pulse

Platform for European Medical Support During Major Emergencies

D7.3 Validation Results

PULSE

Platform for European Medical Support during major emergencies

WP7 Trials & validation

Deliverable D7.3 – Validation Results

31/10/2016

Title:			Document Version:
D7.3 - Validation Results			V1.0

Project Number:	Project Acronym:	Project Title:
607799	PULSE	Platform for European Medical Support during major emergencies

Contractual Delivery Date:	Actual Delivery Date:	Deliverable Type*-Security**:
30/09/2016	31/10/16	Report - PU

Responsible:	Organisation:	Contributing WP:
Sarah Bourke	SKY	WP# 7

Authors (organisation)
Reinhard Hutter/Hans Kühl (CESS), Violel Pectu (ONEST), Sabina Magalini (UCSC), Rowena Rodrigues (TRI), Francesco Malmignati (SES/FINM), Cian O'Brian (IAEMO), Paul Kiernan, Jacinta Bourke, Sarah Bourke (SKY)

Abstract:
This deliverable contains the results of the evaluations of the PULSE platform and its tools. They were evaluated in tabletop and live exercises where the system was exposed to a series of simulated scenes/use cases. They were created and executed in two basically different scenarios: -Emerging Viral Disease (EVD)- and -Mass Casualty Incident (MCI)-.
Results were created via a number of scoring questionnaires that were filled by an excellent group of external stakeholders having participated in the trials, from various health and security related organizations. Verbal answers and comments completed the result sources and evaluations. The results were generally very positive, with some positive suggestions from end users on how the system could be enhanced going forward.

DOCUMENT> REVISIONS:

Revision	Date	Description	Author (Organisation)
0.1.1	04/06/2016	Draft ToC	Reinhard Hutter (RH, CESS)
0.1.2	17.06.2016	Revised ToC	RH (CESS)
0.1.3	22.07.2016	Incl ONEST; distrib.22.07.	RH (CESS)
0.1.4	26.07.2016	Further CESS-input	RH/HK
0.1.4	July/Aug/2016	Integration of OST contrib	Viorel Pectu (OST)/RH (CESS)
0.1.5	10.8.2016	All input incorporated	HK/RH (CESS)
0.1.5	11.08.2016	New chpt.4.2/ integr.	HK/RH
0.1.5	12.08.2016	Chapter 4.3 on EELPS eval.	RH
0.2.0	12.08.2016	Consolidated and distributed for interim review; request of missing input	RH
0.2.1	14./19.08.2016	Input 4.1.8	HK/RH
0.2.1	14./19.08.2016	Input 3.1; 3.3.7; 4.4	Viorel P (OST)
0.2.1	29.08.2016	Input 4.3 (TRI rev. & integrated	RH /Rowena R.
0.2.1	09.09.2016	Input chpt. 4.5 = Technical Evaluation	Francesco M. draft RH integrated
0.2.1	12.09.2016	Further editing; New Annexes; planning input from MCI Trial	RH HK
0.2.1	25.09.2016	Consolidation Request for delivery of missing input, @27.09.	RH
0.3.0	17.10.2016	All input by 17.Oct integrated	HK/RH
0.3.0	19.10.2016	Input OST chpt. 5.4; 6.1.5 TTRI: 5.3; 6.1.4	RH
0.3.1	21.10.2016	Consolidation chpts. 4.4; 5.5 &6.1.6	RH
0.3.1	21.10.2016	Delivered final draft to SKY for final review	RH
0.3.2	31.10.2016	Modifications 3.3.10; 4.5	RH
1.0	31.10.2016	Final updates and review	PK/SB/JC

TABLE OF CONTENTS:

List of Figures

List of Tables

1 Introduction

1.1 Purpose of the Document

The PULSE project aims at designing, developing, testing, demonstrating and evaluating an ICT system and platform for European healthcare. The expected benefits of the system are to improve the effective use of medical resources, reduction of administrative and bureaucratic efforts in the preparedness and response phases by providing decision makers with timely key data, to support the planning and decision processes in a local, regional, national and international environment, and to derive practices for future implementation and training of the system.

This deliverable documents the results of the system demonstration in realistic scenario based trials in deriving and analysing the evaluation results achieved during these trials. Results basically include the validation of

- The system's effectiveness measured against sets of Measures of Effectiveness (MoEs), such as reaction times, exploitation of resources etc.
- The basic system performance characteristics measured in Measures of Performance (MoPs) e.g. user friendliness, flexibility etc.
- The expected impact of the PULSE system concerning ethical, societal, legal, political and possible economic implications
- The general assessment of the PULSE project as a whole, of the trial setup and execution, and of the scenarios and use cases applied
- The assessment of the developed and applied technologies

Depending on the type of questions and results to be generated, different "communities": medical experts, hospital operators, first responders, national and international representatives, emergency management experts, researchers and team members were involved in the validation processes in their different roles.

1.2 Scope of the Document

D7.3 Starts from the findings of the process analyses in WP5 and is based on the preparatory actions of setting up the trials, in WP7.

This deliverable generates information on the expected benefits but also on characteristics of the PULSE system that may need future improvement. It should become a basic source for future steps of further developing it into a fully operational system and of introducing it into the real world of emergency healthcare across EUROPE.

1.3 Structure of the Document

The document is based on the detailed description of the trials definition, documented in D7.1, and of the trials implementation, documented in D7.2.

After chapter 1 - the introduction to and scope of the document -, the general environment is discussed in chapter 2 on the healthcare improvements that are needed and expected to be proven in the trials. In chapter 3, the evaluation methodology and tools are summarized (they are detailed in D7.1). Chapters 4 and 5 and the Annexes document the detailed trial results and their assessment, separately

for the two different trial scenarios and setups. In Chapter 6, results are summarized, including an overall SWOT[1] evaluation.

Figure 1 gives a summary of the document structure.
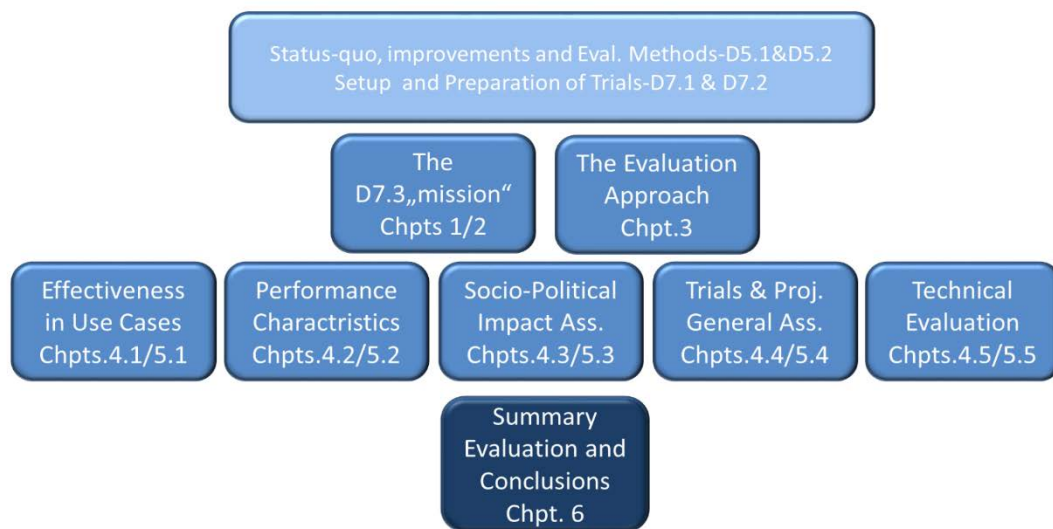
Figure 1 Structure of the Deliverable D7.3

2 Improvement of Health Care

2.1 General Situation

The principal problem of health services in major disasters is the promptness by which they respond. The development of a pan-European technical and operational platform for health services is the scope of the PULSE project. The development of this platform is a complex problem because it requires the identification of a heterogeneous group of organizations, services, resources, procedures, legislative directives and supporting systems of the different European countries involved. And while different platforms exist for Risk Reduction in case of disasters   platforms for management of information and resources are still insufficient and often [8] nationally restricted[10].

2.2 Decision and Planning Support in Emergency Medical Response

After what has been specified in the End-User requirement gathering performed among the different organizations involved in emergency health care in the sectors of an epidemiological and a trauma scenario and as reported in D2.3, the PULSE platform was proposed to the relevant stakeholders and end-users to verify if and how it could be of help in disaster management.

The two scenarios chosen for the project were an epidemiological scenario of a pandemic and a trauma scenario of a stadium crush.

In the first scenario, the importance of the PULSE platform needs to be principally for the decision makers at public health level since the dynamics of an epidemiological

---

[1] Strengths, Weaknesses, Opportunities, Threats

event are those of a „rising tide" and the timing of a rapid response require a faster-than-today, more accurate, and possibly geo-localized information retrieval that allows to take logistics decisions during the time lapse and the evolution of the epidemic. The integration between the decision makers and the operators on the field (Emergency Medical Services, Airport and Travel Medical Authorities, General Practitioners, et al.) needs to be addressed through the simplified and rapid technology to insert information into the system. The easier and more rapid communication among these First Responders is on the field, the better medical operators can be specifically tasked.

The medical benefits of a more rapid epidemiological response are those of the containment of an epidemic with less people getting infected and of the better patient care (the beneficiaries of this are the most vulnerable categories of children, elderly patients and those with immunological alterations such as malnutrition, chemotherapy and poor sanitation conditions). The sparing and better allocation of limited medical resources is a secondary benefit.

The devised platform was re-proposed to the stakeholders/end-users initially consulted, and extended also to the Epidemiological Institute of the Spallanzani Hospital in Rome, Italy, which, together with the Istituto Superiore di Sanità and the Italian Ministry of Health, is deputy to Epidemiological Surveillance and Response in Italy.

The second scenario of a stadium crush focused on a more limited sector of the Emergency Health Management system. This is principally due to the fact that the evolution of such a type of disaster is very sudden and the major medical benefit of a rapid response is in the timing of minutes or hours required to locate, classify and transport patients to the nearest and most appropriate hospital. Of high but secondary priority is the rapid identification of the victims and their relatives. The End Users consulted were the communities of emergency medical systems, hospital emergency departments and management operators, and the decision makers at the level of inter-operating agencies where existing. In this case, it must be remembered that different EU countries have different EMS organizations at local level, while at National Level the Epidemiological Response Systems, thanks also the WHO and ECDC guidelines are more harmonized and homogenous.

The validation of the PULSE platform for the stadium crush scenarios focused on the rapidity of the information input from the First Responders to the Local Decision Making Authority. The larger quantity of information acquirable through PULSE (images, rapid triage results, geo-localization of victims), compared to traditional information exchange should be of great benefit in terms of efficient allocation of patients to adequate but limited medical facilities.

The evaluations performed during the trials and documented here describe in great detail the individual phases of such disasters and the benefits such a PULSE platform would produce when in operation. Also, recommendations for improvement are documented.

3 The Basic PULSE Evaluation Approach

3.1 Scenarios and Use Cases

In accordance with the PULSE's DoW, the validation of the PULSE platform was done in two **trials**, covering major medical emergency **scenarios**:

1. **Emergent Viral Diseases (EVD)** Trial - Rome, Italy and
2. **Mass Casualties Incident (MCI)** Trial - Cork, Ireland.

Details of the different scenarios are documented in D2.2, and of the two trial setups in D7.2.

For each trial, an evaluation scenario has been developed; the scenario is a description of an incident, including the background, the occurrence and the developing events of a hazardous incident, of response and other related processes of relevance:

- **EVD Trial Scenario:** SARS-like event that develops over several weeks. It can affect large numbers of people and is highly contagious and potentially lethal. This scenario takes into account weak signal detection, epidemiological spread of disease with cross border implications, medical emergency service and the hospital response.

- **MCI Trial Scenario:** Crush at a rock concert in a stadium with many casualties and injured at one geographical location in a very short time. It essentially takes into account the triage, transport and medical assistance outside and inside the Hospital, of trauma victims.

As detailed in D 2.2, the PULSE scenarios are broken down into a number of use cases. A use case is as a sample materialization of a part of the scenario, including hazardous event or attack event lines, organizations involved, response procedures, responder and health resources etc.

The PULSE scenarios and use-cases have been designed in order to evaluate the PULSE platform and /or individual tools in a variety of very concrete realistic events or courses of events. There are 9 use cases for the SARS scenario (SA01 to SA09), and 8 for the Stadium scenario (SC01 to SC08), as summarized in D 7.1 Trial Definition – Chapter 2.3.

3.1.1   EVD Trial Scenario and Use Cases

The EVD Trial was a table top exercise meant to evaluate the PULSE platform in a SARS-like event as briefly described above.

The SARS-like Scenario was based on the following key concepts:

- Make reference to a recurrent epidemic management situation →**Pandemic Influenza**

- Develop the trial making reference to a proven operational scheme →**Italian Pandemic Plan, based WHO pandemic phase** (it is coherent with WHO guidelines, which are also adopted by other European countries)

- Involve actors, that have already managed similar situations in the proven scheme →**actors with current or past roles in managing Pandemic Influenza applying WHO phase scheme**

- Make reference to the decision making situations that are expected to be supported by PULSE tools →**the trial runs along the Use Cases** defined in Deliverable *D2.2,* and whose relationship with PULSE tools has been clearly stated in Deliverable *D5.2- Pulse SOP.*

The EVD Trial was assembled from seven "scenes"; Each scene is based on one of the use cases. The sequence of the scenes and the relationship between Pandemic Phases and Use Cases is show in Figure 2.

Figure 2 Sequence of the EVD Trial Scenes

The table puts the use cases in a sequence that is better suited for the trial. Use case 3 (ship) was skipped as it is not supposed to create substantially additional insights compared to use case 2(airplane).

3.1.2 MCI Trial Scenario and Use Cases

The MCI Trial was a live exercise, meant to evaluate the PULSE platform in a STADIUM crush scenario. The scenario was adapted to focus on various stages of a crowd crush incident: pre-incident phase, incident phase and post-incident phase. It was assumed that the stakeholders are working collaboratively to monitor and establish preventive measures, and to be ready for emergency response if an incident happens in a stadium.

The MCI trial ran through numerous focal points, that have been designed in order to cover all key use cases, all PULSE tools and all actions of the Stadium Event Medical Plan. The sequence of the focal points and the relationship between the pre-incident phase, incident phase and post incident phase, and all associated use cases are detailed in Table 1:

Table 1: MCI Trial Sequence of the focal points

Use Case		Stadium Crush		
		Pre-Incident Phase	**Incident Phase**	**Post Incident Phase**
1.	Scoring System in the Event Medical and Other Plan Preparation Phase	X		
3.	User wishes to mobilise additional resources from Public, Private, Voluntary and Response Assets from other member states		X	
4.	Hospital Surge Capacity and Bed Management		X	
5.	Triage in Casualty Clearing Station		X	
6.	Input critical data for the RCS on Site and from other relevant off-site sources		X	
7.	Post-Event, Post Exercise Evaluation			X

	Tool to identify lessons to be learned.			
8.	Casualty Bureau Operation			X

The MPORG MCI UC 2 was validated in a separate session, before the MCI Trial day, with end-users who also participated to the MCI Trial.

3.2 The Trials Setup

The trial concepts have been prepared in detail, and the trial setups are described in D7.1 and D 7.2. They mainly include the

- Key trials concepts and requirements,
- Scenario and scenes of the EVD trial
- Scenario and use cases of the MCI trial
- The scene- and use case-related questionnaires and the cross-cutting evaluation questionnaires
- The trials organization and participants

3.3 Evaluation Methodology

3.3.1 Evaluation Structure

The evaluation of the PULSE system and its components is structured into different aspects as follows:

1. The evaluation of the **effectiveness** of the system in terms of benefits created, compared to a situation without PULSE. In order to measure the effectiveness a set of parameters has been developed by which the effects and benefits of the PULSE platform and its components are described and validated.
2. The second part of the evaluation focuses on the **inherent qualities** of the PULSE platform. This comprises a set of characteristics called Measures of Performance and for the purpose of this project they address efficiency, flexibility, dependability, scalability, interoperability, extensibility and usability of the PULSE platform.
3. The "**socio-political**" evaluation, assessing the system with regard to its expected acceptance and appreciation by society and to the reservations or objections society may have against such a system. These "societal" views include a selection of ethical, economical, legal, political, and societal (EELPS) criteria.
4. The evaluation of the project as a whole, and of **general characteristics of the PULSE trials** comprising a set of criteria addressing trial's preparation and execution primarily.
5. The technical evaluation of the system

For the MCI trial exclusively, the effectiveness and performance of the dedicated smart phone (mobile) application was evaluated.

The basic evaluations were performed by the participants in the trial experiments, applying a number of evaluation tools. Only the main information is repeated here. The details of trials concept, planning and setup are documented in D7.1 and D7.2, respectively.

3.3.2 Participant Categories & Relationship

Developed and tested by the consortium in the months before the actual trials, the PULSE System was put to a test then in order to obtain information for the evaluation and validation of the system's functionality in the two fundamentally different scenarios. Participants chosen in both trials followed a similar concept in that the three participant categories included:

- **Actors**, who were professionals acting in the trial in their respective medical, health care or EMS environment representing the various national, regional or local levels and authorities.
- **Observers**, a group that were composed of likewise professional experts, and
- **PULSE Consortium members**, those technical, scientific or generalist individuals having engineered the PULSE system, readied it for the trials and executed the trials.

Table 2: EVD Trial Participants

Participant Role	# Participants
Actor	17
Observer	7
Consortium member	13

Table 3: MCI Trial Participants

Participant Role	# Participants
Actor & Observer[2]	52
Consortium member	14

Breaking down the number of participants over the type of unit, authority or organisation they represented, resulted as follows:

Table 4: EVD Trial Participant Relationship

Type of Unit, Authority, Organisation	# Participants
University	5
Hospital (specialised)	9
General Hospital	1

---

[2] In contrast to those participants acting and observing all use cases in the Local Coordination Centre (LCC)) the group, which acted or observed use case 5 (triage) in the field and joined the LCC for the last use cases (7 and 8); it was not clear to most of them when and to which part (actor vs. observer) they actually belonged. In consequence, actor & observer have been considered as one group for evaluation purposes.

National Health Care & Emergency Management (Ministry)	4
National Health Care & Emergency Management (other)	3
Public Health Care & Emergency Management (Regional)	2
Public Health Care & Emergency Management (Local)	1
Worldwide Health Care & Emergency Management (WHO)	1
Other	11

Table 5: MCI Trial Participant Relationship

Type of Unit, Authority, Organisation	# Participants
Cork City Council	6
Cork County Council	1
Kerry County Council	3
Health Service Executive	8
National Ambulance Service	4
Inter-Agency Emergency Management Office	2
Irish Police	9
South/Southwest Hospital Group	2
Department of Public Health	1
Irish Defence Forces	2
Voluntary Emergency Service	14

3.3.3 Evaluation Framework

Faced with the European approach of the project and the wealth of systems in operation in a multitude of medical support environments, the trial results offered by the professional trial participants as well as additional public health experts proved to be the leading source of information for the evaluation of the functionality and usefulness of the PULSE System from different angles:

- **Actors & Observers,** in due consideration of their national, regional or local relation viewed it from a professional medical health care and emergency management angle. International coordination and cooperation aspects were woven into this picture. On the background of medical support systems they have to rely on in their daily functions, the prime focus of these stakeholder groups was with the individual functions of the overall PULSE System compared to what they knew in their jobs.
- **Consortium members,** concerned with the reliability of the underlying tools, contributed issues primarily related to respective technical and scientific aspects. Understandably, their focus was first and foremost with the functionality of the system as a whole.

Combining the various stakeholder communities and reflecting the necessity to gather information from one practical event only, a cross-sectional methodology had been

chosen. It was based on structured questionnaires offering a fixed response scale, supported by a free text response possibility. In addition, at the end of each scene (EVD trial) or use case (MCI trial) as well as in the final wrap-up event for each trial a survey was executed consisting of discussions and in some cases of brief interviews.

3.3.4 The Evaluation Pillars

The evaluation of the PULSE system and its components is structured into five different blocks:

1. The evaluation of the **Effectiveness** of the system in terms of benefits created, compared to the situation without PULSE. In order to measure the effectiveness, a set of parameters has been developed by which the effects and benefits of the PULSE platform and its components are described and validated (chapters 4.1 for the EVD trial and 5.1 for the MCI trial).
2. The second part of the evaluation focuses on the inherent qualities of the PULSE platform. This comprises a set of characteristics called Measures of **Performance**. For the purpose of this project they address efficiency, flexibility, dependability, scalability, interoperability, extensibility and usability of the PULSE platform (chapters 4.2 for the EVD trial and 5.2 for the MCI trial)..
3. The "societal" evaluation, assessing the system with regard to its expected acceptance and appreciation by society and to the reservations or objections society may have against such a system. These "societal" views include a selection of **ethical, economical, legal, political, and societal (EELPS)** criteria (chapters 4.3 for the EVD trial and 5.3for the MCI trial)..
4. The evaluation focuses on the general characteristics of the PULSE trials comprising a set of criteria addressing trial's **preparation and execution** (chapters 4.4 for the EVD trial and 5.4 for the MCI trial).**.**
5. **Technical evaluation** of the PULSE platform and tools, primarily by the partners developing the software(chapters 4.5 and 6.1.6.

Chapter 0 gives an overall summary and generalization of the evaluations and draws recommendations.

The basic methodological approach has been set already in D5.2, and further detailed in D7.1. the 5 blocks are again briefly described here, in chapters 3.3.6 to 3.3.10. The main tools were structured asking for ratings between 1=not satisfied and 5=fully satisfied, and additional verbal input. The questionnaires were presented to and filled by participants online via the TYPEFORM system [11].

Evaluations No. 1 to 4 above were performed by all participants, No. 5 only by the developers of the IT system. The results as presented and discussed in chapters 4, 5 and 0 have two components: They refer to the scores of the individual questionnaires and they discuss and interpret the verbal answers and comments noted by the participants.

3.3.5 PULSE Evaluation Framework

In this deliverable, we are evaluating the PULSE system as a whole, not the individual tools. The individual tools have been tested and evaluated in technical detail. The results have been documented in the deliverables D4. of WP4, and in D6.2. A brief description of the tool functionalities as used in the trials is also given in Annex9: Platform and Tools Functionalities. Here in D7.3, the PULSE system is evaluated as a whole when exposed to and operating in realistic "scenes", mainly because of these

reasons:

- In these scenes, the system is acting as an integrated platform. Tools challenged in these scenes are highly interacting. The operational effects and benefits of the PULSE platform usually rely on these integrated processes of the integrated system.
- External stakeholders are the main source of the evaluations. They are not familiar with all individual functionalities of the individual tools an mainly interested in how the whole system will support their operational tasks.

And finally, trying to break down such an evaluation to all the individual components would by far exceed the capabilities and resources for such exercises.

3.3.6 System Effectiveness

System effectiveness was measured by questionnaires, dedicated to individual use cases/scenes (for definition, see chapter 4.1). The evaluation criteria were different for the different scenes. They have been derived from the requirements (D2.1) and from the effects the PULSE system is expected to create when in operation (documented in D5.2). Details of the effectiveness criteria are documented in D7.1.The evaluation scale ranges from 1 to 5;

1: not satisfied –

2: less satisfied –

3: satisfied –

4: very satisfied –

5: fully satisfied

It is assumed that the stakeholders participating in the evaluation will perform this evaluation relative to the situation they are usually working with, the situation "as is". Results are discussed in chapter 4.1

3.3.7 System Performance

Comprising a set of characteristics called Measures of Performance (MoP) this part of the evaluation focuses on inherent qualities of the PULSE platform, which include features such as:

- Human-computer interaction,
- The system's
  - ability to be adapted or modified,
  - maturity and dependability,
  - scalability, e.g. to different threats
  - capability to be extended, and
- The ease of learning the system, to understand it and to use it.

The scoring was done by external stakeholder and by consortium members in a pre-structured questionnaire. Scoring tables also asked to give verbal comments and explanations, to explain the scores or to recommend further improvements, also

asking for a summary evaluation at the end (Results see chapter 4.2).

3.3.8   The System in the Socio-Political Environment

A detailed analysis has been performed by CESS and TRI on the possible ways to evaluate the PULSE system as a future part of the socio-political environment. It resulted in proposing the so called EELPS methodology which is based on a multi-criteria evaluation scheme that contains

- Ethical,
- Economical,
- Legal,
- Political and
- Societal

criteria relevant to be analysed and regarded when a complex system such as PULSE would be implemented in real operation. The basic rationale has been documented in D7.1, chapter 7.4. Presently it contains 48 criteria the evaluator can choose from. During the trials, only a very limited EELPS evaluation could be performed which was based on a subset of 13 criteria structured in a questionnaire. The results of this evaluation are presented and discussed in chapters 4.3 and 5.3. Additionally, a sample experiment was set up with the EELPS tool that demonstrates the full range of such an evaluation with a total of 42 criteria. Sample results are shown in chapter4.3.2. The full criteria set and a guide for tool application is documented in Annex 1:

3.3.9   The Project and Trials General Assessment

The objective of this evaluation section was to collect feedbacks related to the general characteristics of the PULSE project as well as a general evaluation of the trials.

A detailed analysis of the Project and the trials' general assessment is presented in Chapters 4.4 and 5.4 . The analysis is based on processing the answers in evaluation questionnaires collected from the participants. It covers:

- Trial general assessment;
- PULSE project general evaluation;
- Scenarios and uses cases evaluation;
- Final comments.

On each section, the rating analysis by participants type and / or organization category were considered. A summary of the free text answers was also included in each section in order to achieve a complete and concise evaluation.

3.3.10 PULSE System and Tools Technical Evaluation

Most of the evaluations discussed above concentrate on performance, benefits etc. of the PULSE system in certain representative scenarios, scenes and use cases. These evaluations mainly address the PULSE system as a whole. In addition, we created an evaluation of the technical advancement PULSE has achieved. This type of evaluation can only be performed by persons knowing about the technical details of the system architecture and the functionalities of the individual tool. Consequently, this evaluation part is performed by the developers and persons from the team who have deeper insight into the system details. We therefore called it "internal" evaluation. The reason is that only those team members have insight into the technical characteristics and the detailed technologies applied. The results of this technical evaluation are documented

in chapter 4.5 and summarized in 6.1.6.

The summary of all PULSE trial results are presented in chapter 6 and its subchapters.

