	**HoliDes** **Holi**stic Human Factors **Des**ign of Adaptive Cooperative Human-Machine Systems	

D8.1 - Requirements Definition for the HF-RTP, Methodology and Techniques and Tools from a Control Room Perspective

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Table of Contents

List of figures

Acronyms

BG - Border Guard
C2 – Command and Control
C2I - Command & Control Information
CONOPS - CONcept of OPerationS
COP - Common Operational Picture
COTS - Commercial Off The Shelf
ECC - Emergency Call Center
EMS - Emergency Management System
HV - Human Views
HW - Hardware
NAF - Nato Architectural Framework
OSLC - Open Services for Lifecycle Collaboration
RHQ - Region HeadQuarter
RRS - Rapid Response Station
RRT - Rapid Response Team
RTP - Reference Technology Platform
SA - Situation Awareness
SE - System Engineering
SHQ - Section HeadQuarter
SW - Software
UC - Use Case
UML - Unified Modeling Language

1 Overview

This document is the result of the analysis made by the WP8 group for the definition of methods in the assessment of target scenarios, use cases and requirements in the Control Room domain.

In that context, the report provides the approach used to collect the needs of the WP8 partners for requirements as well as the target scenarios and use cases. The report will describe the requirements to be delivered to WP1-5 from a Control Room perspective. All the requirements will be associated with steps of the Control Room engineering life-cycle and will describe how the WP1-5 results are expected to reduce development cost and needed cycles.

The aim of the HoliDes HF-RTP platform is to support challenging adaptivity features. In the Control Room field, adaptivity can be defined as the capability of a cooperative system (made by machine and human agents) to answer to emergency situations in a timely and context-dependent fashion.

We provide a description of a target scenario of interest, related use cases and requirements for the Control Room application domain. Starting from the analysis of the aforementioned scenario a list of the requirements for the system will be provided and analyzed.

2 Introduction

WP8 concerns Control Rooms with two main AdCoS applications: (1) area surveillance (Airbus DS) and (2) energy network surveillance (Iren).

Area surveillance solutions comprise: (a) sensors, (b) a central Command & Control Information (C2I) system and (c) distributed sites where human and/or machine agents execute the orders and provide their input into the C2I system. This type of systems already leverages some adaptive features like the generation of tailored displays of the so-called Common Operational Picture (COP), which shall support the human operators' situation awareness (SA) in the Control Room. Additional support is available to the operators who execute control tasks in form of alerts, recommendations (e.g. presentation of predefined tasking orders to resolve critical situations) and facilities for evaluating potential threats. However, the introduction of more sophisticated adaptivity capabilities in HoliDes will greatly enhance the level of adaptive cooperation between human and machine agents. As a first example, thanks to the adaptivity features that will be deployed, within the Control Room system it will be possible to identify operators overloading. Adaptation will take into account the operator profiles (e.g. role, education, level, culture), experience and country-specific regulatory constraints.

The specific area surveillance AdCoS application to be designed will be tailored for the most promising and urgent areas to be improved within the Control Room domain.

As to the energy network surveillance system, its basic architecture as in the Iren case consists of an Emergency Call Center (ECC) and an Emergency Management System (EMS) for the monitoring of mainly gas, water, heating, eletricity, and waste distribution networks. The "service" of the Iren Control Room can be defined as (1) the management of signals of breakdown/malfunctioning, which can come from a person external or internal to the company, or from an alarm of the network, (2) the reporting

of all the necessary information concerning the breakdown to the operational teams for a correct understanding of the problem and intervention needed, in compliance with the constraints defined by the Italian Regulation Authority, with respect to time, quality and safety.

In the framework of the HoliDes project, the AdCoS will focus on the operators ordinary management of receiving an incoming external call on different type of services (gas, water, heating, electricity, waste).

The call center receives calls from customers who report network failures. These calls are partially filtered by the call center operators and they are then redirected to a group of emergency operators who actually collect the customer reported failures. The emergency operators have to identify the severity of the issue, and start a procedure to handle the incident. Each operator interacts with various human-machine interfaces of several systems to access heterogeneous data (e.g. customer contact information, incident information and severity, network topology, information on similar incidents, …). In these conditions the operators are not provided with suitable tools to share data and goals, i.e. to optimize the emergency management process. The energy network surveillance AdCoS will support the cooperation between operators and the distribution of the situation awareness among the operators.

The AdCoS must maximize the quality of the service of the Energy Control Room in terms of system usability of the operator and activation of the correct intervention in compliance with the response time and by providing all the necessary information, notwithstanding the situational variables (e.g. the type of caller, the frequency of incoming calls, the type of breakdown, the service affected).

Furthermore, the innovative energy network surveillance AdCoS will improve the response time to emergencies and will reduce overheads of the emergency management process in terms of time, costs and resource consumption.

3 Requirement template and collection methodology

In this chapter we describe the template we use to collect and describe the requirements for the AdCos system in the Control Room domain. We then explain how we derive requirements by starting from target scenarios and use cases analysis.

3.1 Requirement template

The requirement model has been designed on the basis of the template discussed when the HoliDes project started. Such a template was conceived for the cross-domain requirement collection among all partners of the project.

WP8 template differs from the other WP templates for an additional column describing which requirements can be referred to the AdCos and which one to the RTP (see Column (c)).

The template we herein used has the following structure:

a) **ID:** this field represents the identificator of the requirement. It is composed according to the following pattern: WPx_Company_Dom_REQyy_vz.z. X is referred to the WP number (8 in this case); "Company" stands for the name of the partner who is the owner of the requirement (it will be Iren or CAS for the WP8

requirements); "Dom" refers to the application domain, "CTR" for the Control Room case; **yy** refers to the consecutive number of the requirement; **z.z** refers to the version number of the requirement.

b) **Name:** the memorable name of the requirement that complements the ID.

c) **RTP vs AdCos:** a classification specifying if the requirement concerns the AdCos system or for the RTP.

d) **Definition:** textual description of the requirement in a maximum of two, three lines.

e) **Rationale:** explanation why the requirement is necessary.

f) **Relevance:** this field expresses the priority level of the requirement. It can assume three possible values:

(i) High ("Essential to have"): the satisfaction of the requirements is a necessary condition for the implementation of the related AdCos, methods and tools;

(ii) Medium ("Important to have"): if the requirement is not satisfied, a degraded performance of AdCos, methods and tools is expected;

(iii) Low ("Nice to have"): a requirement of that kind represents a possible additional benefit feature for the system.

g) **Development Process Step:** specifies the project phase in which the requirement should be considered. It can assume one of the following possible values: Architectural design; Detailed design; Low level test; Low level integration; System integration; Validation.

h) **Classification:** specifies the category of the requirements, that can be: Software; Hardware; Communication; Perception; Others.

i) **Type:** it specifies the type of the requirement ranging among the following values:

(i) Functional (desired functions of the system);
(ii) Non-functional (desired qualities of system, such as testability, maintainability, scalability, etc.);
(iii) Operational (conditions under which the system needs to be operational).

j) **Proof:** the description of how requirement achievement is shown.

k) **UC reference**: the identifier of the use case (UC) from which the requirement has been derived. The use case ID, like the requirement ID, follows a specific pattern: UC_WPx_y.z (more than one use case can be listed).

l) **Responsibility:** the beneficiary partner who creates the requirement.

m) **Author:** the person responsible for the requirement.

3.2 Requirement collection methodology

Requirements have been derived from the analysis of target scenarios and use cases provided by the Control Room applications in the field of area surveillance and energy network maintenance. Internally to WP8, target scenarios and use cases have been discussed since the beginning of the project. This led to a step by step process in which specific requirements and common adaptivity features have been identified in the Control Room domain for Airbus DS and Iren AdCos systems.

