assessment methods, experimental studies, and further data gathered from ATM professionals in WP2.

On the other hand, experiments results will inform the EMFASE Guidelines for comparison and evaluation of Security Risk Assessment Methodology that will support ATM stakeholders to select the proper Risk Assessment Methodology for their current needs. D2.2 and D2.3 (due respectively at M18 and M30 of the project) will document all this work.

7 References

[1] SESAR 16.06.06, Business Case Awareness Package, D06-01_02, December 2010

[2] [SESAR 16.06.06, Training Material, D20-01, March 2011

[3] Flightpath 2050 - Europe's Vision for Aviation, Report of the High Level Group on Aviation Research, Advisory Council for Aviation Research and Innovation in Europe – ACARE, 2011.

[4] SESAR Annual Report 2012 – The European ATM Master Plan, SESAR JU, 2012.

[5] SESAR Release 4, SESAR JU, 2014.

[6] P06.09.03, OSED for Remote Provision of ATS to Aerodromes, including Functional Specification, D04, 00.04.01, 2013.

[7] P12.04.07, Single Remote Tower Technical Specifications Remotely Operated Tower Multiple Controlled Airports with Integrated Working Position, D05, 00.01.00, 2012.

A.1 Appendix – Guidance Material for Evaluation Experiments

Here the Material for Short and Long-running Evaluation experiments has been provided.

The material consists in power-point introductory presentation and in a detailed technical and operational description of the Remote and Virtual Tower Scenario for each type of experiment.

-END OF DOCUMENT-