4   The EVD Trial

The main goal of the trial is to demonstrate the PULSE platform and to validate the effectiveness, performance and societal acceptance of the platform's functionality. The validation and demonstration was based on the simulation of situations that are normally managed without PULSE, and the subsequent application of PULSE was the key difference with respect to the normal way of operating.

Therefore, the SARS-like EVD trial was based on following key concepts:

- Simulating an epidemic emergency management situation (pandemic influenza).
- Applying a proven operational scheme (Italian Pandemic Plan) based on WHO pandemic phases.
- Involvement of actors and observer that have already managed similar situations in the proven scheme and actors with current or past roles in managing pandemic influenza.
- Participation of PULSE Consortium members for the evaluation of the system performance as an entity and on a technical system developers scale.

The full-scale numerical and graphical evaluation of all questionnaires is attaches as Annex5: Detailed Total EVD Trial Evaluations.

4.1   Effectiveness Evaluation

In this Chapter 4.1, the measurement of PULSE System's effectiveness in terms of benefits created for the end-user community and for the affected patients constitutes the first evaluation pillar. Applying a series of trial scenes, as depicted in the following sub-chapters 4.1.1 to 4.1.7, developed along the scenario use cases as defined in D2.2 (Use Case Specifications) and D5.2 (PULSE SOPs), the intent was to demonstrate the PULSE System's functionality, and to exercise or practice some of its individual services, which are supposed to facilitate decision making in medical emergency environments.

For consistency purposes, the relations of "use Cases" and "scenes" is given in Table 6.

Table 6: Reference Table of Scenes and Use Cases:

Scene	U/C	
1	2	An Airplane is landing..., a probable case ....is identified
2	6	ECDC Recommendations
3	4	Identification of a new probable case in a community
4	1	Weak signal detection and surveillance

5	5	Assessment of the available medical resources during the pandemic phase
6	7	National authority periodic assessment
7	8	Post emergency learning at national level

4.1.1   Scene 1 – Airplane Landing

. **Purpose:**

To demonstrate and exercise the information & alerting chain that allows confirming (or not) a case, triggering appropriate actions and also identifying other infected persons related to the suspect case.

Scenario:

Coming back from a breeder fair abroad, an airplane is landing at Frankfurt airport with a group of Italian farmers aboard scheduled to continue to Rome. Among the Italian passengers there are ten passengers having high fever and other severe health problems requiring the notification and alerting of both Italian and German health authorities.

<p align="center">Table 4.1.1 Airplane Landing Questionnaire Evaluation Results</p>

#	Measurements of Effectiveness	1[3]	2	3	4	5	# Answers	Average
4.1.1.1	Reduction of time and error rate in electronically filling and handling forms & documents	1	2	13	12	6	34	**3,6**
4.1.1.2	Immediate availability of documents, regulations and guide lines for the initial confirmation of cases, alert & operational procedures	0	0	9	11	14	34	**4,1**
4.1.1.3	Immediate establishment of communication with appropriate medical facilities, authorities, and respective national actors	1	5	11	9	8	34	**3,5**
4.1.1.4	Speedy allocation of patients to hospitals with disease and treatment specific capabilities	2	4	12	7	9	34	**3,5**
4.1.1.5	Continuous up-date of the epidemic situation on all levels concerned	0	4	5	13	12	34	**4,0**
4.1.1.6	Potential to comprehensively assess events that my constitute a public health emergency	0	4	11	13	6	34	**3,6**

Observations:

---

[3] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

Measures of effectiveness as defined in above table mirrors the given functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 3,7, which brings the functionality of the PULSE platform close to <u>very satisfied</u> in this instance. In summary, it was assessed as an impressive system, extremely useful in practice for reporting and alerting in particular, saving time, facilitating the search for information, formats and documents, mailing lists, addresses etc.

Extending beyond the functionality implemented for the trials, notable additional aspects and recommendations that seemed to be desirable for implementation were documented in the free response sections and during subsequent discussion periods, summarized as follows:

- Solutions to facilitate the workload of providing and collecting numerous data on-scene and entering them into the system.
- Regulations for strict access control for operators of the system.
- Integrating contact tracking and passenger locator information into the given software.
- Adaptation of disease related disembarking procedures.
- Establishment of a link to veterinary surveillance systems.

4.1.2   Scene 2 - ECDC Recommendations

Purpose:

To demonstrate and practice the integration of PULSE and the link to the ECDC for the assessment of the epidemic evolution in ECDC periodic meetings, resulting in the generation of disease specific recommendations and guidelines.

Scenario:

After identifying a new swine flu virus H1N1 (EAH1N1) in China and according to cases confirmed in the USA, WHO and the European CDC have confirmed a new pandemic threat and recommended to the member States to take appropriate actions according to their National Pandemic Preparedness Plan. Consequently the ECDC conveys an international meeting of Public Health Experts in order to revise the epidemiological situation and the available evidence and to provide recommendations to the Member States.

Table 4.1.2 ECDC Recommendations Questionnaire Evaluation Results

#	Measures of Effectiveness	1[4]	2	3	4	5	# Answers	Average
4.1.2.1	Overview of disease cases in Europe and potential epidemiological spread	0	1	13	15	8	37	**3,8**
4.1.2.2	Overview of resources available to be shared at ECDC	2	3	14	11	7	37	**3,5**
4.1.2.3	Provision of particular virological data and suggestions for disease specific recommendations and guidelines	1	2	13	17	4	37	**3,6**

---

[4] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

#		1[5]	2	3	4	5	# Answers	Average
4.1.2.4	Speedy allocation of patients to hospitals with disease and treatment specific capabilities	2	4	12	7	9	37	**3,5**

Observations:

Measures of effectiveness as defined in above table mirrors the given functionality of the PULSE system at the time of the trial execution. Emphasising PULSE providing a good high-level communication channel for ECDC recommendations and guidelines, the overall cumulated average rating amounted to 3,6, which is close to <u>very satisfied.</u>

Extending beyond the functionality implemented for the trials, notable additional aspects and recommendations that seemed to be desirable for implementation were documented in the free response sections and during subsequent discussion periods as follows:

- Potential problems regarding national reservations providing relevant data.
- Need to integrate PULSE with other international surveillance systems, with the ECDC internal database and as already indicated, with animal related data concerning trade and exchange between Europe and actual risk countries.
- In addition to the ECDC, also consider integrating and addressing the European HSC (Health Security Committee).

4.1.3 Scene 3 - Community Case

Purpose:

Originated by a suspected case of the new potential pandemic Influenza virus identified in the community; the purpose of this scene is to activate and practice the alerting chain implemented by PULSE that allows to confirm (or void) a case and to immediately trigger necessary actions (if any).

Scenario:

Referring to a general hospital with fever and dyspnea treatment, a potential patient is suspected to have the new EAH1N1. Sent to an institute specialising in infectious diseases, diagnostics positively confirmed the suspected diagnosis.

Table 4.1.3 Community Case Questionnaire Evaluation Results

#	Measures of Effectiveness	1[5]	2	3	4	5	# Answers	Average
4.1.3.1	Reduction of time and error rate in electronically filling and handling forms & documents	1	4	7	12	5	29	**3,6**
4.1.3.2	Immediate availability of documents, regulations and guide lines for the initial confirmation of cases, alert & operational procedures	0	2	5	10	12	29	**4,1**
4.1.3.3	Immediate establishment of communication with appropriate medical facilities, authorities, and	1	5	8	8	7	29	**3,5**

---

[5] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

	respective national actors							
4.1.3.4	Speedy allocation of patients to hospitals with disease and treatment specific capabilities	0	1	7	14	7	29	**3,9**
4.1.3.5	Continuous up-date of the epidemic situation on all levels concerned	1	2	7	13	6	29	**3,7**
4.1.3.6	Potential to comprehensively assess events that my constitute a public health emergency	0	4	10	10	5	29	**3,6**

Observations:

Measures of effectiveness as defined in above table mirror the given functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 3,7, which is close to very satisfied. The individual as well as the cumulated overall rating very much so resemble the results of scene 1, which used to be an 'airplane case'. More than coincidental it documents and reinforces the excellent usefulness of PULSE in the specific environment of an early disease spread, displaying the epidemiological situation, also offering a great potential in the search for and consultation of documents, and as a teaching aid.

Extending beyond the functionality implemented for the trials, notable additional aspects, comments and recommendations that seemed to be desirable for implementation were documented in the free response sections and during subsequent discussion periods as follows:

- Doubts about the suitability on regional or local level also resulting from the potential lack of formal internal controls in order to forestall unlimited entering of un-authorised data.
- Establish automated access to diagnostic laboratories.
- Integrate a specific data base on secondary cases.
- Consider adding an alarm function for cellular phones and similar communication devices.

4.1.4 Scene 4- Weak Signal Detection and Surveillance

Purpose:

Initiated by the detection of early indications of most likely SARS-type cases, to demonstrate and practice the flow of action starting on WHO/ECDC level down to related activities by national and regional authorities in response to a potential epidemic.

Scenario:

Since in the immediate wake of imported SARS-like cases a number of local secondary transmission cases have occurred. The Ministry of Health requested the improvement of surveillance systems for the detection and geo-localization of cases and clusters, in order to promptly isolate cases and to recognize chains of contacts.

Table 4.1.4 Weak Signal Detection & Surveillance Questionnaire Evaluation Results

#	Measurements of Effectiveness	1[6]	2	3	4	5	# Answers	Average
4.1.4.1	Information on: - Expected disease evolution, - Geographical spread, - Listing of zone-specific signals exceeding thresholds	0	3	8	12	6	29	**3,7**
4.1.4.2	Attention paid to social pattern and geographic characteristics	0	2	11	10	14	29	**3,7**
4.1.4.3	Timeliness of notifications to responsible authorities and suggestions automatically sent to decision makers and laboratories	0	1	13	8	8	29	**3,7**
4.1.4.4	Depiction of: - Hospital resources, - Responder status, - Probable & confirmed cases	0	2	6	7	13	29	**3,9**
4.1.4.5	Visualised epidemic information and screen sharing possibilities	2	1	5	13	14	29	**3,8**

Observations:

Measures of effectiveness as defined in above table mirrors the intended functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 3,8, which brings the functionality of the PULSE platform close to very satisfied. In summary, PULSE was liked because of the rapid and timely epidemic overview and the immediate availability of relevant data and literature; and because of integrating social media along with the implementation of the weak signal concept. Interacting with Twitter it also would accelerate the information flow in particular.

Extending beyond the functionality implemented for the trials, notable additional aspects, comments and recommendations that seemed to be desirable for implementation were documented in the free response sections and during subsequent discussion periods as follows:

- To avoid unnecessary information diffusion, creation of a level dependent data filtering system (is recommended), which also immediately provides decision support in form of level relevant graphics of the epidemic evolution.
- Collecting data (signals) from EMS, general practitioners, animal surveillance sources, and laboratory surveillance networks.
- Extension of weak signal parameters to satisfy a wider variety of diseases.

4.1.5 Scene 5 – Assessment of Available Medical Resources

Purpose:

Subsequent to a WHO declaration of a pandemic disease, national authorities require information on the availability of medical resources from health facilities, and the purpose of this scene is to portray and practice respective activities to be followed.

---

[6] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

Scenario:

Caused by a limited number of imported cases, social contacts contributed to the further spread of the disease also in other geographic locations of the country. So far, cases admitted did not positively respond to anti-viral drugs administered. Vaccination efforts continue.

Table 4.1.5 Assessment of Available Medical Resources Questionnaire Results

#	Measurements of Effectiveness	1[7]	2	3	4	5	# Answers	Average
4.1.5.1	Direct access to real-time resources data and status of medical facilities concerned	3	2	7	14	7	33	**3,6**
4.1.5.2	Effective and reliable forecasting of medical resources requirements	3	3	11	11	5	33	**3,4**
4.1.5.3	Direct and instant communication with national authorities on the resources situation	3	3	8	15	5	33	**3,5**
4.1.5.4	Suggestions for distribution, re-distribution and/or acquisition of medical resources and stocks	3	4	10	12	4	33	**3,3**
4.1.5.5	Continuous up-date on the logistic situation and the measures taken to control the epidemic	3	3	9	11	7	33	**3,5**

Observations:

Measures of effectiveness as defined in above table mirror the given functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 3,5, which indicates a functionality rating in the <u>middle between satisfied and very satisfied,</u> in this instance.

This, compared to other scenes, lower rating originated from doubts about the possibility of continuously collecting and processing data from a variety of sources. Assessed to be a 'good system for local needs' (only), it, however, is viewed as carrying the potential for a rapid communication system.

Extending beyond the functionality implemented for the trials, one notable additional recommendation that seemed to be desirable for implementation as documented in the free response sections and during subsequent discussion periods was:

- Integration and/or link to a medical sample and patient tracking system.

4.1.6 Scene 6 – National Authority Periodic Assessment

Purpose:

To demonstrate the decision support PULSE provides to national authorities and to

---

[7] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

practice selected functions during a national level assessment meeting.

Scenario:

In parallel with the steep rise of numbers of confirmed cases accompanied by information on increased severity and mortality, regions affected inform national authorities on the lack of antiviral drugs and vaccines. Calling for an emergency meeting, the National Steering Group assesses the epidemic evolution and the requirement for new resources.

Table 4.1.6 National Authority Periodic Assessment Questionnaire Evaluation Results

#	Measurements of Effectiveness	1[8]	2	3	4	5	# Answers	Average
4.1.6.1	Continuously up-dated trend on epidemic evolution and review of hospital resources	0	2	8	13	6	29	**3,8**
4.1.6.2	Instant overview of suggestions for procurements and delivery of medical resources to hospitals in risk zones	0	1	9	14	5	29	**3,8**
4.1.6.3	Survey of repeated reconsideration and redesign of plans and decisions taken	0	1	14	10	4	29	**3,6**
4.1.6.4	Provision of templates for information and communication purposes and lists of spokes persons and authorised talking points	1	1	12	12	3	29	**3,5**

Observations:

Measures of effectiveness as defined in above table mirror the given functionality of the PULSE system at the time of the trial execution. Emphasising that PULSE offers a useful and well organised system for data input and data flow in particular, the overall cumulated average rating amounted to 3,7, which brings the functionality of the PULSE platform close to very satisfied in this instance.

Extending beyond the functionality implemented for the trials, notable additional aspects, comments and recommendations that seemed to be desirable for implementation were documented in the free response sections and during subsequent discussion periods as follows:

- Provision of automated support regarding health care management level focused graphics and summary reports.
- Integration of impact assessment using syndrome surveillance information.
- Guidelines for pandemic phase relevant hospitalisation procedures.
- Surge capacity functions also for diagnostics, laboratories, drugs and other critical medical supplies.
- Integrated resource assessment model combining various surge capacity functions with the impact model.
- Framework for authorised entry of data directly by affected health care facilities.

---

[8] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

4.1.7 Scene 7 – National Level Post Emergency Learning

Purpose:

The National Authority evaluates the downgrading of the response and how the country responded to the epidemic. The purpose of this scene is to demonstrate and practice the flow of steps that the National Authority may go through in order to evaluate how the country responded to the epidemic, and to identify the lesson learned.

Scenario:

Following the decline of the progression of the disease and with no more cases reported, the end of the Pandemic emergency has been declared. The Ministry of Health conveys a meeting to evaluate the downgrade of the response, to discuss the lesson learned and to revise and reactivate the preparedness actions.

Table 4.1.7 National Level Post Emergency Learning Questionnaire Evaluation Results

#	Measurements of Effectiveness	1[9]	2	3	4	5	# Answers	Average
4.1.7.1	Automated generation of a data log containing disease surveillance measures, patient referral to hospitals, and medical resources data	0	0	12	14	5	31	**3,8**
4.1.7.2	Immediate access to all data related to the epidemic response	1	2	5	14	9	31	**3,9**
4.1.7.3	Considerable relief in the compilation of data and information for the purpose of producing a lessons learned report/document	0	2	7	17	5	31	**3,8**

Observations:

Measures of effectiveness as defined in above table mirror the given functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 3,8, which brings the functionality of the PULSE platform close to <u>very satisfied</u> in this instance. In summary, PULSE was assessed as a very useful and powerful tool in that it generates a detailed log of data, of information and decisions taken, which very much eases the management and evaluation of a crisis It also helped to overcome often fragmentary and imprecise information on all levels concerned.

Extending beyond the functionality implemented for the trials, notable additional aspects, comments and recommendations that seemed to be desirable for implementation were documented in the free response sections and during subsequent discussion periods as follows:

- Ready formats of summary reports and overview maps in order to improve the user friendliness for higher public health management levels in particular.
- Templates for lessons learned documents and automated production of lessons learned records.
- Background data on population and other demographic indexes

---

[9] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

4.1.8 Effectiveness Summary Evaluation

In pursuing the strategic goals defined in PULSE DoW, Part B, 1.1.4 as to " … define, develop and validate a methodology, architecture and a set of technologies and tools to improve the preparedness and response of key stakeholders during a medical crisis", the EVD Trial was to demonstrate operational effects and benefits of PULSE acting as an integrated platform to support decision making in both preparedness and response phases.

Based on a collection of integrated software applications, contemporary decision support systems are interactive computer-based information systems, which help decision makers by utilizing information, data and related models to improve the quality and effectiveness of decisions (rather than replacing decision-making). Looking for the determining forces driving such systems, one approach [7] lists five conceptual categories, also called 'drivers' as follows:

- Communication – supports more than one person working on a shared task,
- Data – emphasises access and manipulation of a series of data,
- Documents – manages, retrieves, and manipulates information in a variety of formats,
- Knowledge – specialised expertise stored and held accessible,
- Models – access and manipulation of a variety of models to assist in analysing situations.

The seven scenes applied in the EVD Trial were intended to bring about the spectrum of functions founded in the conceptual categories discussed above that would support a better, timely, more comprehensive, more effective decision-making. The summary evaluation result is displayed in below graph.

Figure 3: Summarized EVD Trial Effectiveness
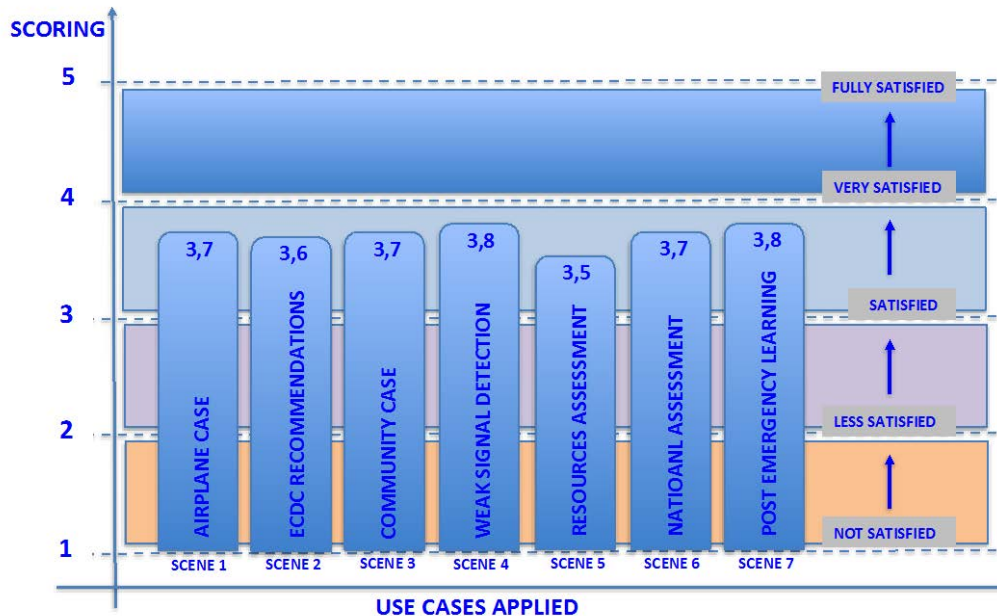
The overall cumulated average rating amounts to 3,7, which brings the functionality of the PULSE platform close to very satisfied. In summary, it was assessed as an impressive system, extremely useful, and offering a great potential in that PULSE:

- Provides a good high-level communications channel
- Facilitates a rapid and timely situational overview
- Accelerates the information flow
- Ensures immediate availability of relevant data, documents, and literature
- Considers and integrates social media
- Maintains a well-organised data input and data flow structure
- Holds a detailed event log and repository immediately accessible.

Extending beyond the initial functionality implemented for the trials, notable additional recommendations that are considered desirable for future implementation or customisation were documented in the free response sections and during subsequent discussion periods. These points have been captured in the Chapters 4.1 through 4.7.

The two critical reflections mentioned across the board are dealing with:

- Local trial venue and WLAN conditions, and
- Improvement of individual familiarisation of trial participants with the soft- and hardware provided.

They are covered in Chapter 4.4 PULSE EVD Trial General Assessment. They show some limitations of the trial setup, however are not weaknesses of the PULSE system itself.

4.2 Performance Evaluation

The second part of the evaluation is concerned with the inherent qualities of the PULSE platform, comprising a set of characteristics called Measures of Performance (MoP) focusing on:

- **Efficiency** - Human-computer interaction.
- **Flexibility** – Adjustable to new, different, or changing situations and requirements.
- **Dependability** - System maturity and readiness.
- **Scalability** – Smooth improvement of software and expansion/ reduction of functionalities depending on needs.
- **Extensibility** – Facilitating transfer to other crisis management domains and applications.
- **Usability** - Ease of learning, understanding and applying/using the system.

These performance criteria are broken down into questions as described below.

The system performance was evaluated once across all EVD use cases (and MCI scenes) applied. The performance questionnaire was presented at the end of the EVD trial. In addition to the scores and comments in the questionnaire, supplementary comments and recommendations were captured during the final discussion period.

Table 4.2 PULSE System Performance Questionnaire Evaluation Results

#	Measurements of Performance	1[10]	2	3	4	5	# Answers	Average
4.2.1	**Efficiency**						29	3,4
	4.2.1.1 Timeliness and speed of the system's operation	2	2	8	15	2	29	3,4
	4.2.1.2 System's resources availability & ease of access	0	3	14	8	4	29	3,4
4.2.2	**Flexibility**						29	3,7
	4.2.2.1 System's adaptability to new or changing situations & requirements	0	5	8	8	8	29	3,7
4.2.3	**Dependability**						29	3,3
	4.2.3.1 System's development stage & readiness for operation	0	7	11	8	3	29	3,2

---

[10] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

	4.2.3.2 Continuity of service without malfunctions or blocking errors	0	6	10	10	3	29	3,3
4.2.4	**Scalability**						**29**	**3,8**
	4.2.4.1 Ability to fit to different organisations/agencies requirements	2	2	6	13	6	29	3,7
	4.2.4.2 Ability to add new functionalities or to address new hazards	1	2	5	13	8	29	3,9
	4.2.4.3 Ability to expand from local to larger geographic environments	3	2	6	10	8	29	3,6
	4.2.4.4 Ability to manage and expand the system's resource pool	1	4	3	11	10	29	3,9
4.2.5.	**Extensibility**						**29**	**3,7**
	4.2.5.1 Transferability & adaptability to other crisis management domains	1	3	6	13	6	29	3,7
	4.2.5.2 Transferability & adaptability to different national or international organisations and frameworks	1	3	8	11	6	29	3,6

4.2.6	**Usability**						**29**	**3,6**
	4.2.6.1 Time and effort necessary to learn and understand the system	0	4	9	10	6	29	3,6
	4.2.6.2 System ergonomics and ease of handling	0	3	8	12	6	29	3,7
	4.2.6.3 Provision of interactive and appropriate feedback to the user	2	1	9	12	5	29	3,6
	4.2.6.4 Ability to adopt 6 use the system in new operational end-user situations	0	3	9	13	4	29	3,6

Observations:

Measures of Performance as defined in above table mirror the inherent characteristics of the PULSE system at the time of the trial execution. Based on the significant number of 'very satisfied' ratings (167 out of 435 possible votes) the overall cumulated average rating amounts to 3,6, which brings the functionality of the PULSE platform close to <u>very satisfied</u>. Notwithstanding its prototype status, some initial deficiencies with wireless connectivity and use of tablets issued, PULSE was assessed to be a very good system, very flexible, very useful, offering a great potential primarily because of its adaptability to many other functions, the large number of features interconnected, the repository of information and data saving time and facilitating information sharing. Figure 4 below displays the summarised ratings across the six performance criteria applied.

Figure 4: Cumulated Performance Evaluation
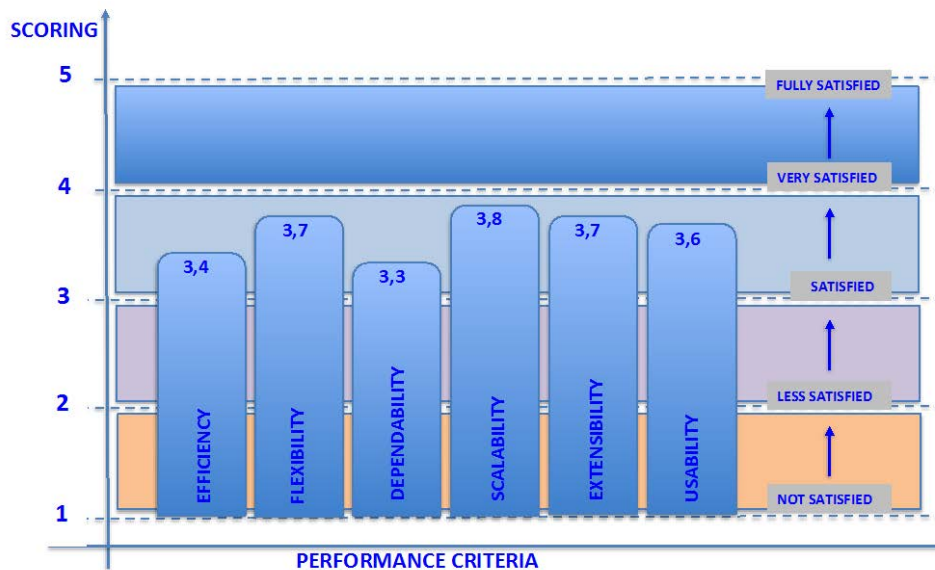
Extending beyond the functionality implemented for the trials, notable additional aspects, comments and recommendations that seemed to be desirable for implementation were documented in the free response sections and during subsequent discussion periods as follows:

- To fully master the system and its functions, end-user need training that should consider different user communities and a variety of operational environments.