The starting point was a focus on the events triggering a critical or risky situation in the Control Room domain and from how the AdCos could support handling the situation.

In the area surveillance domain (Airbus DS), a hierarchical organization is devoted to the management of border security incidents. The region headquarter (RHQ) supervises a set of sector headquarters (SHQ). Each SHQ controls several rapid response stations (RRS). A RRS leverages multiple rapid response teams (RRT), and finally each RRT is supported by different border guard (BG) vehicles. When a security incident is identified within a sector headquarter, an event may be created and then managed inside the SHQ Control Room supported by the border security AdCoS.

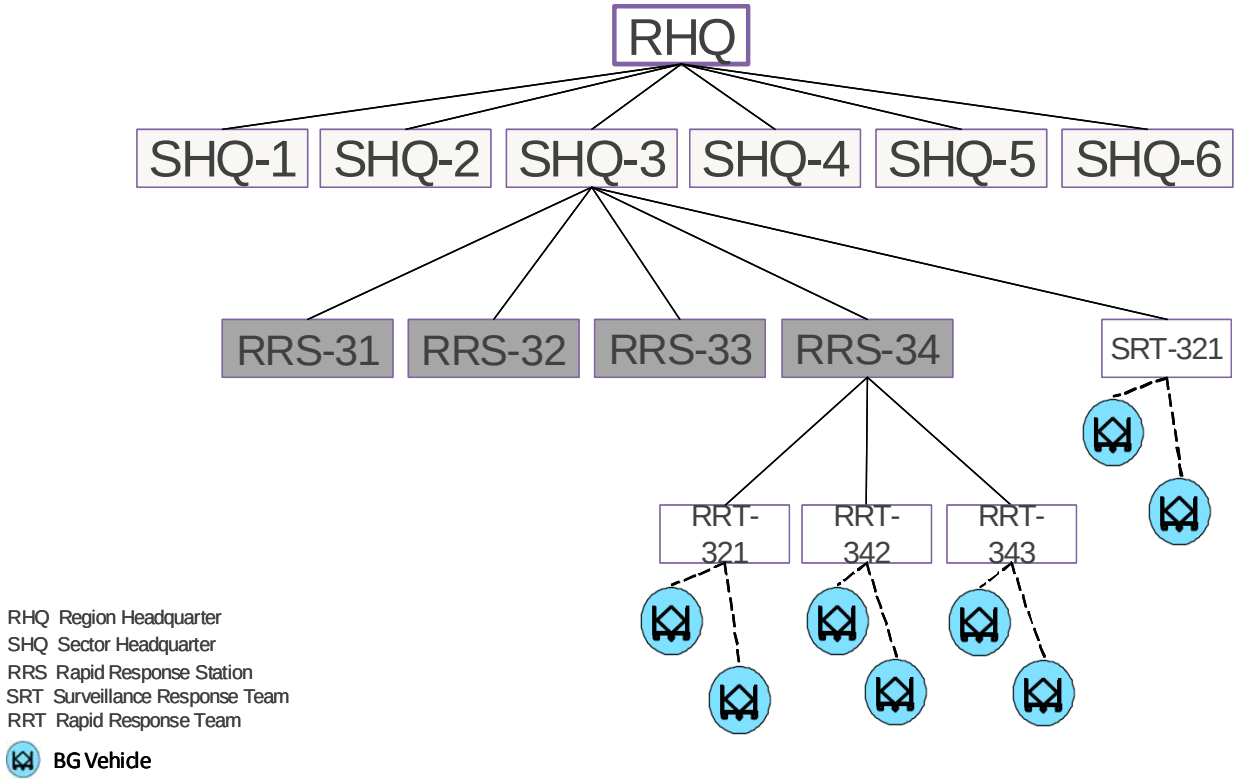


Figure 1. Airbus DS Border Security (BS) system overview

All of the personnel that is involved in the Control Room standard workflow is sitting in the same room. The only exception is the Rapid Response Team. This team is operating in the field and carrying out the missions that might be necessary to solve events. Communication between the RRT (Rapid Response Team) and the Control Room is achieved by radio communication and by using the border security AdCoS capabilities to exchange order/informatio/position data between the Control Room Command and Control (C2) component and the mobile C2 component of the AdCoS used by the Rapid Response Team.

On the other hand, the energy Control Room domain deals with the ordinary management of the Control Room operator receiving an incoming call for different types of emergency services (gas, water, heating, energy electricity, waste). The signals of breakdown/malfunctioning are raised by a person external or internal to the company, (as well as from the controlled network itself, but these signals will not be addressed in the HoliDES project). The signals received from incoming calls have to be transferred to the operational teams with all the information needed for a correct understanding of the problem and a correct intervention, complying with time, quality and safety constraints defined by the AEEG (i.e. the Italian Regulatory Authority for Electricity and Gas, http://www.autorita.energia.it/it/inglese/index.htm), an independent body which regulates, controls and monitors the electricity and gas markets in Italy. It has been established by the law November 14th 1995, n.481 with

the purpose to protect the interests of users and consumers, promote competition and ensure efficient, cost-effective and profitable nationwide services with satisfactory quality levels. AEEG maintains bilateral relations with all the European regulators and in particular with those belonging to countries sharing a border with Italy. The documents that regulates the Control Room operations are: "ARG/gas 120/08", concerning the standard of the quality of the service in the field of distribution and measure of Gas for the period 2009-2012, and "ARG/elt 198/11"**,** concerning the quality of the service in the field of distribution and measure of Electric Energy for the period 2012-2015.

In addition to the Italian regulation framework, the internal Company Quality Chart, called “Carta dei Servizi”, provides performance indicators for the operations in the Control Room.

The AdCos shall support the activity of the operators of the Control Room receiving an incoming external emergency call referred to different type of energy network services (gas, water, electric energy, heating, and waste), with a special focus on the management of emergencies related to electric energy malfunctioning.

In the following picture (Figure 2), the process of management of incoming calls is sketched.

The actors involved are:

- *Human agents:* Control Room operator, Caller, Operational team, Supervisor of the Operational Team (if present)
- *Machine agents:* SW CCE.NET, SW Genesis, SW Reti (*only Gas service*), SW TLC (*either electric energy or fluids*), Mail

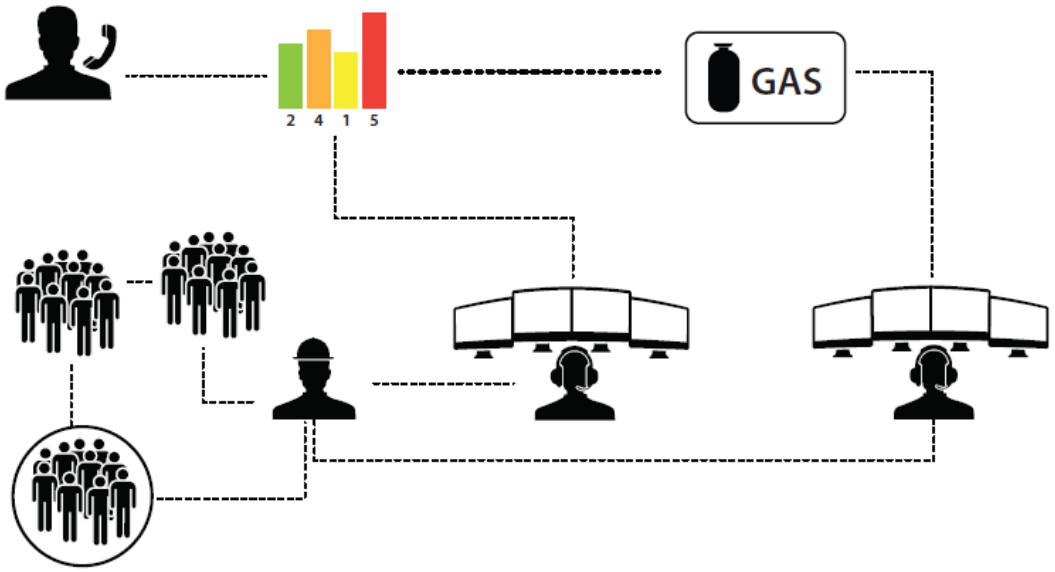


Figure 2. Iren Control room actors and interactions

In Figure 3, the interaction between Humans and Machines is shown:

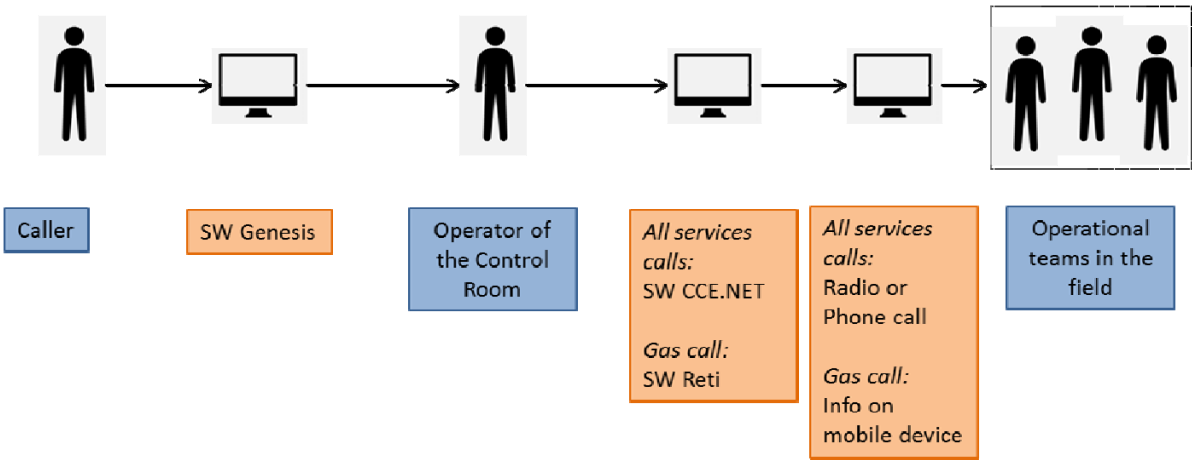


Figure 3. Human-machine interaction

The current status of the Control Room operations have implemented few adaptive features in the management of incoming emergency calls. The current adaptive features are related to: (1) pre-selection of the target service, (2) high priority and preference channel assigned to gas calls (3) weight assignment to the operators in order to have always a dedicated operator to the gas calls.

Given this preliminary view of the application context, the main need in the Energy domain is to guarantee the compliance with the response time defined by the Authority without affecting the quality, the safety, and without increasing the overload on the Control Room operator.

Given that, the main goal of HoliDes for the Energy Surveillance AdCoS is working at the enhancement of levels of adaptive cooperation between human and machine agents in the management of emergency calls.

The AdCoS must maximize the quality of the service of the Energy Control Room in terms of:

(1) System usability of the operator (efficacy, efficiency and user satisfaction);

(2) Correct intervention activation of the operational teams in compliance with the response time and by providing all the necessary information, notwithstanding the situational variables (e.g. the type of caller, the frequency of incoming calls, the type of breakdown, the service affected).

Problems during the ordinary operation cycle of the aforementioned Control Room systems are mainly due to (1) overload, which can be caused by defect of system resources, communication failures, or cognitive overload;

(2) miscommunication between operators and between operators and clients; and (3) misinterpretation of the event.

The AdCos supporting the Control Room operations shall recognize the overload of operators and adapt the Machine agents, as well as sub-tasks and actions as a consequence. Adaptation shall respect country-specific regulatory constraints.

The system will be adaptive in terms of:

(1) Adaptivity to the operator:
   i. Adaptivity to the psycho-physical status of the operator (e.g. high/low workload, time pressure)

(2) Adaptivity to the caller:
   i. Adaptivity to the language competences of the caller
   ii. Adaptivity to the overall understanding of the malfunctioning
   iii. Adaptivity to the geographical localization of the caller and of the target installation
   iv. Adaptivity to the correct relevance of the call (e.g. Has the caller selected the appropriate pre-selection channel with respect to the service involved (e.g. gas, water, district heating, waste management)?)

(3) Adaptivity to the call:
   i. Adaptivity to the frequency of incoming calls
   ii. Adaptivity to the length of the incoming call
   iii. Adaptivity to the quality of audio and connection (e.g. The Operator do call back the caller if the connection drops?)

(4) Adaptivity to the problem / malfunctioning:

i. Adaptivity to the priority level assigned by the Control Room operator to the malfunctioning described by the caller (e.g. The malfunctioning has to be handled first according to the rules defined by the Authority)
ii. Adaptivity to the historical intervention gathered on a target installation
iii. Adaptivity to the type of service (gas or other)

In the following section, we briefly recall the Airbus DS and Iren target scenario in order to better point out where, when and how the intervention of the AdCos adaptivity features is needed. This definitely helps us in the definition of requirements, according to the template we have presented before.

4 Airbus DS target scenario and use cases

Information exchange inside the Control Room is usually performed using the AdCoS capabilities to accumulate and forward data to the persons that need it. The decision making process is normally done personally by the Operations Officer, discussing the possible solution with the Surveillance Supervisor and the Response Supervisor. They might do this from their working places, but they might also get up and meet at the Operations Officer's desk in the Control Room in order to talk.

The following figure shows the spatial organization of personnel and equipment in the Control Room:

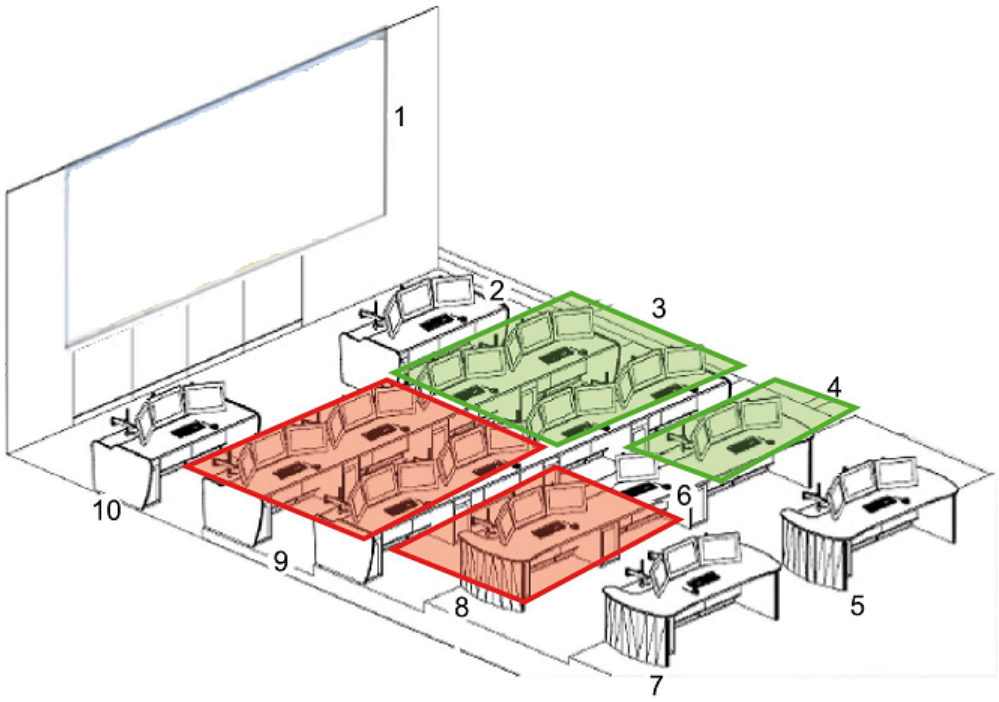


Figure 4. Airbus DS Control Room setup and staff

Below the personnel involved in a typical operational scenario (numbers in brackets refer to the placement, see Figure 3) is listed:

Surveillance Operator (3), four working places

The Surveillance Operator is performing surveillance duty for several hours during his shift and has a predefined sector of the border that he or she is monitoring. He can use different radar and camera equipment to spot targets and take a closer look in order to classify his spottings.