- Implementation is recommended, of ready-to-use graphical and reporting support adequate to the health care   management level concerned. To facilitate this, the system should offer a function allowing the indication of the management level concerned for which decision support and related fidelity and granularity of information is automatically generated.

- Historical and supporting statistical data should be added to the database.

- Incorporation of mathematical models is suggested, for the prediction of epidemic proliferations.

As an exception to the rule, one distinct individual voice (WHO representative) should be quoted in this respect, stating the 'very great potential' of the PULSE system and the 'excellent data' it provides; but also encouraging system developers to implement more management level specific decision support functions as discussed above.

4.3 EELPS Evaluation

The third evaluation "pillar" evaluates the PULSE system   against the following factors:

- **E**thical implications

- **E**conomic factors (qualitative)
- **L**egal compliance
- **P**olitical relevance
- **S**ocietal impacts

The EELPS evaluation has two underlying methodologies:

(1) MCDA tool: this comprises a catalogue of a total of 42 criteria that have been implemented in the EELPS tool. The PULSE platform was evaluated with the tool in 3 different application roles, a local, a national and an international one. The results, however, have mainly illustrative character as the process of analysis of all criteria and the development of all the MCDA utility functions are very elaborate and not within the scope of and would exceed the resources available in, the project.

(2) A questionnaire comprising 13 selected questions (see also Table 7, left columns): The questions were selected by the LEPPI[11] team from the catalogue of 42 criteria, based on their relevance to PULSE and also coordinated with the work in WP8 (some other categories not covered completely here are covered in more detail in Deliverable 8.2).

4.3.1   EELPS questionnaires Evaluation

The EELPS evaluation used this supporting questionnaire, with questions addressing the most relevant EELPS factors, including ethical values, system transparency, market advantages, legal and regulatory compliance, health strategies, and societal impact.

The ratings of the questionnaire range from 1= strongly disagree, 2 disagree, 3 neither disagree nor agree, 4 agree to 5 strongly agree (except for question 4.3.1: see footnote[12]).

Table 7: EELPS Questionnaire Feedback

#	Question / Rating	1	2	3	4	5	# Answers	Average
	ETHICAL							
4.3.1.	Will PULSE change societal ethical values in a negative way?	16	6	6	0	0	28	1,6[12]
4.3.2.	Is PULSE open and transparent in terms of how it handles health-related information?	0	1	6	13	8	28	4,0
4.3.3.	Is PULSE open and transparent in terms of system functionality?	0	2	2	21	3	28	3,9

---

[11] Legal, Ethical, Privacy, Policy Issues

[12] The rating of this question is inverse: "1" meaning most positive and "5" meaning most negative

4.3.4.	Will PULSE help channel medical resources appropriately in a public health emergency?	1	1	4	13	9	28	4,0
	ECONOMIC							
4.3.5.	Will PULSE contribute to, or influence economic stability in any way?	4	5	14	4	1	28	2,8
4.3.6.	Will PULSE create market advantages for its suppliers, developers and operators?	1	1	10	13	3	28	3,6
	LEGAL							
4.3.7.	Does PULSE comply with existing regulations and the rule of law?	0	2	17	8	1	28	3,3
4.3.8.	Is the measure compatible with human rights principles and the core values of the Union as human dignity, freedom, equality and solidarity?	0	2	8	12	6	28	3,8
	POLITICAL							
4.3.9.	Does PULSE fit into related international and EU health strategies?	0	0	10	10	8	28	3,9
4.3.10.	Does PULSE fit into related national health strategies?	0	1	7	13	7	28	3,9
4.3.11.	Does PULSE have the potential to create political risks?	6	5	14	3	0	28	2,5
	SOCIETAL							
4.3.12.	Does PULSE have the potential to increase control over people and/or society?	7	4	7	10	0	28	2,7
4.3.13.	Will PULSE bring direct benefits to people and/or society?	0	0	6	15	7	28	4,0

The form also provided a section for "Summary Assessment, Recommendations, Remarks" by participants**.**

Observations

As was communicated with the trial participants, we recognise that not everybody might have been able to give a fully qualified answer to all these EELPS questions. The analysis here must be read in conjunction with the work carried out in WP8 of PULSE and documented in Deliverable 8.2.

Nevertheless, participants were instructed to provide their best responses and comments or make recommendations where desired.

From Table 7 it can be generally interpreted that the expected impact of the PULSE system would have or cause mainly positive socio-political[13] impact. But there are also some potentially negative impacts to be regarded. Discussion of responses:

ETHICAL

The majority of the respondents veered (22) strongly disagreed that the modelled PULSE system would change societal ethical values in a negative way (none of the respondents agreed or strongly agreed with this assumption). The openness and transparency of the system in terms of how it handles health-related information also received a favourable response with only one disagreeing and 6 being unsure). Openness and transparency in terms of system functionality much more strongly veers towards a positive assessment. Participants also rated PULSE's ability to channel medical resources appropriately in a public health emergency quite positively (22 participants giving an 'agree' and 'strongly agree' rating).

ECONOMIC

With regard to economic factors, the questionnaire throws up some interesting results. The majority (half the sample i.e. 14) of the participants seemed unsure about the influence of the PULSE system on economic stability (9 participants disagreed while 5 agreed). It might be that the economic impacts of a system like PULSE might not have been considered by them before or participants might not have clues on the connection between a health emergency preparedness systems and the larger implications on economic stability.

Nearly half the participants (13) agreed PULSE system would create market advantages for its suppliers, developers and operators, though a large number (10) were unsure. Only 2 disagreed).

LEGAL

A majority of respondents (17) neither agreed nor disagreed whether PULSE complied with existing regulations and rule of law (note, however 8 agreed while none strongly disagreed).

On whether PULSE is compatible with human rights principles and the core values of the Union, such as human dignity, freedom, equality and solidarity, the majority agreed (6 strongly agree, 12 agree). Only 2 disagreed while 8 neither disagreed nor agreed.

POLITICAL

The majority of participants (18) agreed that PULSE fit into related international and EU health strategies (though 10 neither agreed nor disagreed, none disagreed or strongly disagreed). The majority (13 agree and 7 strongly agree) of participants felt that PULSE fit into related national health strategies (7 neither agreed nor disagreed and 1 disagreed). Half the participants were undecided (neither agreed nor disagreed) about PULSE's potential to create political risks[14]. However nearly half disagreed (6 strongly and 5 not so strongly). 3 participants agreed, none strongly agreed.

SOCIETAL IMPACT

The first societal impact question resulted in a mixed bag of responses. 11 disagreed

---

[13] please note that for the criterion 4.3.1 the scoring scale is reversed so that 1.6 would correspond to 3.4 on the regular scale

[14] Political and/or legal risks might result in cases such as e.g. risk of operational failure in case of severe crises, risk of being sued by constitutional courts or other regulatory bodies.
.

(7 strongly, 4 less so) that PULSE had the potential to increase control over people and/or society. 7 neither agreed nor disagreed while 10 agreed. We recommend that this question is carefully considered not only in the project but also adequately addressed when PULSE is implemented in society, based on the recommendations made in Deliverable 8.2.

A large majority (15 agree and 7 strongly agree) responded that PULSE will bring direct benefits to people and/or society. No respondents disagreed or strongly disagreed (only 6 neither agreed nor disagreed). This is very positive result for the PULSE project.

SUMMARY remarks and recommendations from the participants

The trial exercise participants also provided additional valuable information via the "Summary Assessment, Recommendations, Remarks" section of the questionnaire. Below is a summary of the comments:

- Some doubts about compliance with national privacy and confidentiality and data protection regulations, rule of law.
- Covering the legal aspects in the (different) EU countries will be difficult.
- Generally, useful in healthcare improvement and crisis management support.
- Information summaries from PULSE to the political/crisis management level will lead to better decisions and better public support and actions.

These comments should be carefully considered not only by the PULSE project consortium but also in the future implementation of the PULSE platform.

4.3.2 The EELPS Tool demonstration

As indicated in chapter 3.3.8 and further detailed in Annex 1:, a full scale demonstration of the EELPS tool has been exercised. Within the scope of the project, this can only be a sample demonstration. Any real and solid EELPS evaluation will need detailed analyses of all criteria involved, of their weightings, utility functions etc. The demonstration shows how the tool can be applied. The tool itself and the criteria catalogue implemented are the joint result of the PULSE and another EU-FP7 project, ECOSSIAN [4]. The demonstration tries to compare the socio-political benefits and risks or disadvantages of the PULSE system in the EVD scenario, in three different application cases: Only local, national, and international application. Table 8 shows the 3 cases compared, with assumed evaluators from local authorities, national government and EU level.

Figure 5 gives a summary evaluation over the 5 categories (EELPS). As some sample interpretation, the left and middle graph show moderate importance of political criteria (category 4, ratings 1.8 and 2.) while the EU (understandably) rates the political importance much higher (2.9). On the contrary, e.g. a local health operator evaluates the economic impact (3.1 in Case 1) much higher than the EU policy level (-1.2 in case 3) which means EU may expect even economical disadvantages due to high investment cost.

In Figure 6 a sample is demonstrated of how the rating of a category, here Category 5, societal impact, is composed of a distribution of ratings of 10 sub-criteria, with possible positive and negative impacts. The whole result array comprises a total of 3 category summary graphs (one per case) and 15 graphs at criteria level (one per case and category).

Table 8: EELPS Evaluation Cases

Case Parameter	Case 1: Local Applic.	Case 2: National Applic.	Case 3: Internat'l Applic
Security Measure &Application	PULSE at local level	PULSE at national level	PULSE at international level
Evaluator Type	Local Auth./Hospital Oper.	Nat'l governmt./Min. og health	EU-rep.(ECDC?)/ UN-rep.(WHO?)
Evaluation Objective	Local utility & benefit	Nat'l societal & political benefit	International strategic benefit
Scenario/Use Case	EVD	EVD	EVD

Figure 5: Ratings of EELPS categories
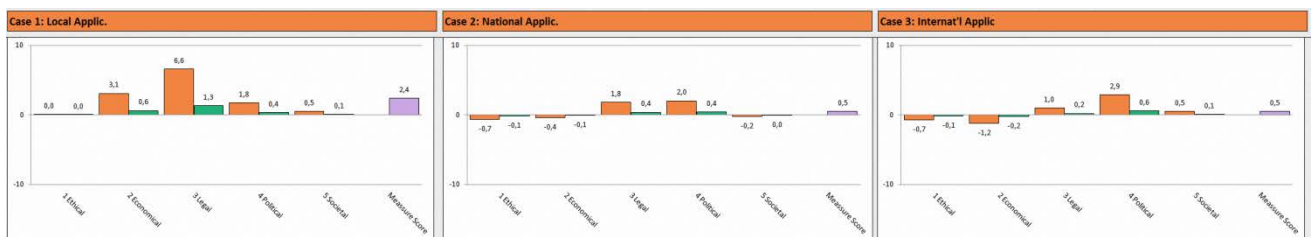
Figure 6: Societal Criteria Evaluation Profile, Case1
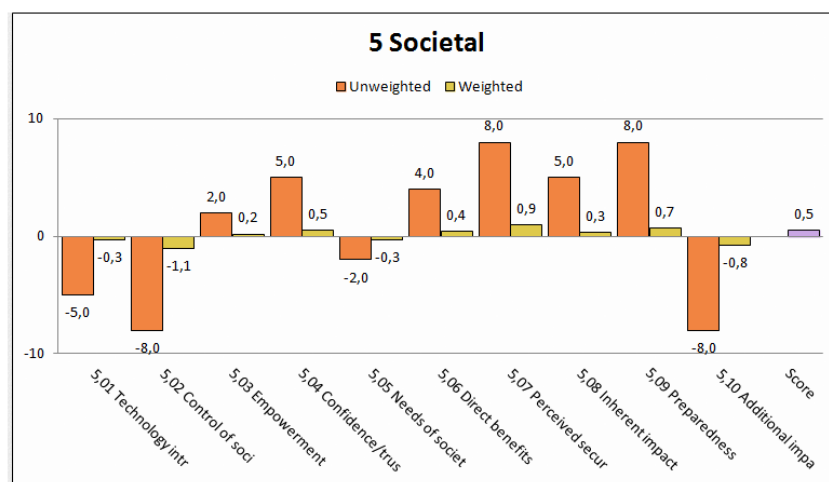
For further details, see Annex 1: EELPS Details, and d7,1/7.2

4.4 General Assessment

The purpose of this part of the evaluation was to receive feedback on a number of general characteristics of the PULSE approach, including

1. The general preparation and setup of the experiments
2. The general concept of the PULSE project
3. The scenarios and use cases /scenes
4. Usability and future use of the PULSE platform

5. Typical drivers and obstacles of future application
6. Typical positive findings
7. Recommendations for improvement
8. Final summary rating

The general assessment of the EVD trial was evaluated with a questionnaire detailing these topics and offering the possibility of scoring the quality features of the PULSE system at a scale between 1 (not satisfied) to 5 (fully satisfied), as well as the option to enter text answers and comments to specific topics. This questionnaire was filled by:

1) The external stakeholders, grouped in two categories:

    a. Actors : external stakeholders actively involved in the trial and giving feedback

    b. Observers : external stakeholders only observing the trial development and giving feedback

2) PULSE consortium members

Numbers differ from those shown in chapter 3.3.2 due to the fluctuation during the course of the trial not allowing all participants to fill the questionnaires. More details about the participants may be found in *D7.1 Trial Definition*. The General Evaluation Questionnaire was filled by 28 participants distributed as shown in Figure 7.

Figure 7: Distribution of the EVD Trial Participants
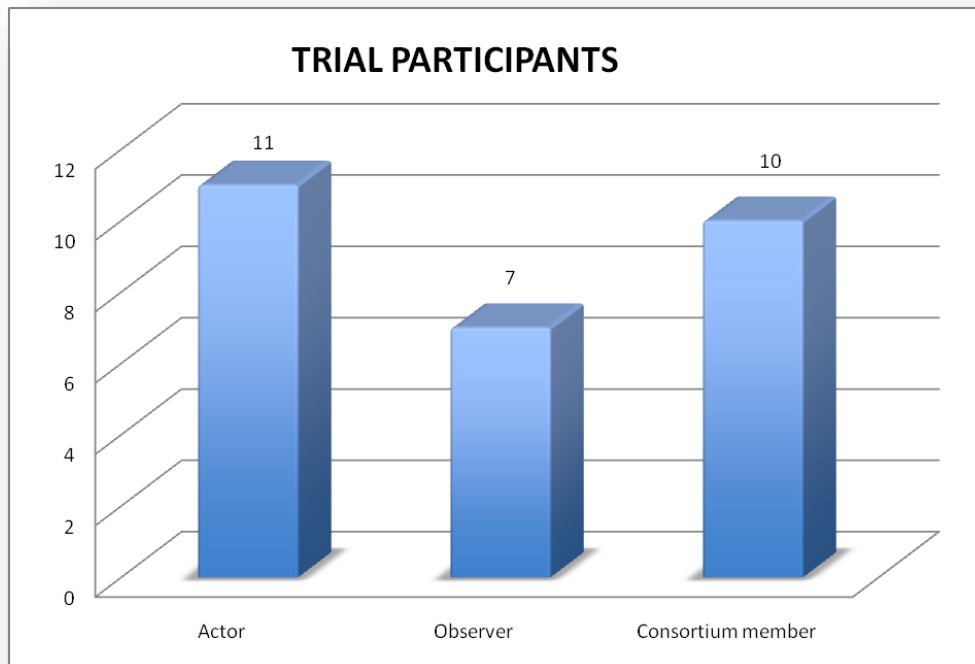
The General Evaluation Questionnaire is documented in

Annex2: EVD &MCI Trials - General Evaluation Questionnaire. The distribution of the

organizations of the participating external stakeholders who filled the general assessment questionnaire is detailed in chapter 3.3.2 on participant categories.

Figure 8: : An Overview of the General Assessment - Averages
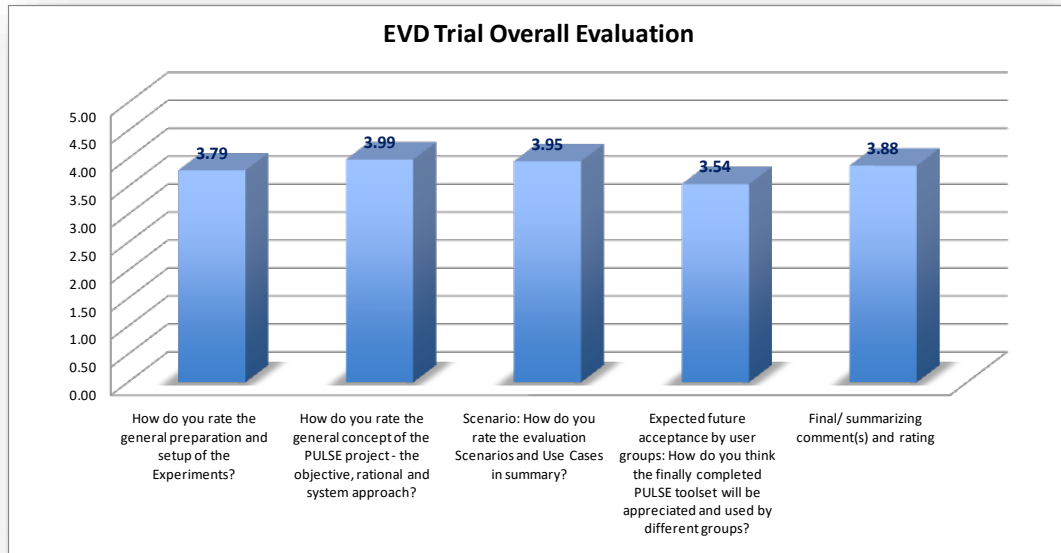
The overall rating average is **3.83**, close to **very satisfying**; highest ratings were received for the trial setup from the perspective of the general concept of the PULSE project (the objective, rationale and system approach) while a slightly lower rating was received for the expected future acceptance of the PULSE system.

The distribution of the results by the participant type is fully documented in *Annex3: EVD Trial- Participant Types*. The overall distribution of the general assessment questionnaire per participant type is presented in Figure 9.

Figure 9: Distribution of the General Assessment per Participant Type

EVD Trial General Evaluation results distribution per participants categories
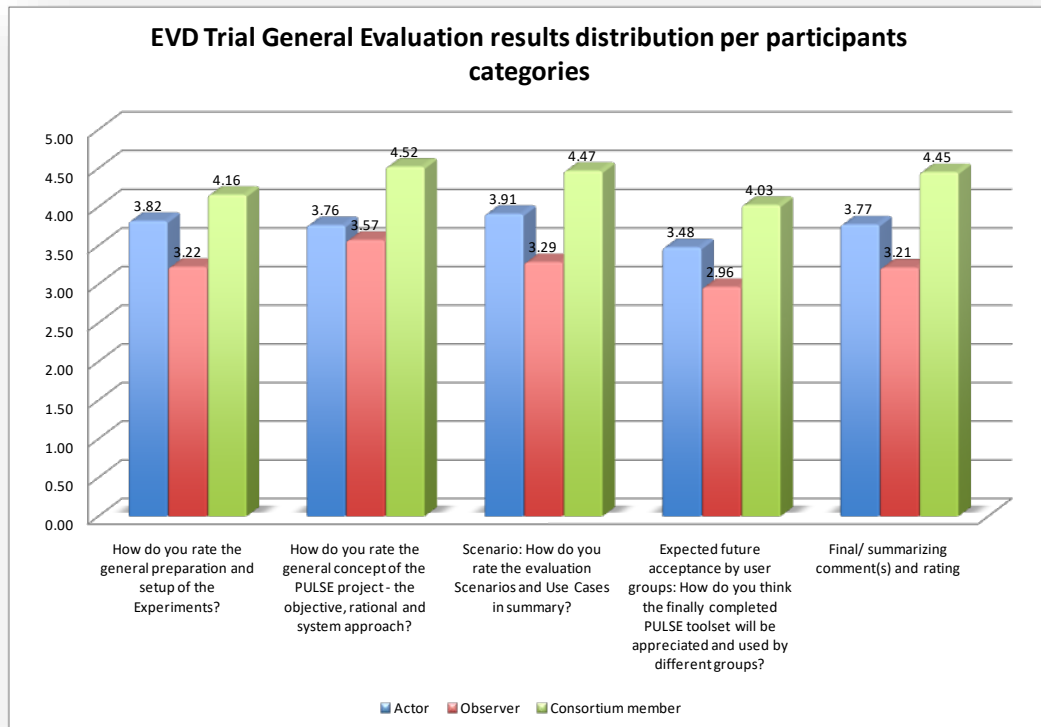
Overall, the consortium members gave the higher rates, followed by the actors and the observers; this reflects the consortium members had the opportunity to practice before the trial and have better knowledge of the PULSE platform. The opportunity to use the tablets and to follow practically the experiments gave to the actors a better view over the PULSE platform than to the observers. The difference between the consortium members and the actors is also a reflection of the need for additional training before the trial as discussed further down.

The general concept of the PULSE project (the objective, rational and system approach) and the summary evaluation of scenarios and use cases gathered the highest rates from all participants. This reflects that the PULSE platform as well as the EVD trial were well received.

The overall ratings for the general preparation and setup of the trial follow on third position; the rates were possibly affected by some initial deficiencies of the WIFI connectivity occurring early on day one, as well as by the effort to get familiar with the tablets and the PULSE functionality. The differences between groups may be explained by the fact that the consortium members better know the system since they had the opportunity to practice before the trial. The actors, compared to the observers, had the opportunity to get hands-on experience working with PULSE and, thus, to better understand it. For them, the initial hesitations in the trial executions might be seen as "reaction" time while the other participants were busy trying to accommodate with the platform and the setup.

The lowest rates were awarded to the expected future acceptance by the user groups by all 3 participant's categories. The expectancy of a functional and mature system shows some scepticism, but after the initial reluctance to such a new system the project results were very well appreciated. It is especially important that participants suggested different applications of the platform and there was an open-minded

approach to the utilization of such a system in the future.

The distribution of the results by the category of the participant's organization is fully documented in Annex3: EVD Trial- Participant Types.The best rates were awarded by delegates from hospitals and local and regional healthcare emergency management services, well reflecting the main user groups of the PULSE platform.

Concerns relating to the potential for trans-national implementation (technical barriers for interconnecting with existing systems, cross-procedural harmonization, multi-language support) are reflected by the rates awarded by the representatives of the national health care emergency management.

A further detailed analysis of the answers is done in the following sections. The last digit of the chapter numbers 4.4.x refers to the question numbers of the questionnaire (

Annex2: EVD &MCI Trials - General Evaluation Questionnaire).

4.4.1 The PULSE Trial general evaluation by individual questions

Q 1. How do you rate the general preparation and setup of the Experiments?

Figure 10: Results Distribution for Q1
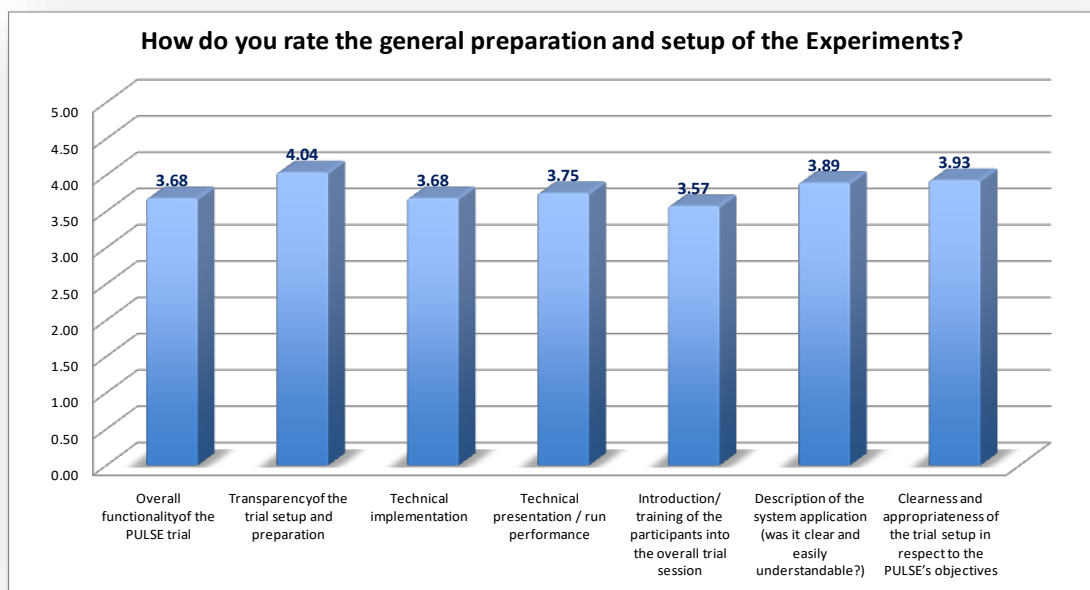
Observations:

1. The overall average score for the question is **3.79** – very close to "very satisfied"
2. Highest rated was the overall trial setup, transparency of the preparation as well as the Clearness and appropriateness of the trial setup in respect to the PULSE's objectives.
3. Slightly lower rates were allotted to the technical implementation and the

introductory training session. As in the first day of the trial, during the first evaluation scenes, the handling of the heretofore tablet-based software combined with lack of more extensive prior training and intermittently weak WLAN connection, might have prevented higher ratings in some cases. Free text responses confirmed such problems in a number of instances.

4. The relevant aspects documented in the verbal response sections were:

    a. Beside a better introductory training it would have helped also to have an enriched preliminary data set already introduced into the system

    b. Very well received overall presentation of the tools

    c. The presence and active participation of the experts was a positive and fostering factor, leading to the collection of valuable feedbacks and improvement suggestions.

    d. Although the need for better training was omnipresent, it was well appreciated that the trial initiation process was done in a fast and straight forward manner

4.4.2 The PULSE project general evaluation

Q 2. How do you rate the general concept of the PULSE project - the objective, rational and system approach?

Figure 11: Results Distribution for Q 2
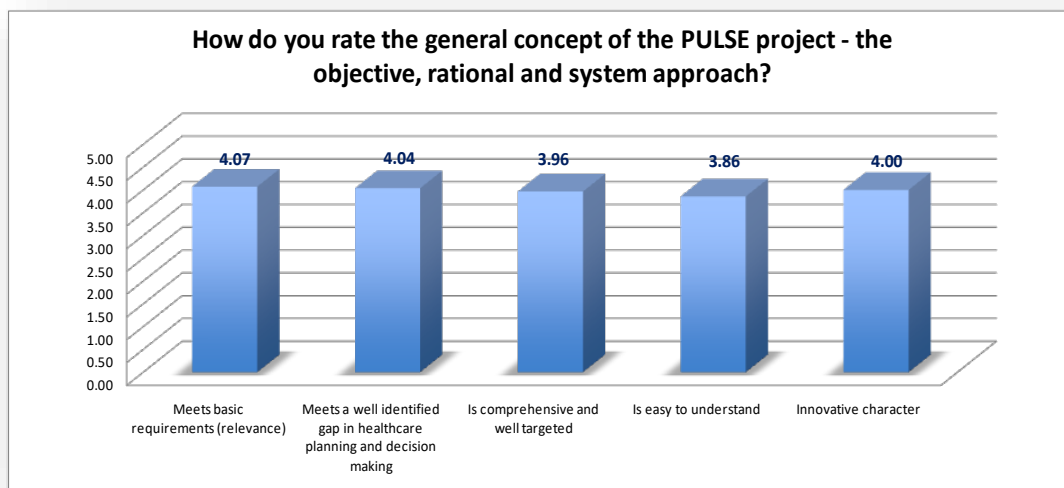
. **Observations:**

1. The overall average score for this question is **4.0** – "very satisfied"

2. The trial presented PULSE as an innovative system, properly addressing a well identified gap in healthcare planning and decision making

3. The difficulty in understanding the system was the main drawback in this section; this might have been induced by the above mentioned trial limitations: need for better training, need for time to learn how to use the tablets and WIFI connection to the online scoring system

4. The relevant aspects documented in the verbal response sections were:

   a. Recommendation to better tailor the PULSE outputs tailored to individual profile and need of the end-user.

   b. PULSE is a complex platform composed of a complex yet open and adaptable toolset allowing real time view over a pandemic event is regarded as an important benefit for the healthcare system.

   c. The PULSE capability to acquire, store and easily access information is also regarded as an important benefit; those features must be completed with a strong reporting support via different types of template formats and an enhanced user interface.

   d. Suggestion for extending the platform to additional medical sectors as the veterinary medicine in order to help the actors in understanding the evolution of the outbreaks.

   e. The need for consistency, validity check and format unification for data input are regarded as a potential obstacles for PULSE implementation, as may be the need for multi-language support.

   f. Possible limitation of future public acceptance of PULSE due to the existence of already well-known systems in use that partially provide already some of the functionalities offered by the PULSE platform.

4.4.3 The scenarios and use cases evaluation

Q 3. Scenario: How do you rate the evaluation Scenarios and Use Cases in summary?

Figure 12: Results Distribution for Q 3
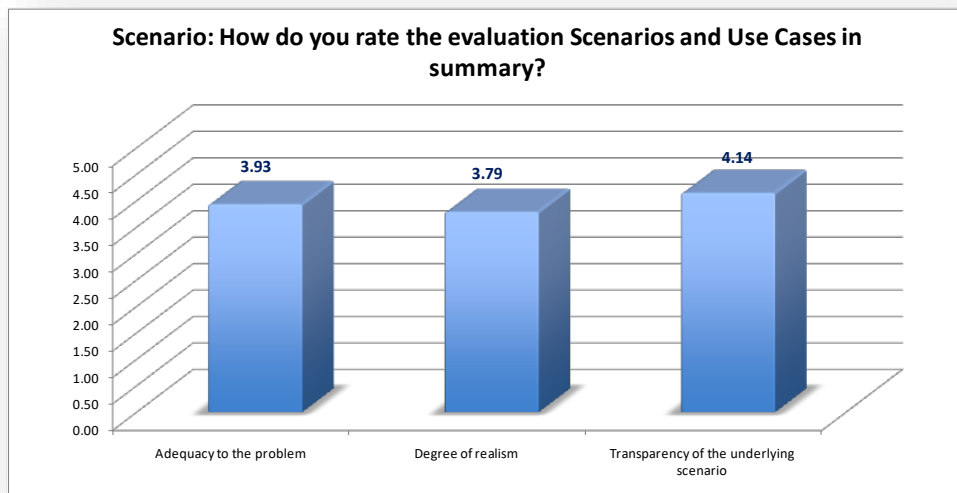
Observations:

1. The overall average score for the question is at the "very satisfied" level of 4.0.

2. The scenario transparency was very well appreciated; the audio & video presentations at the beginning of each scene supported the understanding of the scenario assumptions and developments.

3. The scenario's degree of realism received average rating 3.79, slightly below

the other two criteria, probably due to the overall complexity of the sequence of the 7 scenes simulated. The relevant aspects documented in the verbal response sections were:

  a. The scenario, epidemiologically oriented, is suitable for (analysing) national and international public health agency cooperation.

  b. The participants again stressed the need for better training and/or documentation.

  c. Apart from the PULSE evaluation, the scenario – in its form and development and presentation – triggered debates among the expert participants, allowing collection of valuable inputs and suggestions for scenario improvements.

4.4.4   PULSE usability and acceptance/present status

Q 4. Expected future acceptance by user groups: How do you think the finally completed PULSE toolset will be appreciated and used by different groups?

Figure 13: Results Distribution for Q 4
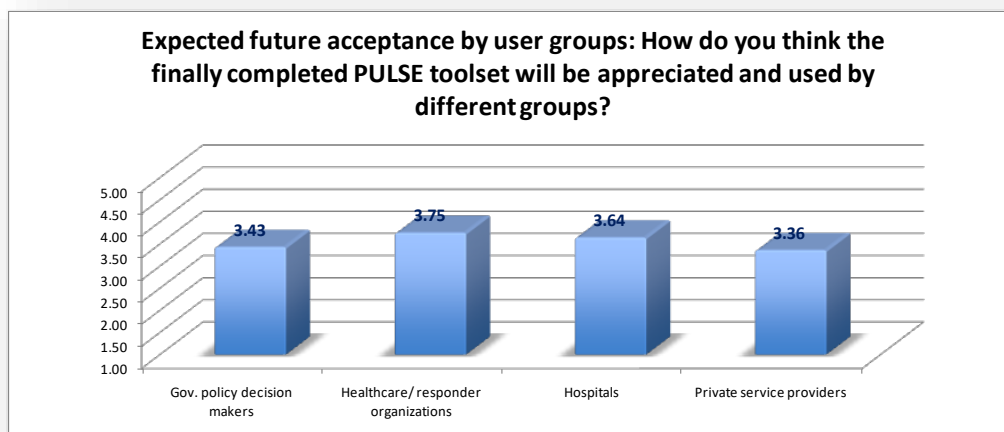
Observations:

1. The overall average for the question is **3.54** – a rating between <u>satisfied</u> to "<u>very satisfied</u>"

2. The highest rate of expected acceptance was attributed by the "Healthcare/ responder organizations". This is the main user group targeted by the PULSE platform, while the lowest rate came from the policy makers segment.

3. The rates reflect both the opinions of the main target group of PULSE (operational healthcare and major emergency management) as well as the development status of PULSE (R&D project technology development / early demonstration of TRL 5+);

4. The relevant aspects documented in the verbal response sections were:

  a. Important market drivers:

      i. fills important gaps;

     ii.   contributes to healthcare harmonization across Europe;

     iii. Is adaptable to different national and local systems and regulations;

     iv. transparency of the resources allocation functionality.

  b. The main expected obstacles:

     i.   diverging procedures & deficits in common standards across Europe;

     ii. lack of political power to enforce harmonization and to enforce a EU-wide introduction of such a system; need for additional resources to be allocated for training (personnel, time);

     iii. resources needed for interoperability / integration with existing systems that cover segments of the PULSE platform

Special recommendations

This section has two evaluation questions with free text answering option and one general final evaluation question with two rating criteria.

The free text answers were analyzed in the above paragraphs and are fully documented into the *Annex 4 EVT Trial General Assessment Questionnaire – Free text answers*.

Here is a summary of the participants' answers:

4.4.5 Typical drivers and Obstacles

- Typical drivers for future end-users to adopt and apply the PULSE system/ tools:

  - The main PULSE drivers are considered to be the hospitals, national and international public health agencies

  - Has friendly user interface and easy to be understood functionality

  - Provides transparent sharing of info on the crisis being managed, in real time and providing easy to see summary details on the crisis as it evolves.

  - Contributes to healthcare harmonization across Europe

  - Is adaptable to different national and local systems and regulation

  - Main beneficiaries of the PULSE are the operational & technical level of the healthcare and emergency management services

- Typical obstacles for future end-users to adopt and apply the PULSE system/ tools

  - Fragmentation of potential adopters, multitude of different national heritage procedures and legacy systems in place that partially provides some of the functionalities offered by the PULSE platform

  - Diverging procedures & deficits in common standards across Europe.

  - Lack of political power to enforce harmonization and to enforce a EU-wide introduction of such a system

o PULSE addresses mainly the health care and emergency management technical and operational level; in its current development state is not as well suitable for clinicians and policy makers level

o Economic resources to acquire the system, to train the users, implement and support of the platform

o The need to tailor the system for other sanitary emergencies such are the food borne diseases

o One major issue is the data formalization and validation upon entering the information into the system

o The need to tailor the output to each type of decision maker

4.4.6 Particularly positive/ convincing experiences/ findings from the trial

o A complex platform of tools, with an open architecture, offering support for sharing the information and achieving a real-time overview of an outbreak

o Different tools in a single system, this increases clarity and usability of the information available during an outbreak

o The statistics and the document archive were compelling

o Intensive dialogue with practitioners long before and during the trial exercise. Very good feedback on needed improvements

o Especially important is that everyone suggested different applications of the platform and there was an open minded approach to the utilization of such a system in the future, opening the opportunity to collect valuable data for PULSE system improvement

4.4.7 What should be improved?

o Tailor output to each level of the different stakeholders

o Extend the functionality to other medical sectors (laboratory data, veterinary, support for drugs devices)

o Interoperability with other national and international systems from technical, procedural and legal perspectives.

o Robust mechanism for data validation, especially for the manually inputted data.

o Enhanced user interface and presentation, more graphical output, better top-management reports.

o Multilanguage support.

4.4.8 The final comments and ratings

Q 8. Final/ summarizing comment(s) and rating

Figure 14 Results Distribution for Q 8

Final/ summarizing comment(s) and rating
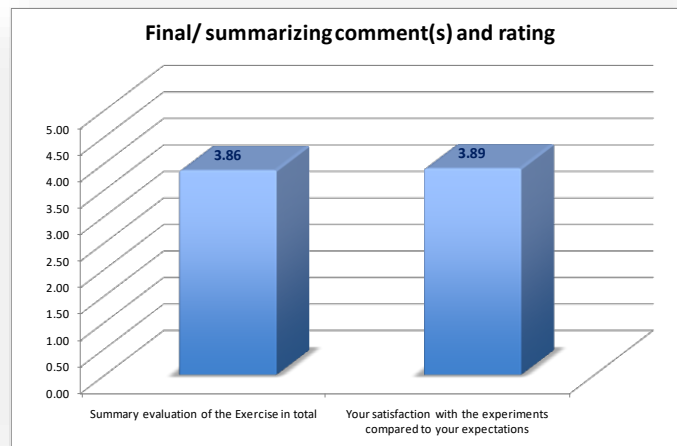
Observations:

1. The overall average rating for the question is **3.88** – close to "very satisfied"
2. Both summary evaluation criteria reflect very good rates, for overall the EVD trial organization as well for the level of satisfaction of the participants.

4.5 System and Tools-Internal Technical Evaluation

The purpose of this part of the evaluation was to assess the performance of the PULSE platform from the developers' point of view. We provided a set of questions to the technical personnel that contributed to the development and verifiction testing of the PULSE platform and we asked for an evaluation based on a set of characteristics already seen and evaluated in Table 9.**Error! Reference source not found.** *Because of the nature of this evaluation this evaluation was done only once, independent of the individual scenarios EVD and MCI.*

The set of characteristics that describe the inherent qualities of the PULSE platform are defined below. They are similar to those used for system performance evaluations by external stakeholders, but additionally include e.g. Interoperability. Criteria include these defined criteria:

- **Flexibility** – Adjustable to new, different, or changing situations and requirements.

- **Dependability** - System maturity and readiness.

- **Scalability** – Smooth improvement of software and expansion of functionalities.

- **Interoperability** – Ability of the system to work with other systems or products without being specially configured to do so.

- **Usability** - Ease of learning, understanding and applying/using the system.

The questionnaire, reported in Table 9, was presented after the conclusion of the trials through the form of a TYPEFORM web questionnaire.

Table 9: PULSE System - Internal Technical Evaluation Results

#	Measurements of Performance	1[15]	2	3	4	5	# Answers	Average
4.5.1	**Flexibility**							**4.00**
	PULSE system's adaptability to new or changing situations and requirements	0	0	1	3	1	5	4.00
4.5.2	**Dependability**							**3.6**
	The PULSE system's development stage and its readiness for operation	0	0	3	2	0	5	3.40
	Continuity of the service without malfunctions/ blocking errors	0	0	3	2	0	5	3.40
	Ability to undergo modifications for dependability improvements	0	0	1	3	1	5	4.00
4.5.3	**Scalability**							**4.3**
	Ability to be enhanced by adding new functionalities or to address new hazards	0	0	0	2	3	5	4.60
	Ability to maintain performance regardless of expansion from a local area to a larger geographic area	0	0	1	3	1	5	4.00
	Ability to scale up to comply with new generations of hard- and software components	0	0	2	2	1	5	3.80
4.5.4	**Interoperability**							**3.40**
	The PULSE's vocabulary is similar or same compared to other known systems	0	0	3	2	0	5	3.40
4.5.5	**Usability**							**4.20**
	Ergonomics and ease of handling the system	0	0	0	4	1	5	4.20

Observations:

The response from the technical people has been good in general, the overall cumulated average rating amounted in fact to 3.9, which brings the functionality of the PULSE platform really close to <u>very satisfied</u>. The evaluation performed by platform developers can be considered risky as a person can be more (or less) critical od biased with the things (s)he actually built. Therefore, in the summary chapter 6.1.6 we made a rough comparison to the external performance evaluation and realized no big differences. In other words, there are no indication that the internal evaluators

---

[15] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

show a positive bias.

Result obtained in this phase were excellent.

Three aspects are worth mentioning from the results:

- The *dependability* property reached the average value of 3.6, it is worth remembering that the developed system is a prototype with a related TRL and requires further development to move to a complete TRL 9 commercial product. The *interoperability* property reached the value of 3.4 which is the lowest result in this part of the evaluation. The platform already includes some integrations with existing 3rd party vocabulary and systems (as described in D6.1) but considering the large variety of available external technologies and the difficulty to acquire the rights to integrate with 3rd party systems, the actual available integration is definitely a valid starting point for follow-up business.
- The *scalability* with 4.3 and *usability* with 4.2 are excellent results that underline the capacity of the platform to be (1) easily upgraded with new functionalities, thanks to its modern and scalable architecture, and (2) the great effort that has been spent in providing a user-friendly and accessible interface.

For a better understanding and support of readers interested in more details of the tools, we have created an Annex9: Platform and Tools Functionalities, which briefly describes how the tools' functionalities were applied in the trials. It also contains references to the detailed descriptions of the tools.

5   The MCI Trial

Normally managed without PULSE, the validation and demonstration in the MCI trial was based on demonstrating and exercising live situations in a running scenario that were supported by PULSE, constituting the key difference with respect to the customary way of operating.

Therefore, the stadium crush scenario (MCI) trial was based on following key concepts:

- Presenting a mass casualty incident during a rock concert in a stadium filled with a big crowd.
- Employment of local first responders accustomed to operating together in major emergencies, guided by established emergency roles and procedures.
- Involvement of actors and observer that have already managed similar situations in proven schemes.
- Participation of PULSE Consortium members for the evaluation of the system performance as an entity and on a technical system developer's scale.

The full-scale numerical and graphical evaluation of all questionnaires is attached as Annex8: Detailed Total MCI Trial Evaluations.

5.1 Effectiveness Evaluation

5.1.1 Scoring System in Plan Preparation

Purpose:

To demonstrate the scoring that will be used to establish parameters for an event medical plan to be prepared and submitted to a regional authority for permission, and to provide the regional authority with a means of assessing the risk likely for a specific event.

Scenario:

Permission has been granted for a concert in a football stadium by a pop group known for its reputation for a negative attitude towards authority followed by a likewise minded larger group of fans. This concert is an outdoor event and the concerts promoters have indicated that it will take place irrespective of the weather. The stage is built in the centre of the pitch with runways, ramps and raised podiums to bring the group every closer to the fans. In the pre-event planning phase the police service have conducted an initial assessment of the potential crowd at the concert. Investigations and monitoring continues.

Table 5.1.1 Scoring System in Plan Preparation

#	Measurements of Effectiveness	1[16]	2	3	4	5	n/a	# Answers	Average
5.1.1.1	Type and completeness of scoring categories	0	4	4	12	8	0	28	**3,9**
5.1.1.2	Possibility to implement and manipulate weighing factors of individual scores	0	1	8	12	7	0	28	**3,9**
5.1.1.3	User review of the running score	1	0	11	7	9	0	28	**3,8**
5.1.1.4	Continuous up-dating of scores	0	0	5	11	11	1	27	**4,2**
5.1.1.5	Visualization & distribution of cascading alert levels	1	2	9	11	5	0	28	**3,6**
5.1.1.6	Possibility to activate appropriate surge capacity generation procedures	0	1	4	14	9	0	28	**4,1**
5.1.1.7	Review of medical resources & responder status based on current summary score	0	0	6	13	9	0	28	**4,1**

---

[16] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

Observations:

Measures of effectiveness as defined in above table mirrors the given functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 4.0, which brings the functionality of the PULSE platform to <u>very satisfied</u> in this instance

In summary, it was assessed as a 'very helpful', 'very good' or even 'excellent tool' for emergency management.

Extending beyond the functionality implemented for the trials, notable additional aspects and recommendations that seemed to be desirable for implementation were documented in the free response sections and during subsequent discussion periods as follows:

- Further refinement and better definition of individual scoring criteria.
- Adding also drugs as a significant influencing factor impacting on the overall scoring.
- Integration of this scoring tool into a comprehensive risk assessment model.

5.1.2 Use of MPORG Simulation

Purpose:

To use the MPORG training platform for personnel involved in crisis management and a training learning management system tailored for the emergency and health services.

The first purpose is to train decision makers in managing healthcare resources in using a game like environment and shared game world with many actors playing different roles. The second purpose is to provide experts with a simulation tool that allow them to extract feedback information for SOPs updates or testing resource management heuristics.

Scenario:

Preparing for a specific high-risk event public health experts and decision maker are scheduled for a training assignment.

Table 5.1. Use of MPROG Simulation

#	Measurements of Effectiveness	1[17]	2	3	4	5	n/a	# Answers	Average
5.1.2.1	Choice of roles & creation of avatars	0	0	6	3	4	0	13	3,8
5.1.2.2	Graphical interface	0	1	4	2	6	0	13	4,0

---

[17] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

5.1.2.3	Selection of medical responses & therapy applicable	0	2	3	1	6	1	12	3,9
5.1.2.4	Multiple victim categories and evolution of patient health status	0	0	4	0	6	3	10	4,2
5.1.2.5	Real-time updates on scenario & resource evolvement	0	1	2	4	6	0	13	4,2
5.1.2.6	Selecting medical responses & appropriate therapy	0	1	3	3	4	2	11	3,9
5.1.2.7	Retrieval of resource information available at hospitals	0	0	4	4	5	0	13	4,1
5.1.2.8	Multiple training options and tracking of training elements and units	0	0	3	3	6	1	12	4,3
5.1.2.9	Assignment of training courses	0	0	3	2	3	5	8	4,0
5.1.2.10	Feedback to improve decision making capability	0	1	2	6	4	0	13	4,0
5.1.2.11	Real-time updates and tracking of decisions taken	0	0	2	6	5	0	13	4,2
5.1.2.12	Automated comparison of decisions taken with optimised solution	0	0	3	5	5	0	13	4,2

Observations:

MPORG MCI UC 2 was validated in a separate session, before the MCI Trial started, with end-users who also participated in the MCI Trial later on.

Measures of effectiveness as defined in above table mirrors the given functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 4,1, which brings the functionality of the PULSE platform to very satisfied in this instance.

It was assessed a very good tool for dispatch training.

Extending beyond the functionality implemented for the trials, notable additional aspects and recommendations were:
- Integration of traffic conditions,
- Further evolution of the patient modelling,

and addressing customisation to national and or county requirements, specific rules for patient assignment and dispatch.

5.1.3 Mobilisation of Additional Resources

Purpose:

To exercise the mobilisation of additional resources focusing on:

- Pre-arranged resources declared as available assets,

- others responding to a general request, and

- also for unsolicited offers that can be validated within agreed national legal and ethical parameters.

Scenario:

In the pre-event planning phase the police service have conducted continuous assessments of the potential crowd at the concert, ultimately leading to requirement for additional resources in order to be prepared for a potential major medical emergency. The on-going data flow will turn the "estimate of demands" into an increasingly accurate list of needs versus availability.

Table 5.1.3 Mobilisation of Additional Resources

#	Measurements of Effectiveness	1[18]	2	3	4	5	n/a	# Answers	Average
5.1.3.1	Capturing data & access to the resource data base	0	0	4	12	15	1	31	4,4
5.1.3.2	Ability for on-line registration of volunteer resources	0	1	1	16	13	1	31	4,3
5.1.3.3	Cross-matching of actual resources against original resource data base entries	1	2	4	14	10	1	31	4,0
5.1.3.4	Tracking of individual smart phone locations/positions	0	0	2	11	19	0	32	4,5
5.1.3.5	Initiation of general requests by broadcast & social media	0	1	4	15	11	1	31	4,2
5.1.3.6	Status of available and committed resources	0	0	3	12	15	2	30	4,4
5.1.3.7	Assignment of resources to specific tasks	0	1	3	12	14	2	30	4,3
5.1.3.8	Issuance of instructions via the smart phone app to ambulances of every service and feeding back status	0	2	7	7	13	3	29	4,1

[18] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

	reports								

Observations:

Measures of effectiveness as defined in above table mirrors the given functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 4,3, which brings the functionality of the PULSE platform to <u>very satisfied</u> in this instance.

Predominantly, it was assessed as an 'effective tool', 'a potentially invaluable resource', or even 'excellent tool' for factoring in relevant data and to communicate with all staff off duty and voluntary services facilitating a real-time visibility of resources available confirming the high average rating.

Extending beyond the functionality implemented for the trials, notable additional aspects and recommendations that seemed to be desirable for implementation were documented in the free response sections and during subsequent discussion periods as follows:

- Possibility of turning off geo-location until responders confirm availability

5.1.4 Hospital Surge Capacity and Bed Management

Purpose:

To demonstrate the management and provision of case related specific information to support decision making by hospital controllers and regional authorities and crisis management teams with regard to hospital admissions focusing on critical care beds, intensive care beds, general beds, and general beds suitable to decant exiting patients.

Scenario:

In a major health emergency the triage information gathered from both the casualty clearing station and the hospital requires to review and determine the amount of available beds to receive triaged patients from the incident site.

Table 5.1.4 Hospital Surge Capacity and Bed Management

#	Measurements of	1[19]	2	3	4	5	n/a	# Answers	Average

---

[19] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

	Effectiveness							
5.1.4.1	Photographic evidence & bar-coding information	0	0	2	10	8	3	20	4,3
5.1.4.2	Matching patient condition with bed type availability	0	0	3	13	5	2	21	4,1
5.1.4.3	The possibility to capture & store currently available resources at different locations or medical facilities	0	1	2	12	6	2	21	4,1
5.1.4.4	Ability to access and display non-committed resources at different levels	0	2	4	14	1	2	21	3,7
5.1.4.5	Actual capacity picture at different stages	0	0	6	8	6	3	20	4,0
5.1.4.6	Report on the level of discontinuity of requirements and availability	0	1	6	10	2	4	19	3,7

Observations:

Measures of effectiveness as defined in above table mirrors the given functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 4,0, which brings the functionality of the PULSE platform just to <u>very satisfied</u> in this instance.

In summary, it was assessed as 'very impressive', having 'great potential', being an 'excellent user module' or even 'excellent tool', which provides real-time overview with patients and hospital capacities, allowing immediate planning and tasking thus helping to buy time on the lead-in.

Extending beyond the functionality implemented for the trials, notable additional aspects and recommendations that seemed to be desirable for implementation were documented in the free response sections and during subsequent discussion periods as follows:

- To feed the necessary data into the system it needs dedicated and trained staff.

5.1.5 Triage in CCS and Links to ePCR

Purpose:

To demonstrate and exercise decision support by on-site co-ordinators and commanders utilizing the PULSE mobile application to input specific patient information in order to facilitate an up-dated RCS of triaged patients.

Scenario:

At the incident site a casualty clearing station has been established.

Table 5.1.5 Triage in CCS and Links to ePCR

#	Measurements of Effectiveness	1[20]	2	3	4	5	n/a	# Answers	Average
5.1.5.1	Real-time mobile capture of data from the on-site triage and the CCS	0	0	0	5	23	1	28	4,8
5.1.5.2	The ability to transmit patient and triage data to a central storage repository	0	0	0	4	24	1	28	4,9
5.1.5.3	Continuous up-date on actual patient location and status	0	0	0	11	16	2	27	4,6
5.1.5.4	Automated availability and presentation of consolidated patient and triage data at the Control Centre, the Hospital Group, and other stakeholders concerned	0	0	2	9	17	1	28	4,5
5.1.5.5	Availability and presentation of consolidated summary in graphical and tabular format at appropriate local, regional or national levels in near real time	0	0	1	9	18	1	28	4,6

Observations:

Measures of effectiveness as defined in above table mirrors the given functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 4,7, which brings the functionality of the PULSE platform almost to fully satisfied in this instance.

---

[20] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

In summary, it was assessed as a 'very impressive and almost perfect', 'very good and user friendly' or even 'fantastic element' for emergency management purposes.

Extending beyond the functionality implemented for the trials, notable additional aspects and recommendations that seemed to be desirable for implementation were documented in the free response sections and during subsequent discussion periods as follows:

- Integration with other management information systems.

- Adding a specific barcode to also activate the colour on the screen.

- Entering data confined strictly to a person/agency with accountable control over the casualty at the moment in time.