Surveillance Supervisor (4), one working place

The Surveillance Supervisor is the Surveillance Operators' superior and supports them in classifying targets. He also participates in decision making.

Operations Officer (7), one working place

The Operations Officer is the one in charge of all regular operations. He is the one to decide how to react on a target spotting and to define actions to be taken and events to be generated by the Response Supervisor in the further workflow.

Response Supervisor (8), one working place

The Response Supervisor is involved in decision making and is responsible for generating the event that includes the surveillance information about the targets as well as the actions to take in order to handle the event. He then assigns the event to one of the Response Operators who are responsible for carrying out the missions.

Response Operator (9), four working places

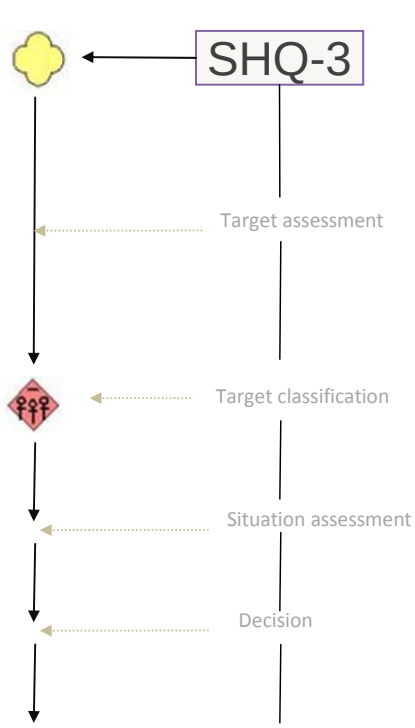
The Response Operator is responsible for handling the events generated by the Response Supervisor. He assigns missions to the Rapid Response Teams and monitors the mission execution.

Rapid Response Team (not shown in picture)

Rapid Response Teams (RRT) are assigned to carry out the missions that are based on events. Rapid Response Teams are either part of the

Sector Headquarter or are located in an external facility, the Rapid Response Stations (RRS). RRTs have one designated commander that is in charge of the rest of the team and responsible for reporting the mission progress to the Response Operator.

The standard workflow starts with the continuous surveillance tasks performed by the Surveillance Operators who are responsible for spotting and reporting potential incidents:



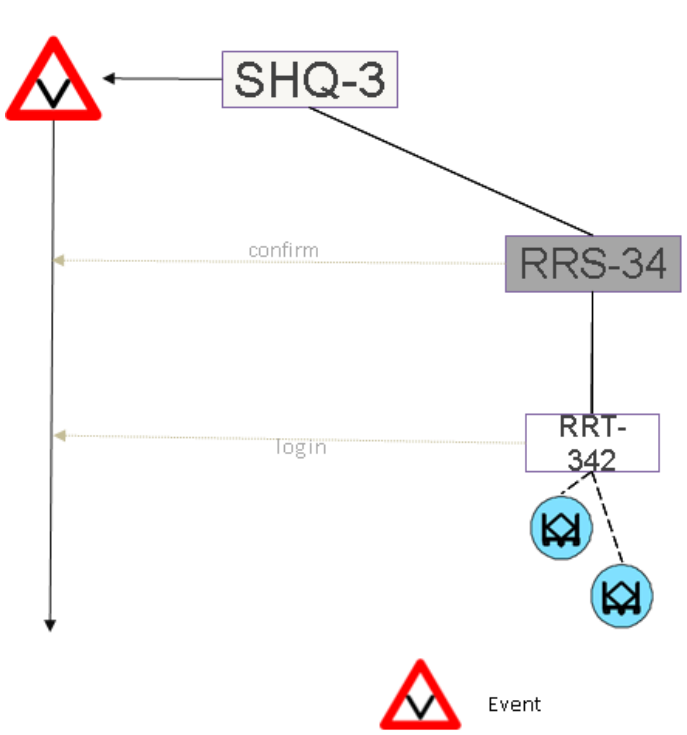
- Surveillance Operator spotting target
- Surveillance Operator reporting the target
- Surveillance Supervisor assists in assessing the situation
- Surveillance Operator checks cameras
- Surveillance Operator classifies target
- Surveillance Supervisor, Response Supervisor and Operations Officer assess the situation
- Operations Officer decides how to handle situation, tasks Response Supervisor

Figure 5. Airbus DS scenario: Surveillance and Decision

After creation of an event by the Response Supervisor a Response Operator gets tasked with its handling. He assigns a mission to an RRT including the necessary information residing in the AdCoS, see Figure 6.

Within the context of the HoliDes project, the main rooms for improvement that have been identified are related to:

1. the development process: it should consider human aspects from the beginning of the design phase in order to account for different educational and cultural backgrounds of the operators, resp. customers
2. the adaptivity of the control room application to the needs of different users.



- Response Supervisor creates the Event
- Response Operator handles the Event
- RRS Commander confirms RRT are ready to process the Event
- RRT personnel log in as Leader or Observer
- RRT (Vehicle) processes the Event

Figure 6. Airbus DS scenario: Event solution

The following are the use cases the project work has to focus on:

1. Improvement of system tailoring and localization, taking the "Help" function as one specific example
2. Operator Overload and Underload
3. System Failover at SHQ Level

4.1 Use Case 1: Improvement of system tailoring and localization

The Airbus DS Control Room AdCoS is to be introduced into customers' organizations from different countries. Consequently, different ways of working, different individual behaviors, e.g. concerning decision processes, and different system understandings from user side have to considered in the development process.

A specific example is a standard "Help" function of the Control Room system which does not match different users' needs. It is to be replaced by a three-layered help function in order to adapt to different user backgrounds. A broader approach to the problem considers context-dependent support for the user and a functionality scaling depending on the user skills.

In order to gain a controlled and verifiable development process, relevant parts will be complemented in order to capture human aspects as early as possible. One example is the addition of Human Views to existing System and Operational views already used in early system design phases as part of architecture framework models.

4.2 Use Case 2: Operator Overload and Underload

The Control Room AdCoS detects that the operator is overloaded by

- one single event or
- many simultaneous events or
- one escalating event

considering e.g. the operator status, or his delayed response, or a system-operator interaction showing less effectiveness resp. efficiency.

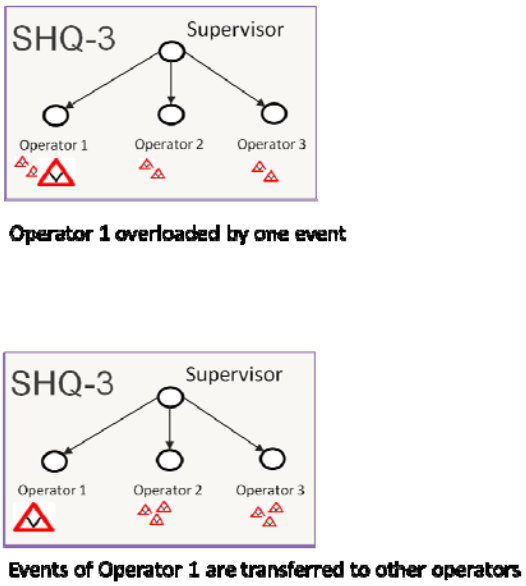


Figure 7. Airbus DS use case 2: operator overload

Following the detection of the overload situation, the AdCoS proposes adequate measures, e.g. it enables a safe and quick transfer of the concerned operator events to further operators (**Fehler! Verweisquelle konnte nicht gefunden werden.**) in the same Control Room.