5.1.6 Input Critical Data for the RCS

Purpose:

To demonstrate the flow of data and information from different sources for the generation of a constantly current recognised picture to facilitate and support decision making by on-site co-ordinators and commanders.

Scenario:

In the course of the start of preparations for the concert, the set-up activities in the stadium and first fans arriving the local coordination centre has been activated assuming coordination functions, building and continuously maintaining a recognised picture to be prepared for emergency operations if so required.

Table 5.1.6 Input Critical Data for the RCS

#	Measurements of Effectiveness	1[21]	2	3	4	5	n/a	# Answers	Average
5.1.6.1	Collection and display of current critical data from on-site co-ordinator, ambulance mobilisation and dispatch services and from other authorities and stakeholder concerned	0	1	1	8	7	1	17	4,2
5.1.6.2	The capability to immediately produce data and information stored to focus on critical issues identified at any given time	0	1	0	8	8	1	17	4,4

---

[21] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

5.1.6.3	Casualty summary and overview in support of the RCS	0	0	1	7	9	1	17	4,5
5.1.6.4	Continuously up-dated information for maintaining currency of the RCS	0	0	0	8	9	1	17	4,5
5.1.6.5	The decision support provided to on-site commanders, dispatchers and coordinators by implementing this PULSE functionality	0	0	2	9	6	1	17	4,2

Observations:

Measures of effectiveness as defined in above table mirrors the given functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 4,4, which brings the functionality of the PULSE platform to <u>very satisfied</u> in this instance.

In summary, it was assessed as a 'great' capability essential at the on-site coordination centre facilitating the critical synopsis of information.

Extending beyond the functionality implemented for the trials, notable additional aspects and recommendations that seemed to be desirable for implementation were documented in the free response sections and during subsequent discussion periods as follows:

- Increasing importance of information management going forward also with the requirement for education of information managers.

5.1.7 Post-event Evaluation

Purpose:

To describe and demonstrate the flow of steps that should be put in place in order to collect "hot-debrief" in the immediate aftermath of an incident or exercise.

Scenario: In the aftermath of an event involving a major public health emergency, lessons learned sessions are conducted and respective reports are to be generated and documented.

Table 5.1.7 Post-event Evaluation

#	Measurements of	1[22]	2	3	4	5	n/a	# Answers	Average

---

[22] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

	Effectiveness							
5.1.7.1	The possibility to store and call-up all contact data relevant to responders involved	0	1	0	9	11	0	21	4,4
5.1.7.2	Automated invitation to individuals identified	1	0	0	6	12	2	19	4,5
5.1.7.3	Usefulness of applying on-line questionnaires	0	1	1	5	14	0	21	4,5
5.1.7.4	Automated generation of a data log containing patient and triage data, patient referral to hospitals and resources information	0	0	3	2	16	0	21	4,6
5.1.7.5	Immediate access to all data related to the incident response	1	0	1	5	14	0	21	4,5
5.1.7.6	The possibility of diffusing knowledge to take into account lessons learned for future events	0	1	1	9	10	0	21	4,3
5.1.7.7	Relief in the compilation of data and information for the purpose of a hot debrief, the production of a lessons learned report or producing evidential information	0	1	2	7	11	0	21	4,3

Observations:

Measures of effectiveness as defined in above table mirrors the given functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 4,4, which brings the functionality of the PULSE platform almost to very satisfied in this instance.

In summary, it was assessed a 'very good, fantastic or even brilliant' feature, however, still needing some work.

Extending beyond the functionality implemented for the trials, notable additional aspects and recommendations that seemed to be desirable for implementation were documented in the free response sections and during subsequent discussion periods as follows:

- In a real-world scenario it would take two people to input data and it is not easily seen on the screen what has been typed (re. spelling mistakes).

5.1.8 Casualty Bureau Operation

Purpose:

To demonstrate the collection and collation of relevant data concerning individuals not immediately accounted for, matching information available on casualties with requests from all those seeking or providing information about persons involved in the incident.

Scenario:

In the course of the major emergency unfolding and involving a significant numbers of casualties, the appropriate authorities (usually the police) have established a Casualty Bureau to collect and collate the details (including condition and location) of all casualties and survivors.

Table 5.1.8 Casualty Bureau Operation

#	Measurements of Effectiveness	1[23]	2	3	4	5	n/a	# Answers	Average
5.1.8.1	On-line collection and multiple point entry during major emergencies	0	1	1	7	12	1	21	4,4
5.1.8.2	Automatic generation of a current overview in the casualty bureau	0	0	0	13	8	1	21	4,4
5.1.8.3	Identification of matching entries	1	0	4	8	7	2	20	4,0
5.1.8.4	The possibility to check entries against the patient data base	0	0	5	9	6	2	20	4,1
5.1.8.5	Visualization & distribution of cascading alert levels	0	0	6	6	5	5	17	3,9
5.1.8.6	Possibility to activate appropriate surge capacity generation procedures	0	1	7	7	5	2	20	3,8
5.1.8.7	Review of medical resources & responder status based on current summary score	1	1	4	7	5	4	18	3,8

---

[23] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

Observations:

Measures of effectiveness as defined in above table mirrors the given functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 4,1, which brings the functionality of the PULSE platform to <u>very satisfied</u> in this instance.

In summary, it was assessed as a 'very good and impressive' capability aiding identification of persons and taking off some pressure from the police by way of separating the functions of call takers from data matchers.

Extending beyond the functionality implemented for the trials, notable additional aspects and recommendations that seemed to be desirable for implementation were documented in the free response sections and during subsequent discussion periods as follows:

- Concerns over confidentiality and reliability over data entry of missing persons.

- Establishment of a backup repository in case PULSE fails during a complex emergency.

5.1.9 Learning Management System

Purpose:

This technique and tool shall be used for the training of end users. The LMS will be combined with a Learning Record Store to provide support for modern tracking of a wide variety of learning experiences within the PULSE training system. This system will allow for trainees to undertake remote training and self-paced training activities if they are unable to travel to the classroom based sessions or wish to perform additional preparatory training in advance of the PULSE trials.

Table 5.1.9 Learning Management System

#	Measurements of Effectiveness	1[24]	2	3	4	5	n/a	# Answers	Average
5.1.9.1	Access to training course material	1	0	1	1	6	0	9	4,2
5.1.9.2	Automatic assignment of courses	1	0	1	2	4	1	8	4,0
5.1.9.3	Individual training plan assigned	0	1	2	1	4	1	8	4,0
5.1.9.4	Interactive training and simulation	0	1	0	4	4	0	9	4,2

---

[24] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

5.1.9.5	Social media with other trainees	0	1	1	1	5	1	8	4,3
5.1.9.6	Online news	1	0	1	2	5	0	9	4,1
5.1.9.7	Online quiz	1	0	1	0	5	2	7	4,1
5.1.9.8	Instant messaging	0	0	2	0	7	0	9	4,6
5.1.9.9	Integration of training experience data from the PULSE system with other training system	0	0	3	1	5	0	9	4,2

Observations:

Measures of effectiveness as defined in above table mirrors the given functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 4,2, which brings the functionality of the PULSE platform to <u>very satisfied</u> in this instance.

Albeit not fully established yet in all its intended features it has been assessed a very good tool for remote and self-paced learning.

5.1.10 PULSE Mobile Application

Purpose:

To demonstrate and exercise the Pulse Mobile Application (PMA), which has been developed for mobile phones & tablets, for the purpose of gathering information from first responders operating in the field and reporting it back to the main Pulse system (DVST & supporting tools D4.1-7).

Table 5.1.10 PULSE Mobile Application

#	Measurements of Effectiveness	1[25]	2	3	4	5	n/a	# Answers	Average
5.1.10.1	Pushing of initial alerts to prompt opening the application	1	0	2	5	14	1	22	4,4
5.1.10.2	Reception of alerts with more detailed information	0	2	2	9	8	2	21	4,1
5.1.10.3	Reception of tasks with associated actions	0	1	2	8	11	1	22	4,3

---

[25] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

5.1.10.4	Sending back reports in response to a task	0	0	2	7	13	1	22	4,5
5.1.10.5	Taking and sending photos	0	0	1	2	20	0	23	4,8
5.1.10.6	Recording and sending notes	0	0	1	3	19	0	23	4,8
5.1.10.7	Scanning and sending QRs	0	0	3	2	18	0	23	4,7

Observations:

Measures of effectiveness as defined in above table mirrors the given functionality of the PULSE system at the time of the trial execution. The overall cumulated average rating amounted to 4,5, which brings the functionality of the PULSE platform to almost <u>fully satisfied</u> in this instance.

Efficient to enhance coordination, command and control this tool was assessed 'very good and useful', and 'well laid out'. Barcodes scanned very well. Proposing to go forward with the further development of the app, the addition of taking and sending video-clips as well as the automated integration of notifications instead of separate messages were recommended.

5.1.11 Effectiveness Summary Evaluation

In pursuance of the strategic goals defined in PULSE DoW, Part B, 1.1.4 as to " … define, develop and validate a methodology, architecture and a set of technologies and tools to improve the preparedness and response of key stakeholders during a medical crisis", in a completely different scenario compared to the EVD trial, the MCI Trial was likewise to demonstrate operational effects and benefits of PULSE acting as an integrated platform to support decision making in both preparedness and response phases.

Based on a collection of integrated software applications, contemporary decision support systems are interactive computer-based information systems, which help decision makers by utilizing information, data and related models to improve the quality and effectiveness of decisions (rather than replacing decision-making). Looking for the determining forces driving such systems, one approach[26] lists five conceptual categories, also called 'drivers' as follows:

- Communication – supports more than one person working on a shared task,
- Data – emphasises access and manipulation of a series of data,
- Documents – manages, retrieves, and manipulates information in a variety of formats,
- Knowledge – specialised expertise stored and held accessible,
- Models – access and manipulation of a variety of models to assist in analysing situations.

The eight use cases and the two additional features applied in the MCI Trial were

---

[26] See: „*Decision Support Systems – Concepts and Resources for Managers*" Daniel J. Power, 2002, Quorum Books – Westport, Connecticut, ISBN-1-56720-497-X, Page 12/13.

intended to bring about the spectrum of functions founded in the conceptual categories discussed above that would support a better, timely, more comprehensive, more effective decision-making. The summary evaluation result is displayed in below graph.

Figure 15: Summarized MCI Trial Effectiveness
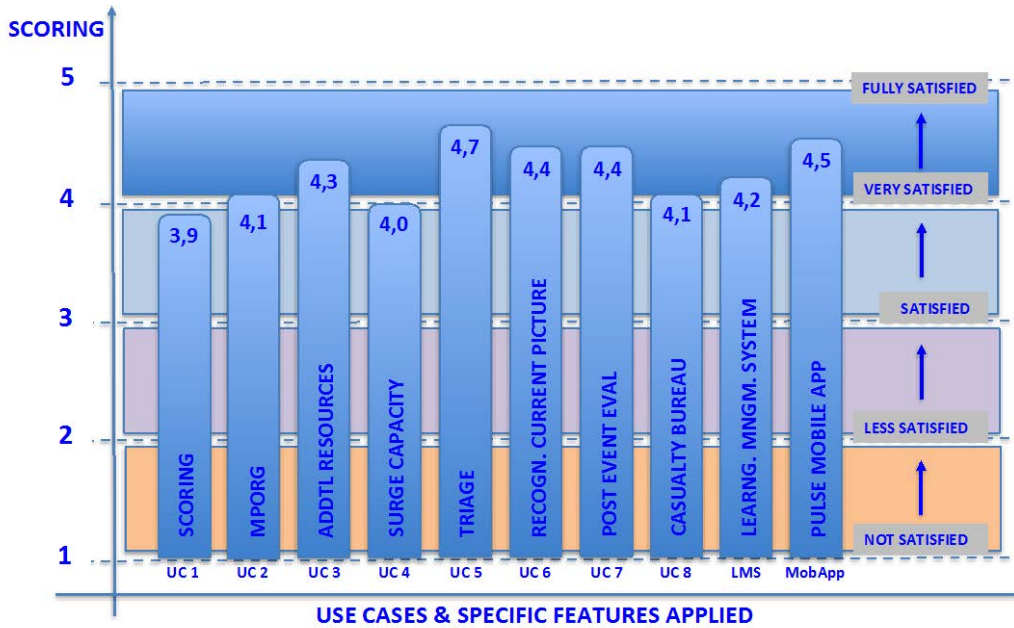
The overall cumulated average rating amounts to 4,3, which brings the functionality of the PULSE platform to a convincing <u>very satisfied</u> outcome in this instance. In summary, it was assessed as a very good, effective and sometimes even excellent system, extremely useful, and offering a great potential for emergency management in that PULSE:

- Provides an invaluable communications resource for the first responder community.

- Facilitates a rapid and real-time situational overview including professional and voluntary public health capacities.

- Accelerates the information flow facilitating immediate planning and tasking essential for on-site situational synopsis and coordination of response activities.

- Considerably aiding the identification of persons matching a variety of sources.

- Considers and integrates social media.

- Maintains a well-organised data input, data flow structure and incident log in support of post event evaluation and possible legal proceedings.

- Offers a good capability for remote and self-paced learning, and

- Demonstrated a convincing mobile application well laid out to enhance coordination, control and command.

Extending beyond the initial functionality implemented for the trials, notable additional recommendations that are considered desirable for future implementation or customisation were documented in the free response sections and during subsequent discussion periods. These points have been captured in the Chapters 5.1 through 5.10.

5.2 PULSE System Performance

The second part of the MCI evaluation is concerned with the inherent qualities of the PULSE platform, comprising a set of characteristics called Measures of Performance (MoP) focusing on the criteria:
- **Efficiency** - Human-computer interaction.
- **Flexibility** – Adjustable to new, different, or changing situations and requirements.
- **Dependability** - System maturity and readiness.
- **Scalability** – Smooth improvement of software and expansion of functionalities.
- **Extensibility** – Facilitating transfer to other crisis management domains & applications.
- **Usability** - Ease of learning, understanding and applying/using the system.

Evaluating the system performance across all use cases and the two additional features (LMS and Mobile App), the performance questionnaire was presented upon the end of the MCI trial. In addition to the scoring questions, supplementary comments and recommendations were captured during the final discussion period.

Table 5.2 PULSE System Performance Questionnaire Evaluation Results

#	Measurements of Performance	1[27]	2	3	4	5	n/a	# Answers	Average
5.2.1	**Efficiency**							23	4,2
	5.2.1.1 Timeliness and speed of the system's operation	0	0	3	11	9	1	23	4,3
	5.2.1.2 System's resources availability & ease of access	1	0	3	10	9	1	23	4,1

---

[27] 1: not satisfied – 2: less satisfied – 3: satisfied – 4: very satisfied – 5: fully satisfied

5.2.2	**Flexibility**						**23**	**4,2**
	5.2.2.1 System's adaptability to new or changing situations & requirements	0	0	5	9	9	1	23	4,2
5.2.3	**Dependability**						**22/23**	**3,6**
	5.2.3.1 System's development stage & readiness for operation	1	1	8	10	3	1	23	3,6
	5.2.3.2 Continuity of service without malfunctions or blocking errors	0	2	8	10	2	2	22	3,5
5.2.4	**Scalability**						**22/23**	**4,1**
	5.2.4.1 Ability to fit to different organisations/agencies requirements	0	3	4	7	8	2	22	3,9
	5.2.4.2 Ability to add new functionalities or to address new hazards	0	0	7	5	11	1	23	4,2
	5.2.4.3 Ability to expand from local to larger geographic environments	0	3	5	3	12	1	23	4,0
	5.2.4.4 Ability to manage and expand the system's resource pool	0	0	6	3	14	1	23	4,3
5.2.5.	**Extensibility**						**23/24**	**4,2**
	5.2.5.1 Transferability & adaptability to other crisis management domains	0	0	6	6	12	0	24	4,3

	5.2.5.2 Transferability & adaptability to different national or international organisations and frameworks	0	1	5	8	9	1	23	4,1
5.2.6	**Usability**							**29**	**4,0**
	5.2.6.1 Time and effort necessary to learn and understand the system	0	0	2	16	5	1	23	4,1
	5.2.6.2 System ergonomics and ease of handling	0	1	1	15	7	0	24	4,2
	5.2.6.3 Provision of interactive and appropriate feedback to the user	1	1	7	8	6	1	23	3,7
	5.2.6.4 Ability to adopt the use the system in new operational end-user situations	0	0	7	9	7	1	23	4,0

Observations:

Measures of Performance as defined in above table mirror the given operational characteristics of the PULSE system at the time of the trial execution. Based on the significant number of 'very satisfied' and 'fully satisfied' scores (253 out of 360 possible votes = 70 %) the overall cumulated average rating amounted to 4,1, which brings the PULSE platform performance to <u>very satisfied</u>.

Graph 5.2 PULSE EVD Trial Cumulated Performance Evaluation
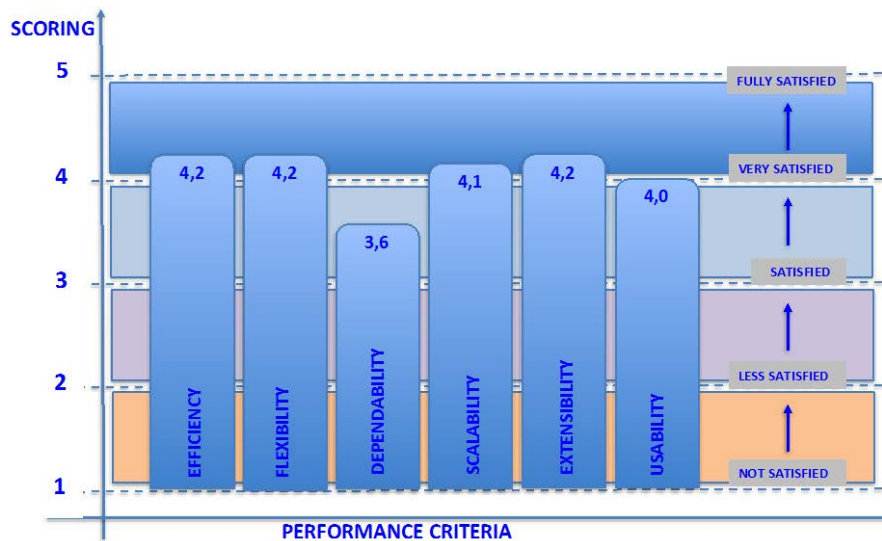
Notwithstanding its prototype status, end-users were pleased with its functions, assessed PULSE system performance as very good, the right tool to better do the job. In addition, the system's flexibility and possibility for expansion was viewed as a capability building tool for organisations, missions and tasks.

The lower score for 'dependability' compared to the other criteria presumably was caused by some network problems as mentioned above and by concerns expressed with regard to the ease of use under adverse weather conditions and ergonomic considerations..

Extending beyond the functionality implemented for the trials, only one comment has been logged as follows:

- Potentially, the main blocker for implementing a system such as PULSE may be government departments rather than first responder organisations.

5.3 EELPS Evaluation

In the MCI trial exercise, the EELPS evaluation used a supporting questionnaire, with 14 questions addressing the most relevant EELPS factors, including ethical values, system transparency, market advantages, legal and regulatory compliance, health strategies, and societal impact. As already discussed in chapter 3.3.8, this evaluation reflects only a small selection of 14 aggregated criteria while a full-scale evaluation with the EELPS tool and 42 criteria lies outside the scope of the project. The ratings of the questionnaire range from 1= strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree 5= strongly agree and n/a (not applicable).

Table 10: EELPS MCI Trial Questionnaire Results

#	Question / Rating	1	2	3	4	5	n/a	# Answers	Average
	ETHICAL								
5.3.1	Will PULSE change societal ethical values in a negative way?	12	6	4	2	3	0	27	2,2
5.3.2	Is PULSE open and transparent in terms of how it handles health-related information?	0	0	6	13	8	0	27	4,1
5.3.3	Is PULSE open and transparent in terms of system functionality?	0	0	4	12	11	0	27	4,3
5.3.4	Will PULSE help channel medical resources appropriately in a public health emergency?	0	0	1	11	14	1	26	4,5
	ECONOMIC								
5.3.5	Will PULSE contribute to, or influence economic stability in any way?	0	1	7	12	6	1	26	3,9
5.3.6	Will PULSE create market advantages for its suppliers, developers and operators?	0	1	7	12	7	0	27	3,9
	LEGAL								
5.3.7	Does PULSE comply with existing regulations and the rule of law?	2	2	9	11	3	0	27	3,4

#	Question / Rating	1	2	3	4	5	n/a	# Answers	Average
5.3.8	Is the measure compatible with human rights principles and the core values of the Union as human dignity, freedom, equality and solidarity?	0	1	4	13	9	0	27	4,1
5.3.9	Do you think the PULSE system creates any data protection risks?	3	4	7	7	6	0	27	3,3
	POLITICAL								
5.3.10	Does PULSE fit into related international and EU health strategies?	0	0	7	11	9	0	27	3,3
5.3.11	Does PULSE fit into related national health strategies?	0	0	8	7	12	0	27	4,1
5.3.12	Does PULSE have the potential to create political risks?	7	6	7	6	1	0	27	2,6
	SOCIETAL								
5.3.13	Does PULSE have the potential to increase control over people and/or society?	3	6	7	7	4	0	27	3,1
5.3.14	Will PULSE bring direct benefits to people and/or society?	0	0	2	10	15	0	27	4,5

The form also provided a section for "Summary Assessment, Recommendations, Remarks" by participants", which are analysed further as follows:**.**

ETHICAL

The results show that the vast majority of participants (18) did not think PULSE changes societal ethical values in a negative way. Four participants neither disagreed nor agreed, two agreed, while three strongly agreed.

21 participants agreed that PULSE was open and transparent in the way it handles health-related information. No participants disagreed; six participants were not too sure either way.

23 participants agreed (11 strongly) that PULSE is open and transparent in terms of system functionality. Four participants neither disagreed nor agreed. None disagreed. This shows a good receptivity to, and understanding of the demonstrated system.

25 participants agreed (14 strongly) that PULSE will help channel medical resources appropriately in a public health emergency. None disagreed, one participant neither disagreed nor agreed, and 1 marked the question not applicable. This is a good sign as it shows that ethical concerns have been properly regarded in the PULSE development.

ECONOMIC

To the question of whether PULSE will contribute to, or influence economic stability in any way, 18 participants agreed. Seven neither disagreed nor agreed, one participant disagreed, and one marked the question n/a. This result doesn't surprise as the "economic influence" at that stage of the project is still rather vaguely defined.

19 participants agreed that PULSE would create market advantages for its suppliers, developers and operators. This is a positive sign for the future development and uptake of the system. Only one participant disagreed, seven neither disagreed nor agreed.

LEGAL

14 participants agreed that PULSE complies with existing regulations and the rule of law. Not strangely (given the backgrounds of the participants), nine neither disagreed nor agreed, while four disagreed. We do recognise that this question does have an associated level of difficulty to respond to, depending on the extent of familarization with applicable regulations.

The vast majority of participants (22) agreed that PULSE is compatible with human rights principles and the core values of the Union such as human dignity, freedom, equality and solidarity. Four participants neither disagreed nor agreed, while one disagreed.

13 participants agreed that the PULSE system creates data protection risks. Seven neither disagreed nor agreed, and seven disagreed (three strongly). One participant clarified that the risks here were no more so than would be present in any social media site – data is shared by consent.

POLITICAL

The majority of participants (20) agreed that PULSE fits into related international and EU health strategies. Seven participants neither disagreed nor agreed. This is a positive indication that the platform is suitable for use at the EU level. 19 participants felt that PULSE fit into related national health strategies. Eight participants neither disagreed nor agreed.

The question on whether PULSE had the potential to create political risks received a spectrum of responses. On the whole, 13 participants disagreed, seven neither disagreed nor agreed, while seven agreed.

SOCIETAL

The question "Does PULSE have the potential to increase control over people and/or society?" received mixed responses. Eleven participants agreed that PULSE had the potential to increase control over people and/or society. Nine participants did not agree (3 strongly), seven participants neither disagreed nor agreed. This result is not surprising given the nature of the PULSE platform to be able to monitor people and resources in public health emergency scenarios.

A resounding majority of participants (25) agreed that PULSE would bring direct benefits to people and/or society (none disagreed, two neither disagreed nor agreed). This is again a very positive result for PULSE.

SUMMARY of VERBAL REMARKS AND RECOMMENDATIONS

Two key ethical issues were highlighted in this section: (a) that photographs of patients could have legal implications, and (b) that the responder app with geo-location activated would allow locations to be tracked – the concern being that people might not buy into this. A related concern was the battery drain on the mobile sets if location was constantly enabled.

One recommendation was that the questions should have been presented as postulations given the nature of the comment range.

On the whole, participants indicated that they were pleased with the results of the PULSE project. They stated that PULSE could "enhance a Member State's reputation by allowing for the effective and efficient handling of a disaster", and that the PULSE Platform "will be a positive contribution to society". The trial exercise itself was also praised as "excellent". One participant stated that they thought PULSE was "an effective and efficient management tool that will aid (accordingly) in the ... management of major emergencies to the benefit of society" and "will also aid in protecting the responders and managers of the scene". Another participant stated that the "proper use of PULSE could streamline and maximise use of critical resources thereby saving lives and minimising mass casualties".

5.4 General Assessment

In an approach similar to the EVD Trial, the purpose of this part of the evaluation was to receive feedback on a number of general characteristics of the PULSE approach, including:

1. The general preparation and setup of the experiments
2. The general concept of the PULSE project
3. The adequacy of the scenarios and use cases (scenes)
4. Usability and future use
5. Typical drivers and obstacles of future application
6. Typical positive findings
7. Recommendations for improvement
8. Final summary rating

The MCI Trial general assessment was based on a questionnaire detailing these topics and offering the possibility of scoring the quality features of the PULSE system at a scale between 1 (not satisfied) to 5 (fully satisfied), as well as the option to enter text answers and comments to the topics. Different from the EVD trial, the MCI Trial has offered the option to leave a certain criteria without marking a score in order to

"choose" the option "Not Applicable" / "Not able to answer" whenever the participant considered appropriate. This questionnaire was filled by:

1) The external stakeholders, grouped in two categories:

   a. Actors : external stakeholders actively involved into the trial and giving feedbacks

   b. Observers : external stakeholders only observing the trial development and giving feedbacks

2) PULSE consortium members

The number of the filled questionnaires may vary due to the fluctuation during the trial development. More details about the participants may be found in *D7.1 and D7.2*. The MCI Trial General Evaluation Questionnaire was filled by 30 participants distributed as shown in the next figure. Only the external participants involved in the live section of the trial had registered themselves as "Actors" while the others had registered as "Observers" although many of them were actively involved in the trial as "members" of the incident management team located into the command room. The Number of external stakeholders who filled the questionnaires was lower than the number of participants (chapter 3.3.2).