Similarly, in the Operator Underload use case, the system detects that, due to a low level of events, the operator is bored, drowsy or even falling asleep. As a countermeasure, the system warns the operator, e.g. by signal, and/or keeps him busy with training exercises or other means like news.

4.3 Use case 3: System Failover at SHQ Level

In this case, the AdCoS switches from a normal operational state to a restricted or non-operational state. The events that are managed using the AdCoS at SHQ level have to be identified, analyzed and assigned to adjacent SHQs (**Fehler! Verweisquelle konnte nicht gefunden werden.**).

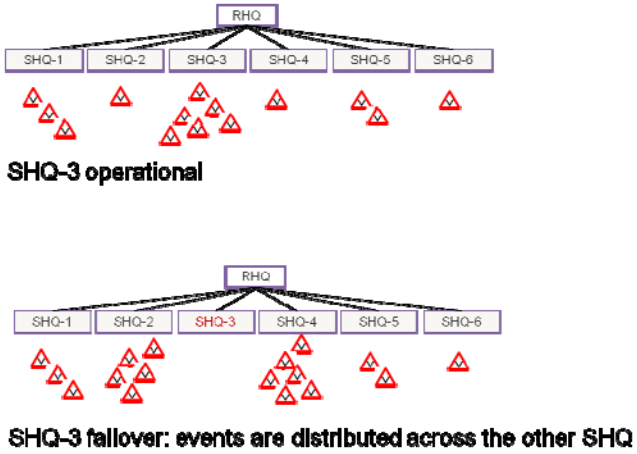


Figure 8. Airbus DS use case 3: system failover at SHQ level

5 Airbus DS requirements

This clause lists requirements collected for the area surveillance domain (Airbus DS).

Requirements have been collected in a spreadsheet containing all the information of the template presented in Sec. 3.1. It contains a list of requirement names and a short description. For details, see Appendix (A).

1. SE process support
2. SE NAF-HV support
3. SE UML views
4. AdCoS model support
5. Extensible meta model
6. Meta model profile inclusion
7. OSLC modelling tools
8. OSLC requirements tool

9. RTP template and schema export
10. RTP template and schema import
11. Modeling adaptivity features
12. Modeling reconfiguration features
13. Import of Operator models
14. Operator Categorization
15. Operator State Assessment
16. Log file analysis
17. Load balancing Headquarter (HQ) level
18. Load balancing Operator level
19. Decision support
20. Layered Help Function
21. Adaptive operator support function
22. Scalability of functionality
23. Localization
24. Adaptivity to Concept of Operations (ConOps)
25. Interoperability partner tools
26. Interoperability HF models
27. Interoperability COTS and partner tools

5.1 System Engineering process support

The RTP shall support the standard system engineering (SE) process ISO/IEC 15288. This is a high-relevance requirement for the AdCos. This is a medium-relevance requirement to be considered across all development steps of the project.

5.2 SE NAF-HV support

The RTP modeling tool shall include a meta model reflecting Nato Architectural Framework (NAF) and Human Views (HV). This is a high-relevance requirement to be considered in the Architectural Design phase of the project. The requirement can be evaluated if human views are integrated in an architectural framework meta model based on the NAF.

5.3 SE UML views

The RTP modeling tool shall include standard UML views. This is a high-relevance requirement to be considered in the Architectural Design phase of the project.

5.4 AdCoS model support

The RTP modeling tool shall support the modeling of adaptive cooperative human-machine systems on systems-tasks, agents and resources levels. This is a medium-relevance requirement to be considered across all development steps of the project.

5.5 Extensible meta model

The RTP modeling tool shall be extensible, i.e. it shall be able to include modeling artifacts coming from different partners and it shall be open to further meta models. This is a high-relevance requirement to be considered across all development steps of the project.

5.6 Meta model profile inclusion

Meta model profile elements (like attributes and links between meta model items) shall be visible and selectable when using the RTP modelling tool. It should be possible to have the profile model elements presented in drop down lists. Also, it should be possible to drag and drop them into the viewgraphs. This is a high-relevance requirement to be considered in the Architectural Design phase of the project.

5.7 OSLC modelling tools

The RTP shall enable data exchange between different modelling tools using the OSLC (Open Services for Lifecycle Collaboration) specification. This is a high-relevance requirement to be considered across all development steps of the project.

5.8 OSLC requirements tool

The RTP shall enable data exchange between the modelling tool and the requirements management tool based on commercial standards such as OSLC. This is a high-relevance requirement to be considered across all development steps of the project.

5.9 RTP template and schema export

The RTP shall enable the generation of templates and schemas and support their export to the software (SW) and hardware (HW) used for designing the adaptive layer of the application SW and human machine interface HMI. This is a medium-relevance requirement to be considered both in the Architectural Design and in the Detailed Design steps of the project.

5.10 RTP template and schema import

The HW and SW tool shall enable the import of templates and schemas developed in the AF modelling tool. This is a medium-relevance requirement to be considered both in the Architectural Design and in the Detailed Design steps of the project.

5.11 Modeling adaptivity features

The AF modeling tool shall support the modeling of the adaptivity features of the system so that it will be possible to model adaptive behavioral aspects. This is a medium-relevance requirement to be considered in the architectural design step of the project.

5.12 Modeling reconfiguration features

The AF modeling tool shall support the modeling of the reconfigurable aspects of the system. This is a medium-relevance requirement to be considered in the architectural design step of the project.

5.13 Import of operator models

The RTP modeling tool shall be able to import operator models provided from other HoliDes WP's using the OSLC interface. This is a medium-relevance requirement to be considered in the Architectural Design phase of the project.

5.14 Operator categorization

The system shall be able to determine quickly the competence and expertise of the operator in order to adapt accordingly. This is a high-relevance

requirement to be considered across all development steps of the project. For evaluating the requirement satisfaction, specific tests will be performed to prove the correct categorization of the operator and adaptation of the system.

5.15 Operator state assessment

The system shall be able to determine the psycho-physiological state of the operator, in order to enable the system to: 1) support the operator to return to his/her nominal working state; 2) inform the supervisor about the psycho-physiological state of the operator and enable the proper reaction measures. This is a high-relevance requirement to be considered across all development steps of the project concerning both perception and communication perspectives.

5.16 Log file analysis

The system shall be able to analyze and classify system-user interactions recorded on log files. Log file analysis is considered as an enabling factor for the adaptivity of the system to the operator and to the customer. This is considered a high-relevance software requirement for the AdCos system. The requirement satisfaction can be evaluated by specific tests.

5.17 Load balancing headquarter level

The system shall be able to analyze the status and the workload of adjacent HQs and subsequently offer support to transfer events to them or take events away. In case of a massive surge in border events or a HQ breakdown, the higher echelon should have support for transferring events to other HQs safely and quickly. This is a high-relevance requirement to be

considered across all development steps of the project and concerns both software and communication perspectives.

5.18 Load balancing operator level

The system shall be able to analyze the workload of operators in one HQ and subsequently offer support to the supervisor to redistribute events among them. In case an event escalates, the supervisor should have support for transferring other events to further operators. This is a high-relevance requirement to be considered across all the development steps of the project and concerns both software and communication perspectives.

5.19 Decision support

The system shall be able to help the operator to take decisions timely. This is a high-relevance requirement to be considered across all development steps of the project and concerns both software and communication perspectives.

5.20 Layered help function

The system shall provide a 3 layered help function for different levels of operator competence (for example basic, advanced and expert). This is a high-relevance requirement to be considered in all project phases.

5.21 Adaptive operator support function

The system shall offer context-dependent support. This is a medium-relevance requirement to be considered in all project phases.

5.22 Scalability of functionality

The system shall offer scaled functionality for reducing system complexity for novices or adapting system functionality in accordance with operator experience. This is a medium-relevance requirement to be considered in all project phases.

5.23 Location dependence

The RTP shall support the timely consideration of location dependent aspects (colours, language, symbols, taboos, local operator perspective) in the development process. This is a high-relevance requirement to be considered both in the Architectural Design and in the Detailed Design steps of the project.

5.24 Adaptivity to Concept of Operations (ConOps)

The RTP shall support the tailoring of the system according to the customer ways of working with respect to organization, hierarchy (planning vs. execution), and procedures, ie. the ConOps. This is a high-relevance requirement to be considered in all project phases.

5.25 Interoperability of partner tools

The methods and tools provided by HoliDes partners shall have an OSLC interface. This is a medium-relevance requirement to be considered in all project phases.

5.26 Interoperability of Human Factors models

The models describing human aspects and human behaviour shall be compliant to be exchangeable via the OSLC standard. This is a medium-relevance requirement to be considered in all project phases.

5.27 Interoperability of COTS and partner tools

The RTP shall enable exchange of data between Commercial Off The Shelf (COTS) modeling tools and tools provided by HoliDes partners. This is a medium-relevance requirement to be considered in all project phases.

6 Iren target scenarios and use cases

In the energy control room domain, the scenario deals with the ordinary management of the operator of the Control Room receiving an incoming call for different type of emergency services (gas, water, electricity, heating, waste).

The considered use cases, ranked by priority, are listed in the following.

6.1 Use case 1: Managing of an inappropriate calls

In this use case, the person who calls is not signalling a malfunctioning, but he/she is simply asking for some information related to the energy network (like, for example, billing, pricing, etc.) and has dialled the wrong emergency number by mistake. The Control Room operator, in that case, has to free the line as soon as possible and eventually redirect the call to the proper department.

6.2 Use case 2: Peak of incoming calls - Emergency for an exceptional event

In this use case, the Control Room is overwhelmed by a huge number of calls referring to the same urgent energy network malfunctioning. Such situation can occur for example when a pipe brakes while there are some work on a public street and every passer-by calls for signalling the damage. This event has a low probability of happening, but is hard to be managed. Operators have to answer to every calls because no filters exist to identify calls for the same or different events.

6.3 Use case 3: Collection of relevant information for the correct interpretation of the malfunctioning

The operator receives the call in normal operational conditions, i.e., when the call frequency has an average value. He/she then has to collect from the caller all the necessary information in order to correctly understand the malfunctioning and to solve the problem consequently. An issue that often happens is that the operator sees that some useful information is missing when the call is already ended.

6.4 Use case 4: Communication between the headquarter and the operational team in the field

In this use case, the headquarter has to communicate the meaningful information to the team in the field. According to the information provided, the proper equipment to fix the damage can be selected, and time can be saved. The choice is performed according to the type of malfunctioning, the energy network that is involved in (electricity, gas, water), the general functioning conditions of the entire system, the location and plant accessibility.

6.5 Use case 5: Foreign language speaking caller

In this use case, there is an incompatibility of language between the caller and the control room operator. The operator receives a call from a non-Italian speaker and he/she has to gather all the necessary information to understand the issue. The person calling who does not speak Italian currently does not receive any help in overcoming linguistic problems.

6.6 Use case 6: Collection of historical information about intervention of each installation for future events

In this use case, data about past malfunctioning events that have been previously collected, stored and shared are used to improve the current malfunctioning recovery. Indeed, it would be very useful to exploit information about past emergency management in order to improve future interventions. Typically, the knowledge about malfunctioning recovery is episodic in nature, possessed by a single operator and not shared. In other words, there is the need of having a case history about the energy networks under surveillance to the aim of gaining benefits from using it in the management.

7 Iren requirements

All Iren requirements refer to the use cases presented in the previous section. Requirements have been collected in a spreadsheet presenting all the information of the template we presented in Sec. 3.1.

The Iren requirements that have been identified concerns all the development process phase, from the architectural design to the validation.

We herein provide a list of their names and a short description. For details the reader can refer to the external sheets in Appendix (A).

1. Operator situation awareness
2. Response time
3. Workload assessment
4. Workload normalization

5. Procedure standardization
6. Operation procedures
7. Cooperation between operators and operational teams
8. Usability
9. Operator state assessment
10. Language adaptivity
11. Geographical localization adaptivity
12. Call frequency adaptivity
13. Priority level adaptivity
14. Historical data

7.1 Operator situation awareness

The AdCoS system shall be able to improve the situation awareness of the operators in comparison to the existent systems that do not benefit of the adaptive collaboration.

An increased situation awareness helps the operator to perform the right decision in case of emergency.

For example, in case of high load for the operator, the information provided by the AdCos makes able the operator to better understand the causes of the overloading.

This is a high relevance software requirements for the AdCoS system.

The requirement satisfaction can be verified by submitting a specific test to the operator in order to prove his/her correct understanding of the situation.

7.2 Response time

The AdCoS shall reduce the time needed to complete an emergency case without reducing the amount of information gathered and provided to the operational team. The response time should be lower than the maximum time fixed by the Authority and it should be reduced in comparison with non-AdCos systems thanks to the optimization of the information gathering process and of the emergency call management.
This is a high relevance requirements that concerns both software and communication perspectives.
Time performance tests can be executed in order to evaluate the introduced benefits in terms of system response time.

7.3 Workload assessment

The AdCoS shall be able to assess the workload of the operator both in normal and in emergency conditions in order to recognize overloading situations. This is a high relevance perception requirement.
A comparison test can be performed in order to verify the operator status derived by the system matches with the actual operator workload.

7.4 Workload normalization

The AdCoS shall be able to normalize the workload of the operator in both high or low load conditions and without decreasing the system performance. This is a high relevance software requirement.

The requirement satisfaction can be verified by means of specific tests measuring the workload level before and after the normalization process.

7.5 Procedure standardization

The AdCoS shall introduce a standardized procedure for the managing of the incoming calls by the operators and for the collection of all the necessary information for a comprehensive situation assessment.
This is a high relevance software requirement.

7.6 Operation procedures

The new procedures introduced by the AdCoS shall be as transparently deployable as possible in order to do not impact on the current ordinary operations of the Control Room.
This is a high relevance requirement.
The requirement satisfaction can be verified by controlling that the new procedures introduced by the AdCos do not affect the existing one.

7.7 Cooperation between operators and operational teams

The AdCoS shall improve the cooperation of the operator with the operational team, by making him/her able to provide to the other colleagues meaningful information for the situation interpretation and for the identification of the proper equipment needed to face the emergency.

This is a medium relevance requirement referring to both software and communication aspects.
The requirement satisfaction can be verified by means of user acceptance test.

7.8 Usability

The AdCoS shall improve the current system usability in terms of efficiency, effectiveness and user satisfaction. This is a high relevance software requirement. The requirement satisfaction can be verified by means of user acceptance test.

7.9 Operator state assessment

The AdCoS shall adapt to the psyco-physical status of the operator, by considering for example if he/she is overloaded, under pressure, or has physical disease in the task assignment decisional process. The AdCoS shall support the operator to return to nominal working state and allocate, in case on high workload, any exceeding task to other suitable operators in the Control Room. This is a medium relevance software requirement that can be verified by designing specific tests controlling that both the psyco-physical status assessment and the following task assignment are performed correctly.

7.10 Language adaptivity

The AdCoS shall adapt to the caller's language. It shall provide language tips to the customer who does not speak the default language (Italian, in the Iren case) in order to make him/her able to preselect the right service and to communicate with an operator that understand his/her language. This is a low-relevance software requirement and can be proved by user acceptance test.