Figure 16 Distribution of the MCI Trial Participants
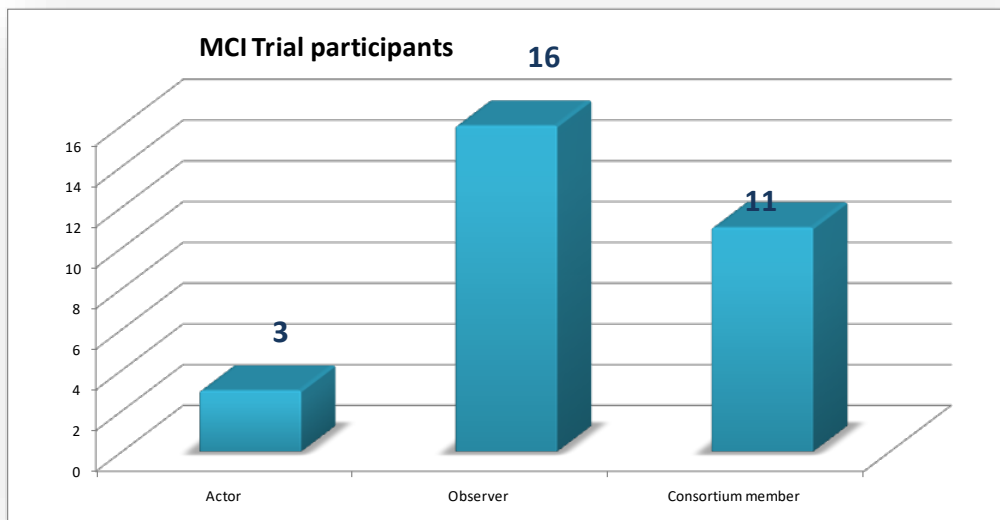
The MCI Trial General Evaluation Questionnaire is documented in

Annex2: EVD &MCI Trials - General Evaluation Questionnaire.The MCI Trial general assessment is presented in Figure 17.

Figure 17: MCI Trial An Overview of the General Assessment - Averages

MCI Trial Overall Evaluation
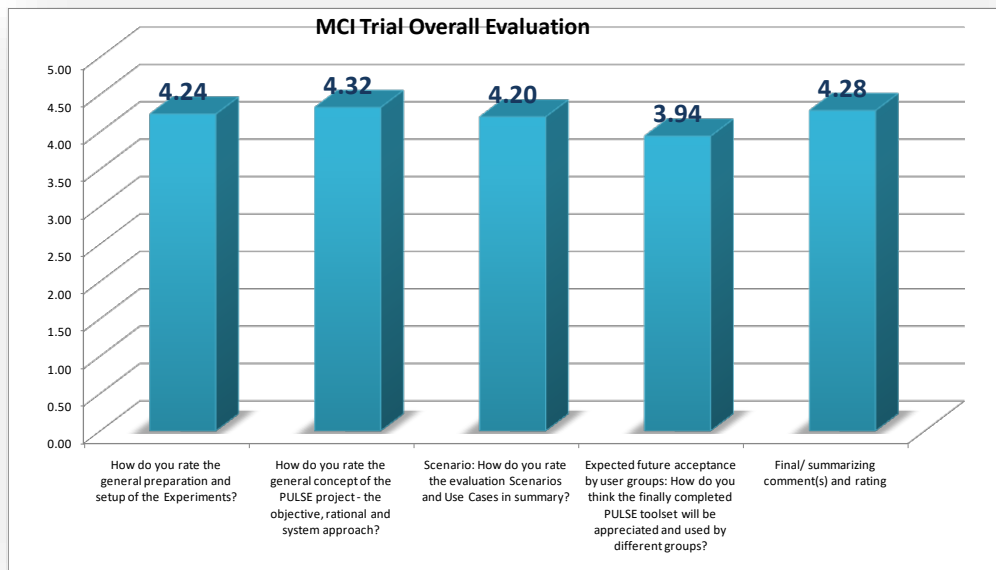
The overall rating of the MCI Trial is **4.2**, above **very satisfying** level with highest ratings received for PULSE general concept (objective, rationale and system approach). Very good scores were also awarded to the trial general preparation and the overall evaluation. The lowest (yet high) ratings were received for the expected future acceptance, reflecting legitimate concerns regarding the implementation of the PULSE platform that currently is at the demonstrator state.

The distribution of the results by the participant type is fully documented in *Annex 6 MCI Trial General Assessment Questionnaire – Distribution of the results per participant type*. The overall distribution of the general assessment questionnaire per participant type is presented in Figure 18.

Figure 18: General Assessment by Participant Categ.

MCI Trial General Evaluation results distribution per participants categories
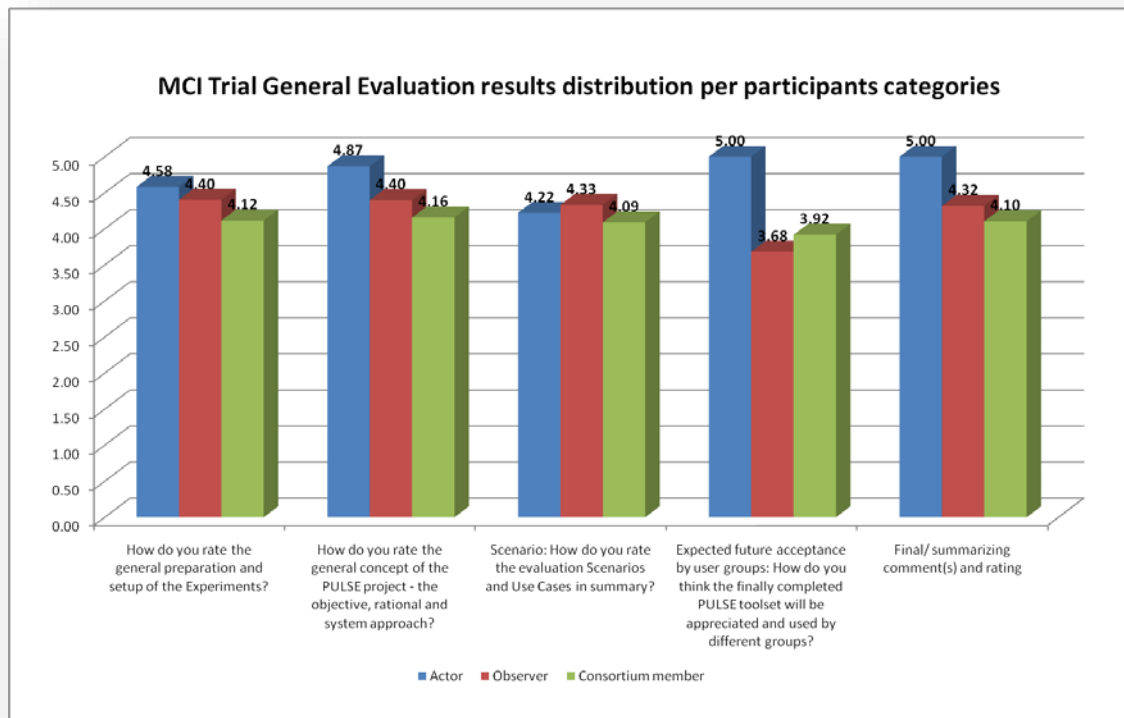
 Overall, the highest rates were given by the actors followed by the observers and the lowest by the consortium members. So, the highest rates were given by the people involved actively into the trial and having the opportunity to operate the PULSE tools. This reflects a very good appreciation of the PULSE platform as well as it's friendliness and easiness in operation. Consortium members involved in the development and acting as facilitators during the trial were even more critical than external stakeholders. This result is also a good consequence of the fact that video presentations were given to the invitees and actually, were publically available on the PUSE web site before the trial.

The **"actors"** who filled the general assessment questionnaire were volunteers actively involved in the live section of the trial. They awarded the highest rates to the overall rating of the PULSE platform and to the trial as well as the expected future acceptance of the platform. Both reflect a quite enthusiastic reaction. Very good rates were also given to the general trial preparation and general concept of the PULSE project. The lowest rates were for the scenarios and use cases. This reflects the fact that they are mainly involved in operational interventions in major incidents and less in the preparation and management of the reaction (since just 1 out of 8 scenes was dedicated to triage and on-site intervention, their core competence).

The "**observers**" were mainly managers and decision makers from the municipality, police and main emergency management services. Their rates were quite evenly distributed; the highest rates were given to the general preparation of the trial and for the general concept of the PULSE project while the lowest were given on the future acceptance. This can be interpreted as a very good feedback from professionals with high expertise in both operational and managerial fields who were well impressed by the results and, on the other hand, were aware of the inherent difficulties and need for additional resources and investments for operational implementation.

The **consortium members** gave very good rates – above 4.3 – with one exception, the future acceptance. This is, again, a qualified feedback from people who know best the actual PULSE platform, but, on the other hand are aware of the needed effort for operational implementation.

A further detailed analysis of the answers is done in the following sections. The 1st digit of the chapter numbers 4.4.x refers to the question numbers of the questionnaire. The free text answers to the questionnaires are documented in **Error! Reference source not found.**.

5.4.1   The PULSE MCI Trial Evaluation

Q 1. How do you rate the general preparation and setup of the Experiments?

Figure 19 Results Distribution for MCI Trial General Assessment Q1
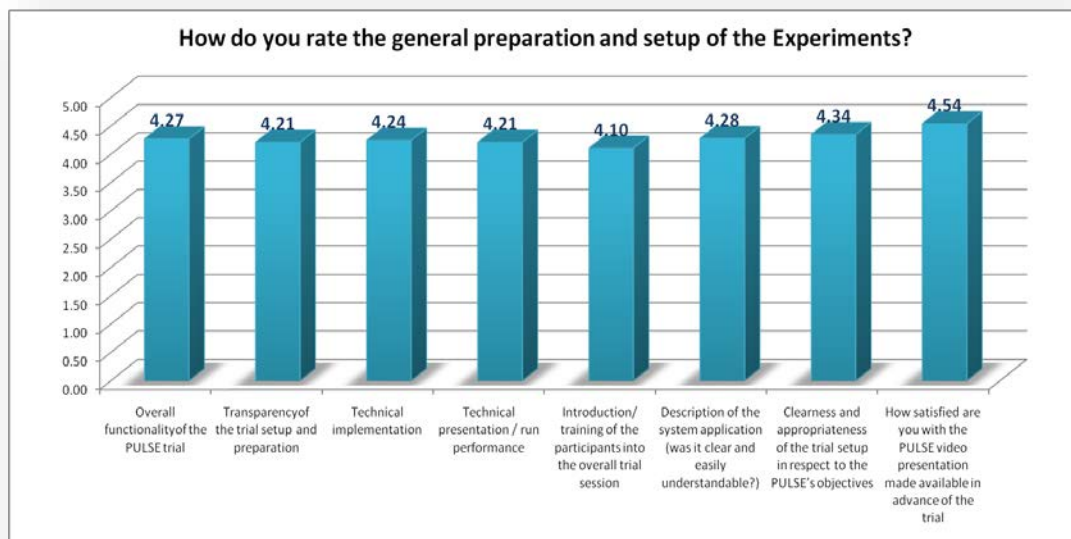
Observations:

1. The overall average for the question is **4.27** – well above "very satisfied"
2. The informative video material made available before the trial was most appreciated and supported the very good scores for clearness and appropriateness of the trial setup as well as for PULSE overall functionality and description of the system application.
3. Yet, more training would have been appreciated by the participants, as supported by the recorded text comments.
4. The relevant aspects documented in the verbal response sections were :
    a. The number and diversity as well as the active involvement of the external stakeholders was much appreciated
    b. The system functionalities and the trial and scenario setup were well appreciated
    c. Additional training would have helped. During the trial development, the tools operation was sometimes difficult to follow by the observers

5.4.2 The PULSE General Project Evaluation

Q2 : How do you rate the general concept of the PULSE project - the objective, rational and system approach?

Figure 20 Results Distribution for MCI Trial General Assessment Q2
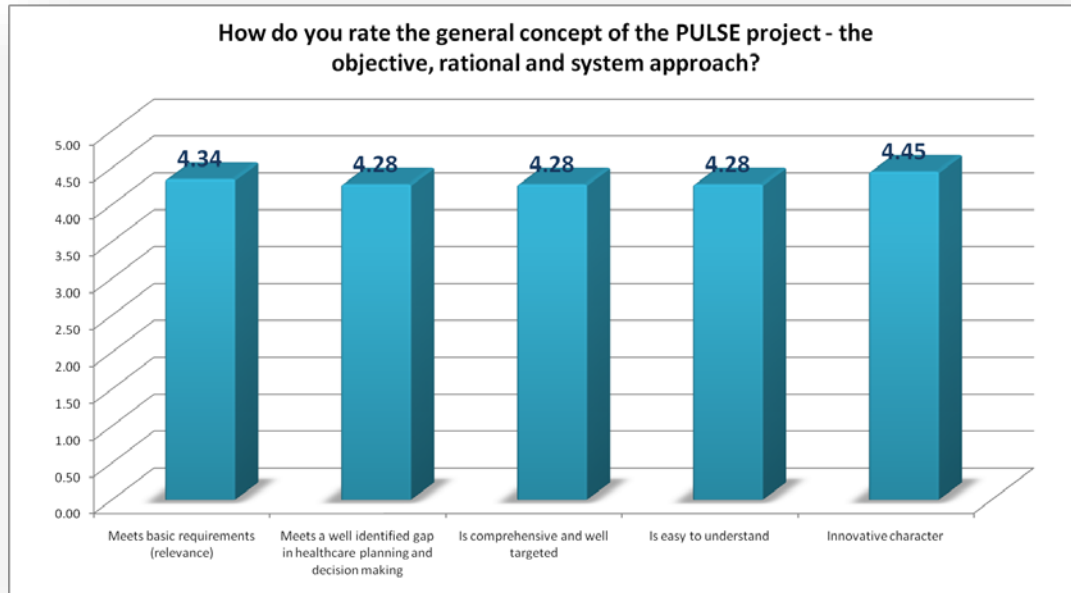
Observations:

1. The overall average for the question is **4.32** – well above "very satisfied"
2. From all general assessment questions, this one received the highest rates
3. Most appreciated was the innovative character of the PULSE platform
4. The relevant aspects documented in the verbal response sections were :
    a. PULSE was appreciated as a platform with very good potential for the major medical emergency management as well as suitable for other segments (is an adaptable and expandable platform)
    b. The user friendliness of the tools was much appreciated
    c. Complementarities with the legacy systems, need for integration with existing systems and interoperability with existing national and international systems may need additional development
    d. A well designed and applicable application that will aid in the effective management of major emergencies not only within Ireland but also within Europe

5.4.3 The Scenarios and Use Cases Evaluation

Q3 : Scenario: How do you rate the evaluation Scenarios and Use Cases in summary?

Figure 21 Results Distribution for MCI trial General Sssessment Q3

Scenario: How do you rate the evaluation Scenarios and Use Cases in summary?
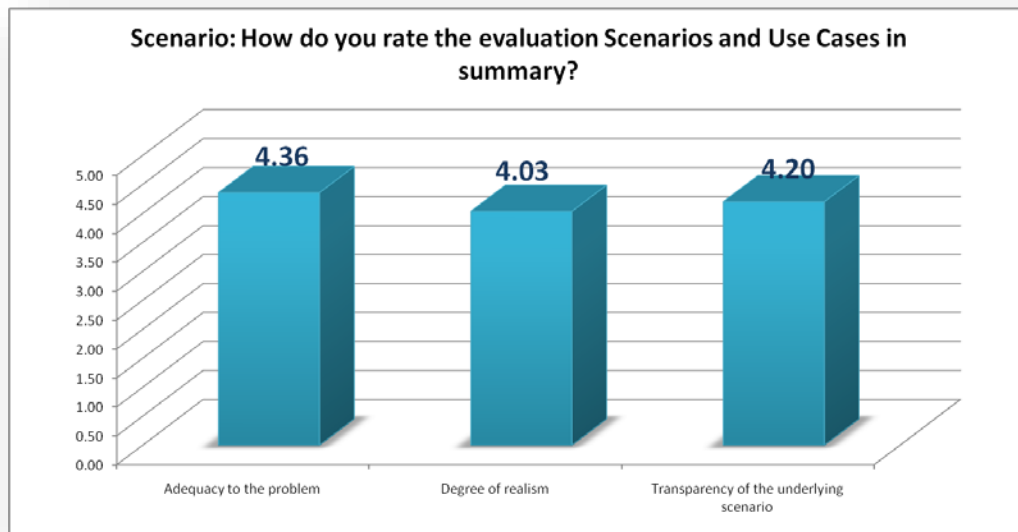
Observations:

1. The overall average for the question is **4.09** – above "very satisfied"
2. The trial scenario was considered adequate and with a very good degree of realism
3. The scenario transparency was very well appreciated; the audio & video presentations at the beginning of each scene supported the understanding of the scenario assumptions and developments.

5.4.4 PULSE Usability and Acceptance/present status

Q4 : Expected future acceptance by user groups: How do you think the finally completed PULSE toolset will be appreciated and used by different groups?

Figure 22 Results Distribution for MCI Trial General Assessment Q4

Expected future acceptance by user groups: How do you think the finally completed PULSE toolset will be appreciated and used by different groups?
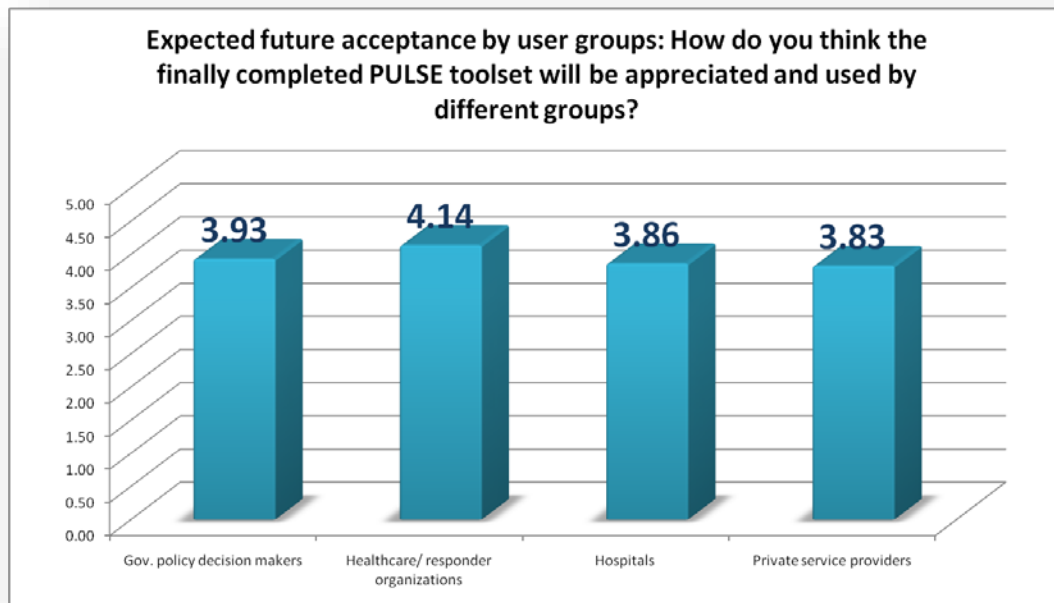
Observations:

1. The overall average for the question is **3.92** – very close to "very satisfied"

2. The highest rates were given to the future acceptance by the healthcare and first responder organizations, which actually fits the profile of the trial as well as the main user group targeted by PULSE

3. Although it received a quite good score, it is the lowest among the general questions ratings. This well reflects the development status of PULSE (R&D project technology development / early demonstration of TRL 5 0).

4. The relevant aspects documented in the verbal response sections were:

    a. Resources (will be) needed for interoperability / integration with existing systems that cover segments of the PULSE platform

    b. Common interagency platforms to be merged need to be tested on large scale.

    c. Integration of different Agencies/command and control issues and user familiarity with the system needed in the initial stages. Also, potential information overload is a concern.

5.4.5 Further Free-text Answers and Comments

This section asked for comments on drivers and obstacles, convincing experiences and recommendations on future improvements.

5.4.5.1 Typical drivers and Obstacles

The relevant aspects documented in this verbal response section were:

    a. Important market drivers:

        i. EU commitment, (would be) needed to face complex hazards at a higher level, as well as common capabilities for complex resources management

ii. PULSE fills important gaps;

iii. Is adaptable to different national and local systems and regulations;

b. The main expected obstacles:

i. Legacy systems are in use

ii. PULSE functional dependence of the data network availability

iii. Resources needed for interoperability / integration with existing systems that cover segments of the PULSE platform

iv. Independence of agencies, hospitals. Differences in high level organization and different culture of agencies

v. Ethical issues of photographing patients, live hospital feeds etc.

5.4.5.2 Particularly Positive/convincing Experiences/findings

- Video presentation material (made available before the trial) and the video injects have helped to understand the PULSE platform as well as the scenario developments
- The tools are easily to be understood and used
- A complex platform of tools, with an open architecture, offering support for sharing the information and achieving a real time overview of an incident
- Pulse anticipates evolving public communication preferences
- Different PULSE tools were very well received (triage apps, missing persons apps etc),
- The actors coming from the Irish operational emergency management services were actively involved in the trial and interacted very well with the PULSE tools.
- Control and retention of real time records and time savings in processing of data

5.4.5.3 What should be Improved?

- Interoperability with existing national and international systems
- Should be tested on larger scale / made available to all emergency services
- Data protection/ legislative barriers; ethical issues of photographing patients, live hospital feeds etc. require further analysis and potential developments
- Dependence on Internet / public data networks is a critical point

5.4.5.4 Final Comments and Ratings

Q 8. Final/ summarizing comment(s) and rating

Figure 23 Results Distribution for MCI Trial General Assessment Q4

Final/ summarizing comment(s) and rating
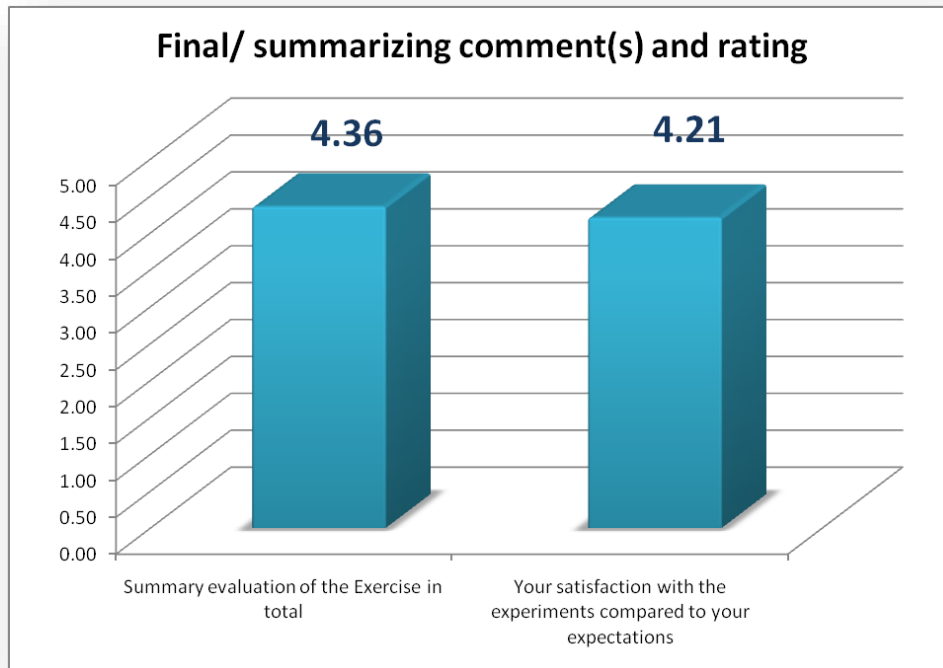
Observations:

1. The overall average for the question is **4.10** – above of <u>"very satisfied"</u>
2. Both summary evaluation criteria reflect very good rates, for overall MCI trial organization as well as for level of satisfaction of the participants related to their expectations.

5.5 System and Tools-Internal Technical Evaluation

Because of the nature of this evaluation, it was decided to do this evaluation only once, independent of the individual scenarios EVD and MCI. This evaluation is documented under chapter 4.5.

For a better understanding and support of readers interested in more details of the tools, we have created an Annex9: Platform and Tools Functionalities, which briefly describes how the tools' functionalities were applied in the trials. It also contains references to the detailed descriptions of the tools.

6 Conclusions and Final Validation

6.1 Trial Summary and Conclusions

6.1.1 Trial Set-up and Evaluation Aim

In conducting the EVD- and MCI trials the main goal was to demonstrate and validate the effectiveness and performance of the PULSE tools and platform. PULSE technologies and scientific concepts developed aim at spanning the whole range of scenarios and requirements for medical support during major emergencies in a

national and European context.

For the purpose of evaluation and validation, by design the two scenarios chosen were quite different by hazards involved, geographic distributions, target audiences affected, and inherent scenario dynamics, as described in detail in D2.2. Emphasising this approach the EVD trial applied an extended table-top scheme while the MCI trial has been execute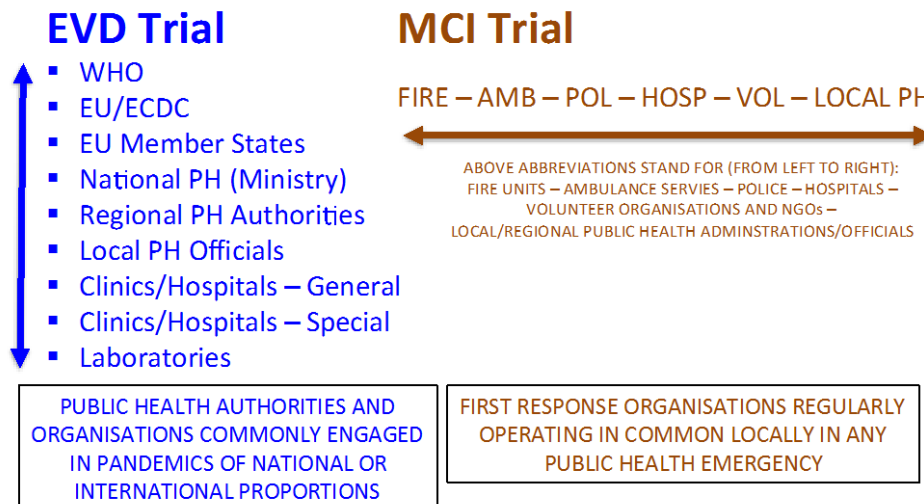d in a semi-live format. Moreover, executing the trials in Italy and Ireland under realistic conditions has meant to encounter nationally shaped emergency routines and differently designed or interpreted international connections, all having had their own specific impact on the planning and execution of the trials. In consequence the trials' evaluation will need to generalize as far as possible and avoid conclusions that are limited to national or local specificities, and possible impacts caused by technical limitations encountered during the execution of the trials.