7.11 Geographical localization adaptivity

The AdCoS shall adapt to the geographical localization of the caller and of the target installation. It shall provide the operator a map representation of both the caller and of the target installation on a map.
This is a low-relevance software requirement and can be proved by user acceptance test.

7.12 Call frequency adaptivity

The AdCoS shall adapt to the frequency of incoming calls. Moreover it shall recognize that a high frequency of incoming calls refers to a same malfunctioning and behave consequently. This is a high-relevance software requirements and can be proved by means of simulation test verifying the system adaptation.

7.13 Priority level adaptivity

The AdCoS shall adapt to the priority level of the malfunctioning detected by following the rules and constraints defined by the Authority for that priority level.
This is a high-relevance software requirements and can be proved by means of simulation test verifying the system adaptation.

7.14 Historical data

The AdCoS shall adapt to the historical intervention gathered on a target installation. The AdCos shall consider indeed the information on the historical interventions that have been performed on a target installation recovered by the operator in order to recognize a recurring problem. This is a low-relevance software requirements and can be proved by means of simulation test verifying the system adaptation.

8 Common adaptivity features

WP8, in addition to the definition of scenarios, use cases and requirements, started a process to identify common adaptivity features. The process is still in progress. Following the list with a brief description.

8.1 Adaptive, 3-layered help function

The Help function has 3 layers to support operators with 3 categories of system knowledge: [basic, advanced, expert]; an operator is categorized according to selection menu, few questions, log file analysis or operator state analysis.

8.2 Peak workload handler

The system provides a workstream to the supervisor, the higher echelon and the adjacent HQ(s) to handle the transfer of events: status of other systems, approval to transfer events, approval to take over additional events or transfer of events.

8.3 Failover Handler

The system detects a HQ breakdown, reports the situation to a higher echelon and provides support for transferring of events to adjacent HQs (see also Peak load handler).

8.4 Escalation handler

The system detects that the operator is overloaded by one single event (operator state, delayed response, increased system-operator interaction,..) and offers a workflow to enable a safe and quick transfer of the operator's other events to further operators by the supervisor.

8.5 Minimun load handler

The system detects that the operator is bored/falling asleep (eg. by camera or operator state analysis), it awakens and keeps him busy with training exercises or other measures like news.

9 Conclusions

During the first three months of the projects WP8 has collected and discussed use cases, scenarios and requirements. The identified requirements will be part of an iterative refinement process through the successive phases in order to meet HoliDes needs and goals.

Appendix A

This section contains the WP8 requirements in tabular form, including all attributes.

ID	Name		Definition	Rationale	Relevance	Development Process Step
WP8_ADS_CTR_REQ001_v0	SE process support	RTP	The RTP shall support the standard System Engineering (SE) process ISO/IEC 15288.	[process] We will use a standard system engineering development process <<ISO / ECEC INCOSE>>	H	AD to V
WP8_ADS_CTR_REQ002_v0	SE NAF-HV support	RTP	The RTP modeling tool shall include a meta model reflecting Nato Architectural Framework (NAF) and Human Views (HV)	[Method] We will use an Architectural Framework. More specifically, we will use NAF and HV	H	AD
WP8_ADS_CTR_REQ003_v0	SE UML views	RTP	The RTP modeling tool shall include standard UML views	[Tool] In case where no suitable human centered aspect is suitable, standard UML represenation will be used as backup.	H	AD
WP8_ADS_CTR_REQ004_v0	AdCoS model support	RTP	The RTP modeling tool shall support the user to model the 3 layers of the adaptive cooperative human machine systems- tasks, agents, resources	[Tool] To support modeling of the adaptive cooperative human-machine systems	M	AD to V
WP8_ADS_CTR_REQ005_v0	Extensible meta model	RTP	The RTP modeling tool shall be extensible to extend the metamodel with other human centered aspects.	[Tool] We might include modeling artifacts from other WPs, so the modeling RTP should be flexible to include these	H	AD to V
WP8_ADS_CTR_REQ006_v0	Meta model profile inclusion	RTP	The meta model shall be included in the modeling tool. The meta model profile items (as attributes, links between meta model items) shall be visible, selectable when using the	[Tool] The elements of the meta model should be underlyed in the modeling tool. The elements should be	H	AD

ID	Name		Definition	Rationale	Relevance	Development Process Step
			tool	present in drop down lists. Also, the elements should be dragged and dropped into the viewgraphs.		
WP8_ADS_CTR_REQ007_v0	OSLC modelling tools	RTP	The RTP shall enable to exchange data between different modeling tools using the Open Services for Lifecycle Collaboration (OSLC) specification	[Tool] We will exchange data between different modeling tools of the RTP	H	AD to V
WP8_ADS_CTR_REQ008_v0	OSLC requirements tool	RTP	The RTP shall enable to exchange data between a model and requirement tools using the OSLC specification	[Tool] We will exchange data between the modeling tool and the requirements management tool. The exchange of data should be based on commercial standards as OSLC. The interconnection between Tools should support the data exchange.	H	AD to V

ID	Name		Definition	Rationale	Relevance	Development Process Step
WP8_ADS_CTR_REQ009_v0	RTP template and schema export	RTP	The RTP shall support the export of templates and schemas from the modelling tool to the SW and HW design tool	[Tool] From the modeling tool we will export templates / schema which could be used to design the adaptive layer of the procesing SW and HMI of the application	M	AD, DD
WP8_ADS_CTR_REQ010_v0	RTP template and schema import	RTP	The HW and SW tool shall enable the import of templates and schemas developed in the AF modeling tool	[Tool] From the modeling tool we will export templates / schema which could be used to design the adaptive layer of the procesing SW and HMI of the application	M	DD
WP8_ADS_CTR_REQ011_v0	Modeling adaptivity features	RTP	The RTP modeling tool shall support the modeling of adaptivity features	[Tool] We will be able to model adaptive behavior aspects	M	AD
WP8_ADS_CTR_REQ012_v0	Modeling reconfiguration features	RTP	The RTP modeling tool shall support the modeling of reconfiguration features	[Tool] We will be able to model reconfiguration aspects.	M	AD
WP8_ADS_CTR_REQ013_v0	Import of Operator models	RTP	The RTP modeling tool shall be able to import operator models provided from other HoliDes WP's using the OSLC interface	[Tool] We will be able to use operator models from partners within AD process	M	AD

ID	Name		Definition	Rationale	Relevance	Development Process Step
WP8_ADS_CTR_REQ014_v0	Operator Categorization	AdCos	The system shall be able to determine quickly the level of Competence & Expertise of the Operator in categories [basic/advanced/expert]	[Performance] The system will be able to categorize the operator quickly in order to adapt itself accordingly	H	AD to V
WP8_ADS_CTR_REQ015_v0	Operator State Assessment	AdCos	The system shall be able to determine the psycho-physical status of the operator	[Performance] In order to enable the system to 1) support the operator to return to nominal working state 2) inform the supervisor on the operator state in order to subsequently initiate measures if necessary the psycho-physical state of the operator is needed	H	AD to V

ID	Name		Definition	Rationale	Relevance	Development Process Step
WP8_ADS_CTR_REQ016_v0	Log file analysis	AdCos	The system shall be able to analyze the system-user-interactions in the log file and do a subsequent classification (to be detailed)	[Performance] in order to enable the system a classification of the operator and/or generally to adapt to the user log file analysis is a prerequisite	H	AD to V
WP8_ADS_CTR_REQ017_v0	Load balancing Headquarter (HQ) level	AdCos	The system shall be able to analyze the status and workload of adjacent HQs and subsequently offer support to transfer events to them	[Functional] In case of a massive surge in border events or a HQ brakdown the higher echelon should have support for transferring events to other HQs safely and quickly	H	AD to V
WP8_ADS_CTR_REQ018_v0	Load balancing Operator level	AdCos	The system shall be able to analyze the workload of operators in one HQ and subsequently offer support to the supervisor to redistribute events among them	[Functional] In case an event escalates (partly system break, too many decisions,..) the system the supervisor should have support for transferring other events to further operators	H	AD to V
WP8_ADS_CTR_REQ019_v0	Decision support	AdCos	The system shall help the operator to take decisions timely	[Functional] Local cultures may inhibit the rapid responses	H	AD to V