Intended by the different trial scenarios, respective target audiences deliberately pursued a vertical approach for the EVD trial and a horizontal one for the MCI trial as shown in below graph.

TRIAL TARGET AUDIENCES
COMPARISON

EVD Trial
- WHO
- EU/ECDC
- EU Member States
- National PH (Ministry)
- Regional PH Authorities
- Local PH Officials
- Clinics/Hospitals – General
- Clinics/Hospitals – Special
- Laboratories

MCI Trial

FIRE – AMB – POL – HOSP – VOL – LOCAL PH

ABOVE ABBREVIATIONS STAND FOR (FROM LEFT TO RIGHT):
FIRE UNITS – AMBULANCE SERVIES – POLICE – HOSPITALS –
VOLUNTEER ORGANISATIONS AND NGOs –
LOCAL/REGIONAL PUBLIC HEALTH ADMINSTRATIONS/OFFICIALS

PUBLIC HEALTH AUTHORITIES AND ORGANISATIONS COMMONLY ENGAGED IN PANDEMICS OF NATIONAL OR INTERNATIONAL PROPORTIONS

FIRST RESPONSE ORGANISATIONS REGULARLY OPERATING IN COMMON LOCALLY IN ANY PUBLIC HEALTH EMERGENCY

By reason of the selective use cases applied to fit the different scenarios, which in turn indicated the exercising and demonstration of specific PULSE functionalities, the summary evaluation combining the findings from the two trials concerning the effectiveness of the PULSE platform in particular has its natural limitations. They cannot be directly compared in all its parts. Above target audience comparison supports this notion.

The evaluation of 'performance' and the societal criteria (EELPS) beam towards the function of the PULSE platform as a whole, no matter specific scenarios or environments. This allows a more direct comparison and summary evaluation

combing the findings of the two scenarios. The same goes for the evaluation part called 'General Assessment'. It is primarily concerned with the trial's set-up and execution and other more general aspects.

A system such as the PULSE platform is also considered possibly having considerable "societal" implications (EELPS), which has added another pillar to the evaluation effort as mentioned before. These implications may range from positive effects of societal perception of improved security and healthcare to negative effects as the increased risk of abuse of personal data, from generating a competitive advantage for industries to inappropriate manipulation of the distribution and allocation of health resources.

Aiming at drawing conclusions for the PULSE system as a whole, subsequent paragraphs undertake to compare the findings from the individual trials.

6.1.2 Effectiveness Assessment, Summary

Notwithstanding the differences of the two scenarios and trials, the cumulated effectiveness of the PULSE platform in the individual use cases applied attained '**very satisfied**' scores.[28]
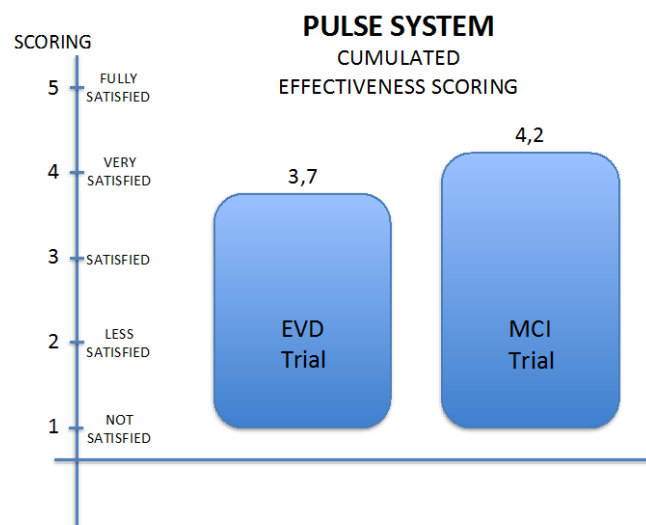
Acting in their professional environments and/or observing real-life rescue and response scenes, the semi-life character of the MCI trial obviously was better suited to promote the PULSE system. Moderated by a focused leadership during the trial, a group of homogenous participants physically and virtually experienced the benefits PULSE provided, appreciating what it can bring to the scene. The higher scores granted for PULSE in the MCI trial support this observation. Participating in the EVD trial, which was conducted in table-top format, a collection of diverging professionals

---

[28] In the fixed part of the scoring system used 'very satisfied' is understood ranging from 3,5 up to and including 4,4. Rounding up or rounding off respectively, to the next whole number results in 'a very satisfied'.

each in his/her province, faced scenes taken out of a much larger timely context. Here, the PULSE system earned a somewhat lower overall score. Anyhow, the complementary free text response in the questionnaires, in both trials, PULSE has been uniformly characterised as a very good, impressive, effective and sometimes even excellent system, extremely useful and offering a great potential for emergency management in that PULSE:

- Provides an invaluable communications resource,
- Facilitates a rapid situational synopsis and real-time situational overview,
- Accelerates the information flow supporting immediate planning and tasking essential for on-and off-site coordination and control of response activities,
- Considers and integrates social media.
- Maintains a well-organised data input, data flow structure, repository and incident log.

Both combined, scoring and free text response of the two trials substantiate the 'very satisfied' result for the PULSE platform, also indicating the benefit and value the platform could provide to all potential scenarios happening in between the two extremities actually exercised.

Offering the most proper scenario environment and end-user group, two unique features, Learning Management System (LMS) and the Mobile Smartphone Application (MobApp), have been demonstrated and exercised in the MCI trial only. Ratings 4,2 for the LMS and 4,5 for the MobApp document in a convincing manner the benefit PULSE brings to the table, very much so supporting the overall 'very satisfied' effectiveness outcome.

6.1.3 Performance of the PULSE System

The second part of the evaluation was concerned with the inherent qualities of the PULSE platform, comprising a set of characteristics called Measures of Performance (MoP). Subsequent the evaluation of the system effectiveness, which focused on individual use cases and the two additional features (LMS and Mobile App), the performance evaluation raised the perspective one level higher cutting across all use cases and specific functionalities. Consequently, the questionnaire was presented upon the conclusion of each trial. In addition, supplementary comments and recommendations were captured during the final discussion periods.

Figure 24: Pulse Performance Comparison

PULSE PERFORMANCE CRITERIA EVALUATION
Comparison
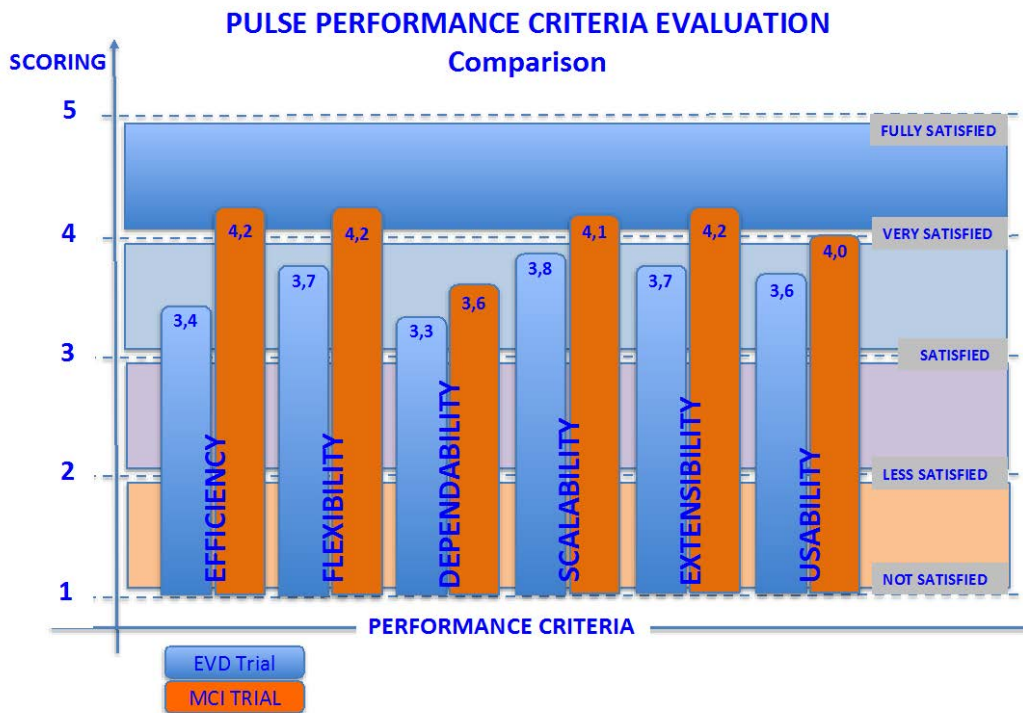
Compared to the results of effectiveness evaluation, the performance evaluation results display a strikingly similar distinction in the rating of the functionality of PULSE in the EVD and the MCI trials. The difference in the scenarios applied, the sequence of use cases executed, the trial format used, the character and background of the trial participants, and the impact a focused moderation had, obviously continue as a recurrent theme also to other evaluation pillars. However, it also proves the consistency of the evaluation effort.

Looking closer, there is one slight statistic deviation though, because in both trials 'dependability' earned a lower score relative to other categories. Further analysis of provided by a number of free text responses and contributions in discussions, some lack of familiarisation with technical equipment as well as real-life technical inadequacies, did impact on the way PULSE could be fully demonstrated and exercised by all participants. In addition, the PULSE system is a prototype system with a related TRL.

Ultimately aiming at an innovative operational and technical framework, PULSE is to support an enhanced European health system providing the scientific and technological backbone of this framework. Assessing and evaluating established performance criteria, they had to be validated against the requirements as outlined in the operational guidelines (see D5.2, Chapter 4).

Figure 25: Performance and SOP Areas

PULSE PERFORMANCE EVALUATION
PERFORMANCE CATEGORIES VS. SOP AREAS

	INTELLIGENCE & INFORMATION GATHERING	THREAT & RISK ANALYSIS ALERT & WARNING	OPERATIONAL PICTURE & SITUATION ASSESSMENT	TASK & RESOURCES PLANNING	TRAINING & EXERCISING CAPABILITY	KNOWLEDGE MANAGEMENT
EFFICIENCY	EVD Trial UC1 MCI Trial UC1 UC8	EVD Trial UC1 UC2 UC4 MCI Trial UC1	EVD Trial UC6 UC7 MCI Trial UC1 UC6	EVD Trial UC5 UC7 MCI Trial UC3 UC4 UC5	MCI Trial UC2 (MPORG) LMS	EVD Trial UC8 UC9 MCI Trial UC7
FLEXIBILITY						
DEPENDABILITY						
SCALABILITY						
EXTENSIBILITY						
USABILITY						

Above operational guideline areas (SOP areas, top line) describe the basic functionalities relevant for the PULSE platform. They constitute a plausible and realistic flow of actions and functions embedded in a recurring process cycle, contingent on each other. They have the character of basic processes, which have the potential to contribute to a common European framework that will ease harmonization of systems, cross-border coordination and knowledge sharing. Deliberately applying the use cases selected, during the two trials each operational guideline area has been checked and validated in view of the performance categories. Identifying the primary use cases applied targeting the SOP areas and the performance categories at the same time, preceding graph proves the integrated trial concept.

Overall and notwithstanding its proto-type status, the PULSE system performance was assessed as very satisfactory, offering considerable potential for emergency management across all operational domains and performance categories in national and international environments.

6.1.4 EELPS Assessment, Summary

Here we briefly present a short comparative analysis of the EELPS assessment for both exercises. This is interesting insofar as the two scenarios were so different with respect to their ethical and political implications, geographical range, dynamics of development, and expected impacts on society.

Ethical
In both trial exercises, results show that the vast majority of participants did not think PULSE changes societal ethical values in a negative way. In both cases, participants strongly believe that PULSE will help channel medical resources appropriately in a public health emergency. The risk to privacy was a recurrent concern.

Economic
While the majority of participants in the EVD exercise were unsure about the influence

of the PULSE system on economic stability, just over half the participants in the MCI exercise thought that PULSE could contribute to, or influence economic stability. In both cases, there was a strong belief that PULSE would create market advantages for its suppliers, developers and operators. As stated before, this is a positive sign for the future development and uptake of the PULSE system.

Legal
Nearly half the MCI exercise participants agreed that PULSE complies with existing regulations and the rule of law. In contrast with this, the majority of respondents in the EVD trial exercise did not answer this question conclusively (choosing to neither disagree nor agree). In both trials, participants agreed that PULSE is compatible with human rights principles and the core values of the Union such as human dignity, freedom, equality and solidarity.
The MCI exercise had an additional question on data protection risks and half the respondents stated that the PULSE systems created data protection risks (however, one participant clarified that the risks here were no more so than would be present in any social media site).

Political
The majority of participants in both the trial exercises agreed that PULSE fits into related international and EU health strategies. This is a very positive indication that the platform is suitable for use at the EU level. The majority in both exercises also agreed that PULSE fits into related national health strategies (although they are so different!).
In both cases, the question of whether PULSE had the potential to create political risks received a spectrum of responses. While in the EVD trial, half the participants were undecided; in the MCI trial half the participants disagreed (with the postulation that PULSE could create political risks).

Societal
In both the EVD and the MCI exercises, the question "Does PULSE have the potential to increase control over people and/or society?" received mixed responses. Nearly the same number of participants agreed that PULSE had the potential to increase control. Thus we recommend this to be adequately addressed in the future implementation of the PULSE platform.
A resounding majority of participants in both cases agreed that PULSE would bring direct benefits to people and/or society. This confirms that PULSE could be highly beneficial to health crisis management and the enhancement of emergency preparedness and response by facilitating better decision making and resource allocation. As the participants themselves put it, the "proper use of PULSE could streamline and maximise use of critical resources thereby saving lives and minimising mass casualties".

6.1.5 General Assessment, Summary

In this section, the general characteristics of the PULSE platform were evaluated. The questions were identical, with one exception – an additional criterion was inserted into the MCI version in order to assess the feedback for the video presentations made available in advance of the trial. Although the main questions were identical, the type of the external participant's organizations had different structures and origins, in accordance with the trials' specificities. The numbers of the participants who filled the general evaluation questionnaire were comparable.

The overall evaluations of both trials reflect a very good appreciation of the PULSE results. In both cases, the highest rates were awarded to the general concept of the PULSE project while the lowest rates were given to the expected future acceptance of the PULSE platform. Apart from the fact that PULSE is a research project (TRL 5)[29] with segments that require further developments in order to become a mature and ready-to-market product, the participants indicated, in both trials, similar expected obstacles for future PULSE implementation:

- need for integration with legacy systems
- heterogeneous operational frameworks
- investment for needed further developments
- general resistance to changes

All 5 evaluation pillars have a similar distribution of the ratings for both EVD and MCI trials with one exception – the assessment of the general preparation and setup of the trial – which was better assessed in MCI Trial than in the EVD Trial participants. This may be explained:

- The video material made available before the MCI Trial offered the possibility to better learn about the PULSE platform and the exercise in advance;
- The technical difficulties with the WI-FI connection on the first day of the EVD trial seems to have created some impact on the ratings, although this deficiency had nothing to do with the PULSE system itself..

From the participants' type perspective, the EVD Trial was mostly appreciated by the consortium members and lowest ratings were awarded by the observers while for the MCI Trial the highest rates were given by actors and the lowers by the consortium members. This may reflect the fact that in the MCI Trial the observers were more involved in the exercise development compared to the observer's status in the EVD Trial. Overall, more involvement in the trial and better understanding of the PULSE platform meant better ratings – an aspect that reflects a very good appreciation of the PULSE results, after all.

Trial general preparation and setup

In both trials, the introduction / training of the participants could have been done better , an aspect that is quite realized in such circumstances. The ratings distribution was quite well balanced and reflected a very good appreciation of the overall setup and its technical presentation and implementation.

The number and diversity as well as the active inclusion of the external stakeholders were much appreciated in both trials.

The PULSE general project evaluation

In both trials, this was the evaluation question that received the highest rates.

The participants appreciated the innovative character of the PULSE platform; it is considered as addressing a well identified gap in healthcare planning and decision making, yet an open and scalable platform with very good potential to be implemented in other sectors.

---

[29] technology validated in relevant environment

The scenarios and use cases evaluation

The scenarios were considered adequate for the scope of the trials; the audio & video injects at the beginning of each scene supported the understanding of the scenario assumptions and the developments of the scenes, leading to high rates for the scenario transparency criterion in both cases.

PULSE usability and acceptance/present status

This question received the lowest rates, expressing the situation of a research project still in a technology demonstration phase as seen through the eyes of professionals actively involved in major disaster management.

An interesting aspect is that – although the profile of the external participants spans over a wide area of medical emergencies – the profile of the answers to the evaluation criteria is more or less the same. the most satisfied group is the healthcare/responders organizations, followed by policy/decision makers, hospitals and private service providers.

Typical drivers and Obstacles

The main drivers for a future PULSE-type implementation:

- national and international public health agencies, supported by the EU commitment to raise the major emergencies preparedness and response capabilities
- PULSE support for healthcare harmonization across Europe
- PULSE usability and functionalities, and its scalability

The main foreseen obstacles:

- Fragmentation of potential adopters, multitude of different national heritage procedures and legacy systems in place that partially provide already some of the functionalities offered by the PULSE platform
- Need for investment for integration with existing systems and implementation
- Diverging procedures and deficits in common standards across Europe.

Particularly positive/ convincing experiences/ findings from the trials

PULSE was appreciated as a complex platform of tools, with an open architecture, offering support for sharing the information and achieving a real-time overview of an incident.

The number and diversity of the external participants and the active discussions during the trials was very well appreciated.

The PULSE's support for actions/data logging and post incident analysis was very well regarded in both trials.

What should be improved?

Interoperability with existing national and international systems was mentioned as a major issue for a successful implementation.

Data validation (especially for the manually input data) as well as the data protection and ethical aspects regarding to the collecting / storage of the information were mentioned as areas that would require further developments.

Extending the functionality to other medical sectors (laboratory data, veterinary, support for drugs devices, other emergency services) and testing the platform on larger systems would enhance and complete the PULSE's platform.

<u>The final comments and ratings</u>

PULSE has received very good ratings for the trials organizations and a high level of satisfaction of the participants.

6.1.6 Technical Assessment, Summary

The main findings from the technical assessment by the platform and tool developers are that all criteria applied, - flexibility, dependability, scalability, interoperability, and usability as defined in the questionnaire – were evaluated basically "very satisfactory", with suggested improvements of dependability and interoperability.

As the evaluation was performed by internal staff only, it must be critically viewed. Nevertheless, the check-back to the performance evaluation done by external stakeholders revealed no significant differences to the performance evaluations in the MCI case, and a slightly more sceptical external evaluation in the EVD case.

Generally, for a system at this prototype stage, the evaluations of system performance from external stakeholder <u>and</u> from internal developers can be judged as very satisfactory.

7   Terms and Acronyms

Term/ Acronym	Meaning
CCS	Casualty Clearing Station
DVST	Decision Support Validation Tool
ECDC	European Centre for Disease prevention and Control
EELPS	Ethical, Economical, Legal, Political, Societal
ePCR	Electronic Patients Care Records
EVD	Emerging viral disease (scenario)
HSC	Health Security Committee
ICT	Information and Communications Technology
LEPPI (-team)	Legal, Ethical, Privacy and Policy Issues
LMS	Learning Management System
MCDA	Multi-Criteria Decision Analysis (similar to QCA)
MCI	Mass Casualty Incident (scenario)
MoE	Measure of Effectiveness
MoP	Measure of Performance
MPORG	Multi-Player Operations Role Game
PMA	PULSE Mobile Application
Q	Often use as abbreviation of "Question"
QCA	Qualitative Criteria Assessment (similar to MCDA)
R&D	Research and Development
RCS	Recognized Current Situation
SC	Scene (Corresponds to the term Use Case in the EVD trial
SOP	Standing (or Standard) Operating Procedure
SWOT	Strengths, Weaknesses, Opportunities, Threats (a common high-level evaluation methodology)
TRL	Technology readiness level
UC; U/C	Use Case
WHO	World Health Organization

8 References

[1] EUROPEAN COMMISION - HORIZON 2020 – WORK PROGRAMME 2014-2015 General Annexes G. Technology readiness levels (TRL) (https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf)

[2] Belton & Tewart: Multi Criteria Decision Analysis – an Integrated Approach, Kluwer Academic Publschers, 2002: https://books.google.de/books?hl=de&lr=&id=mxNsRnNkL1AC&oi=fnd&pg=PR11&dq=mcda+multi+criteria+decision+analysis&ots=DKJoKSAzJE&sig=nE1Q9odQ1tihrjLiiEkVlQkbokc#v=onepage&q=mcda%20multi%20criteria%20decision%20analysis&f=false or full copy: http://bookzz.org/s/?q=multiple+criteria+decision+analysis+belton&t=0

[3] ValuSec Project, D6.3 : http://www.valuesec.eu

[4] ECOSSIAN Project: http://ecossian.eu

[5] CIRAS Project: http://www.cirasproject.eu

[6] ISO/TS 14441:2013 Health informatics -- Security and privacy requirements of EHR systems for use in conformity assessment)

[7] „Decision Support Systems – Concepts and Resources for Managers" Daniel J. Power, 2002, Quorum Books – Westport, Connecticut, ISBN-1-56720-497-X, Page 12/13

[8] Complexity in healthcare management: ..., in International Journal of Healthcare Management, Vol.9, 2016-Issue1

[9] International Federation of Red Cross....,"Emergency needs Assessment", http://www.ifrc.org/en/what-we-do/disaster-management/responding/disaster-response-system/emergency-needs-assessment

[10] https://ec.europa.eu/digital-single-market/en/eu-funded-projects

[11] https://www.typeform.com

[12] Ethics Appraisal and Societal Impact in H2020: http://ec.europa.eu/rea/pdf/5_ethics_in_h2020.pdf

Annex 1: EELPS Details

EELPS Criteria and Guide

 (For a further detailed EELPS rationale see D7.1, Annex7)

A1.1   The EELPS criteria

The criteria presented here may have varying meanings and importance depending on the subject of evaluation. For example, the protection of personal data in a system for improving healthcare in cases of pandemic, has characteristics which are different from that of personal data protection evidenced in domestic smart energy systems.

This section discusses the tentative qualitative criteria with respect to their characteristics and features they might show in PULSE.

Societal criteria have two dimensions. They may (a) describe how a system (such as the PULSE platform) may impact society and individuals, and (b) show how society, societal groups or individuals will perceive and evaluate such a system. The scales may vary from positive (welcome, appreciation,) to negative (fear, rejection, protests) reactions. The need, relevance and expected effects related to the criteria discussed, may in certain cases (e.g. for ethical or legal issues) be perceived differently by different stakeholders, by individuals, by social groups, by IT systems providers and operators or by politicians.

98 criteria developed in the ValueSec [3] project were taken as a starting point for selecting those that might be relevant for systems like PULSE. However, we have also used other relevant projects and societal impact sources (as outlined below). These sources were analysed and reviewed for applicable criteria. The criteria developed in this document for PULSE also underwent several rounds of discussion as part of WP8.

The grouping of the criteria into the EELPS categories and the individual criteria are tentative and can be adapted, if changes are required and in further iterations, or during the final evaluation. The categories and criteria descriptions listed in the table below are those which have been collaboratively determined as relevant for systems like PULSE. However, they could also be adapted to other types of systems. There could also be other criteria that might need to be included depending on the context.

The interpretation of the criteria below and of their possible benefits and shortfalls assumes a future situation when the PULSE System would be implemented in Europe. Models of how many health organisations and nations would participate, and the role of the EU in implementation and operation of such a system will be exemplified in PULSE work package 7 trial scenarios.

The Criteria are grouped into the following categories:
   1. Ethical Criteria

2. Economic Criteria
3. Legal Criteria
4. Political Criteria
5. Societal Criteria

The questions are framed using the term "measure", rather than "security measure" as PULSE might not be viewed by all external stakeholders as exclusively a "security measure".

Remark: The following part is not included in D7.1

In the tables below, column 1 lists the criteria short title, column 2 lists typical question, column 3 provides a short explanation on the possible relevance of the criterion in the PULSE context. This should not pre-empt any evaluation by the trial participants. Column 4 lists the sources of inspiration and from where the criteria have been derived. Please note, the criteria, questions and explanations have been adapted to fit the PULSE context.

List of sources (column 4, tables below)

VS 1.5= ValueSec Project here e.g. Criterion # 1.5 of the original List, (http://www.valuesec.eu)

SP=SURPRISE Project on SOST[30] (http://surprise-project.eu)

PU= PULSE D8.2 V1.0[31]

O=other analysis

A = ASSERT project = http://assert-project.eu

H2020 = H2020 societal impact [12]

A1.1.1 Ethical criteria (E)

The ethical criteria category includes criteria which address the possible impact of PULSE-like systems on ethical values and principles. Given the positive value of the PULSE system, it is important that any ethical impacts are identified and addressed early so that its success as a public health technical solution is not jeopardised in any way.