ID	Name		Definition	Rationale	Relevance	Development Process Step
WP8_ADS_CTR_REQ020_v0	Layered Help Function	AdCos	The system shall provide a 3 layered help function for [basic, advanced, expert] operator competence	[Functional] Help function as an "easy" test case	H	AD to V
WP8_ADS_CTR_REQ021_v0	Adaptive operator support function	AdCos	The system shall offer context-dependent support	[Functional] In case the user needs support in terms of operational context and/or effective system operation	M	AD to V
WP8_ADS_CTR_REQ022_v0	Scalability of functionality	AdCos	The system shall offer scaled functionality	[AdCos] Reduce system complexity for novices or adapt system functionality in accordance with operator experience	M	AD to V
WP8_ADS_CTR_REQ023_v0	Localization	RTP	The RTP shall support the timely consideration of localization aspects (colours, language, symbols, taboos, local operator perspective) in the development process	[RTP] Reduce localization efforts	H	AD to DD
WP8_ADS_CTR_REQ024_v0	Conops adaptivity	RTP	The RTP shall support the tailoring of the system according to the customer ways of working wrt. organization, hierarchy (planning vs. execution), procedures	[RTP] Reduce adaptation resp. re-development effort	H	AD to V

ID	Name		Definition	Rationale	Relevance	Development Process Step
WP8_ADS_CTR_REQ025_v0	Interoperability partner tools	RTP	The methods and tools provided by HoliDes partners shall have an OSLC interface	[RTP] [Interoperability}	M	AD
WP8_ADS_CTR_REQ026_v0	Interoperability HF models	RTP	The models describing human aspects and human behaviour shall be compliant to be exchangble via the OSLC standard	[RTP] [Interoperability}	M	AD
WP8_ADS_CTR_REQ027_v0	Interoperability COTS and partner tools	RTP	The RTP shall enable exchange of data between commercial modeling tools and tools provided by HoliDes partners	[RTP] [Interoperability}	M	AD
WP8_IRN_CR_REQ001_v0	Operator situation awareness	ADCOS	The AdCoS shall be able to improve the situation awareness of the operators	[Performance] In case of high load on the operators, the tool provides the needed information in order to improve the situation awarness of the operator	H	AD to V
WP8_IRN_CR_REQ002_v0	Response time	ADCOS	The AdCoS shall reduce the time needed to complete an emergency case without reducing the amount of information gathered and provided to the operational team	[Performance] The response time is fixed by the Authority. The response time should be lower than the maximum time allowed by optimizing the	H	AD to V

ID	Name		Definition	Rationale	Relevance	Development Process Step
				gathering of information and the call management.		
WP8_IRN_CR_REQ003_v0	Workload assessment	ADCOS	The AdCoS shall be able to recognize the workload on the operator	[Performance]In normal and emergency conditions, the AdCoS is able to assess the status of the operators	H	AD to V
WP8_IRN_CR_REQ004_v0	Worload normalization	ADCOS	The AdCoS shall normalize the workload, either low or high, on the operator	[Performace] In high or low workload conditions, the AdCoS is able to normalize the operator status without decreasing his/her performance	H	AD to V
WP8_IRN_CR_REQ005_v0	Procedure standardization	ADCOS	The AdCoS shall introduce a standardized procedure	[Process] A standardized procedure guides the operator in managing incoming calls and collecting the necessary information in order to interpret correctly the mulfunctioning	H	AD to V

ID	Name		Definition	Rationale	Relevance	Development Process Step
WP8_IRN_CR_REQ006_v0	Operation procedures	ADCOS	The AdCoS shall not have an impact on the ordinary and current operations of the Control Room	[Process] The current working procedures are not affected by the tests with the AdCoS performed in the Control Room	H	AD to V
WP8_IRN_CR_REQ007_v0	Cooperation between operators and operational teams	ADCOS	The AdCoS shall improve the cooperation of the operator with the operational teams	[Performance] The operator is in the conditions of providing all the necessary information to the teams in the field for the correct interpretation of the event and the identification of the correct equipment needed	M	AD to V
WP8_IRN_CR_REQ008_v0	Usability	ADCOS	The AdCoS shall improve the current system usability	[Performance] the usability of the emergency management tool is improved in terms of efficiency, efficacy and user satisfaction	H	AD to V

ID	Name		Definition	Rationale	Relevance	Development Process Step
WP8_IRN_CR_REQ009_v0	Operator Categorization	ADCOS	The AdCoS shall adapt to the competence and expertise level of the operator	[Performance] The system will be able to categorize the operator quickly in order to adapt itself accordingly	M	AD to V
WP8_IRN_CR_REQ010_v0	Operator State Assessment	ADCOS	The AdCoS shall adapt to the psyco-physical status of the operator (e.g. high/low workload, time preassure,physical features)	[Performance] The AdCoS support the operator to return to nominal working state and allocate, in case on high workload, any exceeding task to the most suitable operator in the Control room	M	AD to V
WP8_IRN_CR_REQ011_v0	Operator role adaptivity	ADCOS	The AdCoS shall adapt with respect to the role assigned to each operator for incoming calls	[Process] The AdCoS dynamically adapt the incoming call assignment to the most suitable operator, according to the role that has been assigned to him/her (e.g. gas or other service)	M	AD to V

ID	Name		Definition	Rationale	Relevance	Development Process Step
WP8_IRN_CR_REQ012_v0	Language adaptivity	ADCOS	The AdCoS shall adapt to the language competences of the caller	[Process] The AdCoS provide language tips to the customer who does not speak italian in order to preselect the right service and to communicate with the operator	L	AD to V
WP8_IRN_CR_REQ013_v0	Geographical localization adaptivity	ADCOS	The AdCoS shall adapt to the geographical localization of the caller and of the target installation	[Process] The AdCoS recognize the localization of the caller and provides to the operator the visualization on a map of the caller	M	AD to V
WP8_IRN_CR_REQ015_v1	Call frequency adaptivity	ADCOS	The AdCoS shall adapt to the frequency of incoming calls	[Process] The AdCoS support the operators in managing a high frequency of incoming calls on a same mulfunctioning	H	AD to V
WP8_IRN_CR_REQ017_v3	Priority level adaptivity	ADCOS	The AdCoS shall adapt to the priority level of the malfunctioning detected and the type of service addressed	[Process] The malfunctioning is handled first according to the rules and constraints defined by the Authority	H	AD to V

ID	Name		Definition	Rationale	Relevance	Development Process Step
WP8_IRN_CR_REQ018_v4	Asynchronous adaptivity	ADCOS	The AdCoS shall adapt to the asynchronous between the call and the malfunctioning detection	[Process] The AdCoS supports the management of asynchronous calls	L	AD to V
WP8_IRN_CR_REQ019_v5	Historical data	ADCOS	The AdCoS shall adapt to the historical intervention gathered on a target installation	[Performace] The operator receives the information on the historical interventions that have been performed on a target installation in order to evaluate if it is the case of a recurring problem	L	AD to V
WP8_IRN_CR_REQ020_v6	Load balancing Headquarter level	ADCOS	The AdCoS shall adapt to the number of operators available	[Performace] In case of a peak of incoming calls, the AdCoS supports transferring events to other operators safely and quickly	M	AD to V

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