1.Ethical Criterion[32]	Question	Explanation	Source
1.1 Societal	Will the measure change societal	Societal values are relevant as a PULSE-like system could have	PU O

---

[30] SOST= Surveillance Oriented Security Technologies
[31] in particular from Table under 3.5.2; may be further explored
[32] Grey shaded criteria are of minor importance or are redundant to other criteria. They have not been implemented in the tool

1.Ethical Criterion[32]	Question	Explanation	Source
ethical values	ethical values and rights in a positive or negative way?	many effects upon them in relation to human dignity, wellbeing, healthcare access, restrictions on freedoms if emergencies and quarantines are declared.	H2020 A
1.2 Privacy	Does the measure respect the right to privacy?	There is the risk of violation of privacy when the PULSE systems tracks individuals (e.g. location, disease development, contacts with other persons, etc.), collects handles/ uses personal data .	VS4.3 PU H2020 A
1.3 Equality, non-discrimination	Does the measure support equal treatment or discriminate between certain groups or individuals?	Generally, the risk of discrimination through the PULSE-system is expected to be low to nil. But there may be special cases where the risk arises to discriminate between societal groups or even between individuals (e.g. in distributing of scarce medical resources).	PU H2020 A
1.4 Freedom	Does the measure impact freedoms of individuals? (e.g. of information, communication, assembly, travel,...)	PULSE might have an impact in cases where detention of people will be authorised due to the danger of spreading infectious diseases etc.	PU H2020 A
1.5 Confidentiality	Does the measure enable/ endanger personal (e.g. medical) information or might it lead to a breach of confidential information?	Medical information needs to be protected and rules for using this information need to be clear, established and supervised. (The rules have been documented in the related WP5&6 deliverables, in cooperation with the development of the PULSE confidentiality IT concept)	PU
1.6 Trust	Does the measure enhance trust in healthcare and other involved institutions, infrastructures, ...?	Depending on the strategy of implementation, this may be seen to be positive and negative. If the system is transparent to the end users and clearly contributes to improve preparedness and response of European Health Services, the reaction can be positive. If it is not transparent,	VS5.3

1.Ethical Criterion[32]	Question	Explanation	Source
		the perception and reaction may become very negative. A healthcare example may be the introduction of chip cards in the health system if access authorization is not transparent	
1.7 Openness/Transparency (not taken into model because it cannot be answered today)	Is the measure open and transparent (a) in terms of treatment of medical information (b) in terms of functionality?	Information on PULSE policies, procedures and practices and how the system has been designed and is being implemented should be available not only to end users, but also to other interested parties such as the public or groups representing the public.	PU
1.8 Relationships	Could the measure have an adverse or pos. impact on relationships between patients (as a group) and the organisations involved (clinical teams, hospitals)?	Adverse impacts might occur if adequate training is not provided in the use of the PULSE system.	PU
1.9 Integrity of the decision maker	Is the integrity of the decision maker on the measure verified?	The PULSE system may become operational only under the governance of multiple PPPs between EU, national governments and healthcare providers and operators. This might raise questions about the integrity of the partners and decision makers involved, on political as well as on industry level.	VS5.2
1.10 Stewarding of resources	Will the measure be able to channel resources appropriately in a public health emergency?	One of the key concerns of PULSE stakeholders is that the PULSE system should be able to steward resources appropriately, and in particular when it comes to shortages	D8.2 PULSE
1.11 Fairness	Is the security measure predisposed to make fair decisions	There should be fair crisis standards of care protocols. Policies supporting PULSE should reflect disparities in access to	D8.2 PULSE

1.Ethical Criterion[32]	Question	Explanation	Source
	on treatment and sufficiently supported by ethical guidance for public health emergencies?	care.	

A1.1.2 Economic Criteria (Ec)

The dominating economic criterion is usually return on investment (ROI). In healthcare, however, ROI calculations are not the driving decision criteria. This is due to the fact that main factors of economical influence such as value of life, type of threats and likelihood of occurrence exhibit high uncertainties, and that the implementation process of a system like PULSE may be mainly driven by socio-political rather than economical objectives and motivations. For these and other reasons, it is very hard to directly translate security investments such as PULSE into quantified monetary benefits for the "business". On the other hand, economic factors are increasingly dominating expenses on, and investments into the health sector.

Therefore, here we offer a few criteria that facilitate the evaluation of the PULSE or similar systems from an economic perspective without the need to translate them into money.

2 Economic criterion	Question	Explanation	Source
2.1 Economic stability	Does the measure contribute to, or influence economic stability?	In "regular" non-health emergency situations, the contribution of the PULSE system to economic stability may be limited. From a political point of view, however, at both the national and the EU level, the contribution of systems such as PULSE to economic stability may be significant. This will become even more important in future possible public health emergency scenarios or other crisis events.	VS6.9
2.2 Compensation for side effects	Could any undesirable side effects caused by the system	There are uncertainties in the operation of the PULSE system, all of which may not be resolved during the project. If there are any	VS3.11

2 Economic criterion	Question	Explanation	Source
	operation be effectively controlled, tolerated or compensated (e.g. via insurance, legal contracts, compensatory remedies etc.)?	side effects e.g. breach of confidentiality, unclear liabilty, it should be clear what compensation would be applicable (if at all).	
2.3 Cost-benefit	Is the benefit of the measure vs. cost, clear and transparent?	Clear cost-benefit ratios are impossible to calculate presently, as implementation and operation cost, cost sharing models etc. are outside the scope of PULSE and it would be too early to try them now. This methdology, however, allows a first order scaling of the ratio between expected investment cost and expected benefit in assumed scenarios and use cases.	SP
2.4 Validation	Does the introduction of the measure foresee measurement of the measure's effectiveness and evaluation on a regular basis?	The direct measurement of technical performance should be provided. Furtermore, the system should provide a scheme and method for capturing lessons learned which can contribute to such validation and subsequent improvements.	SP
2.5 Cooperation [33]	Will the measure support or block/hamper cooperation (e.g. among health stakeholders, between EU countries and international organisations)?	Detailed cooperation models still need to be worked out, based on existing agreements and regulations. Generally, assuming nations and the EU to expect health, economic and political benefits from the system, the cooperation between all levels will be fostered. Or the other way: Well-functioning cooperation is a decisive prerequisite for the success of the PULSE system.	O H2020 A
2.6 Market	Does the measure support/increase/d	The market advantage of future PULSE marketing and operating	VS6.4

---

[33] This could also be a political factor. The user can decide where to put it

2 Economic criterion	Question	Explanation	Source
	ecrease market advantage of the supplier, developer, operator?	partners will develop, compared to competitors not participating in the PULSE system operation. Market advantages will further grow in case a system like PULSE becomes a role model for the EU.	
2.7"Outside" sectors	Will the measure require involvement of "other" sectors (e.g. private security org's., foreign health service providers, military)?	PULSE will need the cooperation of all affected parties. This includes different but dependent health partners, national and EU organizations for healthcare. It also requires cooperation with interest groups of society, possibly NGOs, partners, subcontractors and suppliers. Depending on the cases, this may result in supporting or hampering cooperation and efficiency.	SP
2.8 Dependence on foreign technology	Is the measure dependent on "foreign technology[34]"; if so, how critical is this?	This relates to existence of a situation where the components of the techology underlying a system are sourced or imported from abroad.This might curtail the growth of local initiatives in the same industry. It may open risks from IT security exploits	VS7.2

A1.1.3 Legal Criteria (L)

Legal criteria relate to compliance with the law, and specific legal requirements, national and international rule of law, national and international treaties and contracts relevant to PULSE.

3 Legal Criterion	Question	Explanation	Source
3.1 Data protection	Does the measure endanger or support data protection & information privacy?	How is data protection guaranteed in the system, both organizationally and in terms of implemented software and rules? How flexible is the data protection concept for required adaptations to diferent national standards? Are there adequate data protection	PU H2020 A

---

[34] from outside the EU, e.g. Indian, China.

3 Legal Criterion	Question	Explanation	Source
		policies and procedures?	
3.2 Legal conformity/compliance	Does the measure comply with existing regulations and the rule of law?	Have legal requirements and possible gaps been clearly identified and assessed? Does PULSE assume adherence to a certain national legislation? Is this adequate as a role model for other EU MSs? How easily can it be adapted to different national requirements? Has this been verified with examples?	VS3.6 & 3.7
3.3 Human rights	Is the measure compatible in particular with human rights principles and the core values of the Union as human dignity, freedom, equality and solidarity?	The measure should respect human rights principles enshrined for e.g. in *Universal Declaration of Human Rights*, *EU Charter of Fundamental Rights*, *The European Convention on Human Rights (ECHR)*.	D8.2 PULSE H2020 A
3.4 International compliance	Does the measure comply with relevant international guidelines, regulations, treaties etc.?	These include: relevant legal frameworks for the preparedness planning and response to public health emergencies (e.g. International Health Regulations (IHR), Public Health European Parliament and Council regulation 851/2004 (ECDC) etc; relevant WHO and (at least samples of) bi- or multilateral agreements. .	VS3.8 PULSE

A1.1.4 Political Criteria (P)

This category sets out criteria that will help analyse the effects of PULSE relating to political issues such as political preferences and responsibility, security strategy etc. Also covered here are the political aspects that may affect the performance of, or the application options, that are open to PULSE.

4 Political Criterion	Question	Explanation	Source
4.1 Responsibilit	Is responsibility for decision making clearly assigned?	We expect the system will work rather smoothly in every-day operations and become a support	VS5.19 H2020

4 Political Criterion	Question	Explanation	Source
y and accountability		system integrated into existing decision structures. A conflict potential arises when it comes to serious disruptions of the health system with disastrous results to society. Adequate provisions must be made to demarcate responsibility, and ownership for decision making.	A
4.2 Strategy & political relevance	Does the measure fit into related health strategies (if existing); national, EU and at the international level?	PULSE should be able to fit into the existing health operational models where is is proposed to be implemented and it is also important that it is suported by policy to that extent.	VS5.12 PU
4.3 Partnerships (PPP)	Does the measure imply/call for partnerships, particularly PPP including NGOs? Are there risks of failure or abuse of these partnerships?	If the PULSE system requires public-private partnerships, adequate measures should be in place to facilitate these and optimise their use, and minimise any negative effects.	O
4.4 Reputation	Will the measure improve or reduce political reputation (e.g. locally, nationally, internationally)?	The PULSE systems has the potential of becoming a model for good cross-border collaboration in cases of public health emergencies, and the countries implementing it are expected to benefit both from the sharing of resources, as well as reputation-wise.	O
4.5 Political acceptance	What is the potential for the measure to be politically accepted?	Politicians may be reluctant to implement a EU health platform with joint responsibility. The company/organisation hosting the platform may be afraid of becoming over-regulated by the government in relation to the system's operation. How broad or narrow will be the acceptance on both sides, and at EU level?	VS1.4
4.6	Does the measure	The ISO 27000[35] series of	VS3.13

---

[35] http://www.iso.org/iso/catalogue_detail?csnumber=56891

4 Political Criterion	Question	Explanation	Source
Relation to Standards	comply with standards on information security and health informatics?	standards regarding information security matters was identified as relevant to PULSE as were the standards on privacy (ISO 29100) and health informatics (ISO 27799:2008 Health informatics -- Information security management in health using ISO/IEC 27002; ISO/TR 21089:2004 Health informatics -- Trusted end-to-end information flows; <u>ISO/TS 14441:2013 Health informatics -- Security and privacy requirements of EHR systems for use in conformity assessment)</u>	PULSE
4.7 Opportunism	Is the measure opportune to political agenda(s) & objectives other than strategy (e.g. political reputation, imminent elections)?	Politicians tend to support solutions which give them public visibility, often with a rather short-term perspective. Would a decision to implement the PULSE system be opportune from a political perspective? Political motivations for implemetation may be different in individual states and at the EU level.	
4.8 Media acceptance	How will the media respond to this measure? Have adequate steps been taken/been underlined to bring the media on board?	The PULSE systems may become a highly "visible" system. The operational concept must provide clear guidance for media liasion. The media will play a rather important role in: (a) publicising the PULSE system (b) in the early warning and alerting of the public?	VS5.9
4.9 Acceptance by civil society	How will health sector civil society organisations such as NGOs, patient advocacy groups react?[36]	If the PULSE system is to be truly succesful, a buy-in by all relevant stakeholders such as NGOs, patient and support advocacy groups is necessary.	VS5.13
4.10 Political risks	Does the measure have the potential to create political risks? (local,	Political and/or legal risks might result in cases such as e.g. risk of operational failure in case of severe crises, risk of being sued	O

---

[36] possibly linked to environmental criteria

4 Political Criterion	Question	Explanation	Source
	national, international; specific cases?)	by constitutional courts or other regulatory bodies.	

A1.1.5 Societal Criteria (S)

Societal criteria are those related to impacts upon the society, in which they are conducted, and upon different individual groups. While the category *0A1.1.1 Ethical criteria (E)* outlined criteria related to ethical aspects, here we outline criteria to evaluate the effects of a PULSE-like system on society in general. It is often not easy to make clear cut separations between societal, ethical, legal and political criteria, or define them independently of each other, and there might be some overlaps. We have tried to address these distinctions as possible.

5 Societal criterion	Question	Explanation	Source
5.1 Fundamental rights and values (not taken into the model because of strong overlap to crit.1.1, 1.4 and 3.3)	Does the measure respect or endanger fundamental rights and values e.g. family life, personal individuality, liberty, health, integrity?	A new system may unduly have an negative impact on the rights and civil liberties of individuals. The risk of this happening (deliberately or by chance) is particularly high with complex ICT systems that have direct influence on social life. Could there be cases in which these rights may be or need to be limited or impaired through the system? Will these effects be motivated politically, economically, technolgically?	VS4.1 & 4.2 & 4.4 PU H2020
5.2 Technology intrusiveness or surveillance	Does the measure support (in the positive sense) or enhance (in the negative sense) intrusion of technology in society and the private lives of individuals?	The system may foster or enhance intrusion of technology into the private sphere of individuals. The system must ensure any data collected, used, shared is necessary, fair and not unreasonably intrusive. Tracking of individuals should only as warranted and where possible, less intrusive means are used.	SP PU
5.3 Culture of (society)	Does the measure have the potential to increase control	Centralized IT systems can have or may create undemocratic control attitude towards society	VS5.1

5 Societal criterion	Question	Explanation	Source
control	over people/society[37]?	(e.g. by public surveillance or "big data" access). Could a PULSE-like system be unduly abused for gaining more control over people and their medical information? – By the medical sector institutions? by powerful companies?	
5.4 Empowerment	Will citizens feel more secure and empowered by the implementation of the measure?	Ultimately, PULSE aims to provides life-saving and treatment benefits for many European citizens, by helping prepare and respond effectively during a major medical crisis.	VS1.7 PULSE
5.5 Confidence or trust in institutions	Does the measure enhance or reduce the trust in institutions?	New and complex systems when enforced by the political system tend to create suspicion or aversion in societies. This is particualrly true if their adoption and use created unwanted effects such as increased surveillance of people, infringes people's civil liberties. Lack of transparency in relation to the sytesm and public awareness might lead to a lack of confidence and trust in medical institutions and health emergency management.	VS1.3 H2020
5.6 Needs of society	Does the measure address a documented societal security need and address threats to society?	PULSE aims to provide an interoperable framework with the ability to provide a coordinated European response to any major medical incident. Might this improve societal security and enable better preparation and response to public health threats?	H2020 A
5.7 Direct benefits to society[38]	Will the measure bring direct benefits to people/society?	Society/people may have different expectations and criteria to measure the benefits of a system. E.g. outside health emergency situations, the	SP PU H2020 A

---

[37] Might be evaluated negatively by individuals; may be evaluated positively by security organizations.
[3838] May be fused with 5.6

5 Societal criterion	Question	Explanation	Source
	Might it benefit particular segments of society or society as a whole?	benefits of the system may not even be visible. In cases of major health emergencies, the, benfits may become paramount.	
5.8 Perceived security	How does the measure influence societal feeling of security?	Real security and perceived security are two different things. How will the system contribute to the perceived and subjective feeling of security, particualrly health security?	VS2.1
5.9 Inherent impact on health	Will the measure have inherent (negative/positive) impact on the mental and/or physical health of individuals?	Are there any direct or indirect inherent factors identified which may have an influence on the physical and/or psychological health of people? Have these factors been identified, analysed and communicated before implementing the system?	VS2.4 & 2.5 PU
5.10 Attitude towards technology (not taken to the model because it overlaps to other criteria)	Will society welcome the technology and processes wich would be implemented by the measure?	Experiences with introducing new technologies show that they can create a certain attitude in societies or societal groups. With the widespread use of IT to manage public health and healthcare emergencies, the public may not show any resistance to a system that supports effective delivery of healthcare.	SP
5.11 Preparedness	Does the measure enhance general preparedness of society to cope particularly with new and unexpected risks?	One of the objectives of PULSE is to provide generic procedures and processes to enhance the effective functioning of national agencies, intra agency support in improving preparedness, response and decision making in EHS.	VS1.5 PU
5.12 Public awareness (not regarded because it cannot be	Are there adequate strategies/policies to provide information to people about the measure?	The strategy of informing people about the introduction of a new system is often poor or even deliberately misleading or even false (e.g. TTIP/CETA). Does PULSE include a strategy to	VS1.10

5 Societal criterion	Question	Explanation	Source
answered today)		inform people about the introduction and their role in its operation and effective functioning?	
5.13 Additional impacts on society	Does the measure imply or create any additional impacts for society or individuals?	Additional possible impacts on society can be: increase in the cost of healthcare due to the need to finance/support the PULSE system; generation of a false sense of health emergency management.	VS2.3 PU
5.14 Impacts on vulnerable groups (not taken to the model because it cannot be answered today)	Could the measure have adverse impacts upon vulnerable groups?	Vulnerable groups include groups, including, but not limited to: the elderly, the disabled, children and young adults, homeless people, economically disadvantaged people and people in precarious situations, immigrants or noncitizens, and lesbian, gay, bisexual, transgender or queer (LGBTQ+) people).	A H2020
5.15 Environment (Not taken to the model because it's irrelevant for PULSE)	Does the measure have significant (positive/negative) impact on environmental or other parameters valuable from societal point of view?[39]	The PULSE system might not have a direct enviromental impact in the scenarios foreseen; but there may be indirect environmental impacts e.g. the dispatch of multiple ambulances and of the wrong type of resources that might result in inefficient energy and fuel usage etc.	VS8.x

A1.2 EELPS Application Guide

This chapter guides the user of the QCA methodology through the preparation of EELPS evaluations of the PULSE system. The menus samples given are based on the EXCEL tool which was partially developed in the ECOSSIAN and PULSE projects, based on the preceding work of ValueSec [3] and CIRAS [5].

---

[39] Environmental impact, depending on the type of SM, may be broken down into many more sub-criteria

A1.2.1 Scope of the evaluation

Beside or instead of the XLS tool, the JAVA version implemented on the server of the ValueSec and CIRAS partner ATOS Spain may also be used, but the functionality is basically identical.

A1.2.2 Preparation Process

A good guidance on the necessary steps of the evaluation process is given in the ASSERT project on "Criteria for Assessing and Mainstreaming Societal Impacts of EU Security Research Activities".

This part in ASSERT is limited to the assessment of privacy (and surveillance) impact assessment (PIA) but the project also discusses social and societal impact assessment (SIA) and constructive technology assessment (CTA). There is a rather comprehensive list of steps to be generally taken for such assessments. A step by step guide to privacy impact assessment).

> 1. Determine whether a PIA (or surveillance impact assessment) is necessary
>
> 2. Identify the PIA (or surveillance impact assessment) team and set the team's terms of reference, resources and time frame;
>
> 3. Prepare a PIA (or surveillance impact assessment) plan;
>
> 4. Determine the budget for the PIA (or surveillance impact assessment);
>
> 5. Describe the proposed project to be assessed;
>
> 6. Identify stakeholders;
>
> 7. Analyse the information flows and other impacts;
>
> 8. Consult with stakeholders;
>
> 9. Determine whether the project complies with legislation;
>
> 10. Identify risks and possible solutions;
>
> 11. Formulate recommendations;
>
> 12. Prepare and publish the report, e.g., on the organisation's website;
>
> 13. Implement the recommendations;
>
> 14. Ensure a third-party review and/or audit of the PIA (or surveillance impact assessment);
>
> 15. Update the PIA (or surveillance impact assessment) if there are changes in the project;
>
> 16. Embed privacy awareness throughout the organisation and ensure accountability

These sources contain a sound analysis of different aspects and needs for such kind of assessments, and provide a number of very useful references PULSE can benefit from. For our the purpose, the points 2, 3,5, possibly 6, 9 and 10 of the above list are of importance. They will be discussed in the following chapter. The other points, in "reality" also need to be considered, however not so in a research project.

Before doing further preparation of using this methodology, it is suggested to start with a few basic questions that should be discussed and decide upon beforehand. Otherwise the potential "space of evaluation"- the number and variety of parameters- is too large. Parameters should be limited to the PULSE-specific needs.

Questions may include but will surely not be limited to:

1. Which will be the main objectives of such evaluation: e.g. benefit for society? scepticism / mistrust of society? Security increase as anticipated by society? Political preferences? Potential conflicts with the rules of law (which ones)? Different "attitudes" of different societies/societal groups? Expected constraints to and limitations of, the application of the PULSE platform and tools?
Depending on what we choose from 1. above, the criteria, the methodology setup and the evaluation process will differ substantially

2. Who will be the real or assumed evaluators: The project team? Society/societal groups; which ones? Political planners and decision makers? Operators or anticipated operators of the PULSE Platforms? Beneficiaries of the platforms, e.g. CI operators, first responders, victims , affected society , politicians….?
Just an example: Expectations of society will lead to completely different results than expectations of politicians than those of hospital operators than those of CSOs in critical infrastructures and so on.

3. How far can or should we break down and detail the evaluation; e.g. by individual tools (e.g. see PULSE architecture elements in D6.1)

4. How far can and should we formalize and organize the evaluations? Do we prefer verbal discussion, brainstorming, or scoring schemes? (we probably need all).

There will be more aspects to be discussed and decided upon to be discussed during setup of experiments and preparation of the evaluation.

A1.2.3 The QCA setup process

A1.2.3.1 General parameters and variations

The evaluation methodology uses a number of operational terms which need to be clear and kept unchanged. These definitions include few basic parameters:

1. Measure: The measure planned to be applied and which will be evaluated. Usually, in one evaluation session one can/will compare alternative measures in order to find indications on which one to prefer (e.g. the installation of CCTV cameras as opposed to intensifying personal screening. In the case of evaluating the PULSE system, individual components could be taken and compared.

2. Evaluator type: The individual or group of evaluators. Choosing different evaluator types would show how the socio-political evaluation may differ depending on the basic priority setting and objectives of different individuals or groups. An NGO may come to completely different results than a CI manager.

3. Main evaluation objective category: Objective of an evaluation could e.g. to evaluate the perception of a new system by a critical society, The expected

acceptance in a certain political constellation, , the expected risks from incompliance with international law etc. This "main objective is usually closely correlated with the type of evaluator (parameter 2. above).

4. Scenario: Assumptions on the basic characteristics of the scenario in which the security Measure is assumed to work and against which its effectiveness will be evaluated.[40]

5. Other important parameters, which may dominate a certain measure and the decision to be made, e.g. alternative political framework conditions or strategies, basic cultural differences of countries in which the same system/ measure should be operated.

For the sake of clear separation of effects, in one Evaluation Session, only one of these basic parameters should be varied. The others be kept the same. Exception may be parameter2. and 3. which are often correlated.

The following Tables give some examples of typical candidates of evaluation sessions (samples taken from another EU security project, PULSE, on a complex healthcare improvement system.

Table 11: Comparison of measures

Session Name: PULSE Eval.			
CASE Parameter	**Case 1:** National	**Case 2:** EU	**Case 3:** Reference
Measure	PULSE national/local level	PULSE incl. international level (EU+WHO)	Status Quo; no PULSE system
Evaluator type or individual	National healthcare authorities	national healthcare authority	national healthcare authority
Main evaluation objective	Public acceptance	Public acceptance	Public acceptance
Scenario	SARS	SARS	SARS
Other parameters to be varied			
Other			

In this case, the sophisticated security system(PULSE platform) will be evaluated assuming different application environments (national, case1 and EU-level, case2), against the status quo (case 3

Table 12: Comparison of different groups of interest

Session Name: PULSE Eval.			
CASE Parameter	**Case 1:** National	**Case 2:** EU	**Case 3:** Reference

---

[40] Evaluation of effectiveness is not part of a QCA analysis but needs to be performed with a different methodology based on Measures of Effectiveness (MoEs)

Measure	PULSE on national and international level (EU+WHO)	PULSE on national and. international level (EU+WHO)	PULSE on national and international level (EU+WHO)
Evaluator type or individual	Hospital operators authorities	national healthcare authority	EU healthcare authority
Main evaluation objective	Satisfaction of victims	Public acceptance	Political role model
Scenario	Major flood disaster	Major flood disaster	Major flood disaster
Other parameters to be varied			

This evaluation session would show the differences when the same system would be evaluated by three different stakeholders: Hospital operators (case1), national authorities (case2) and EU healthcare authorities (Case3).

Table 13: Comparison in different scenarios

Session Name: PULSE Eval.			
CASE Parameter	**Case 1:** National	**Case 2:** EU	**Case 3:** Reference
Measure	PULSE on national and international level (EU+WHO)	PULSE on national and. international level (EU+WHO)	PULSE on national and international level (EU+WHO)
Evaluator type or individual	National first responders	National first responders	National first responders
Main evaluation objective	Cooperation willingness of society	Cooperation willingness of society	Cooperation willingness of society
Scenario	Major flood disaster	Major pandemic	Major terror attack with international effects
Other parameters to be varied			

In this session, the cooperation of the public will be evaluated in three different scenarios, a flood (Case1), a pandemic (case2) and a terrorist attack (case3).

A1.2.3.2 Setup of sessions

Usually, in EELPS type analyses, the main objective is to compare different options or "Measures" and help the decision maker(s) find the "Best" option, and this with a consensus and compromise-building process between stakeholders of diverging interests. In security in general and in the PULSE project in particular, the scene is different: Te main objective of this EELPS experiment is to make aware of and making

transparent the different intangible factors which may be of importance for the PULSE system and its application. That means, we don't look at alternatives to the PULSE system, maybe with the exception of comparing it to a status-quo situation with no system like ES in place. Furthermore, we may want to evaluate and compare the system from different stakeholders' points of view. A CI enterprise will have different preferences and objectives than a national crisis management organization. So will a potential operator of the ES at E-SOC level have different or partially differing objectives and political preferences than a national government. An a scientific community or societal representatives, again may have different views on an ES-type system.

In PULSE, the SESSION parameters offer a range of variations:

1. Measures: It should comprise application and configuration of the PULSE system. Variations can be: Full scale or partial system, application at local, national or EU level. Many subsets of system configuration and application appear possible

2. Evaluator type: There are at least five basic different types of evaluators: (a) Society, societal groups or individuals, (b) CI operators and managers, (c) National security organizations, (d) EU/ international security organizations, and (e) the scientific community and the PULSE project team itself.

3. Main evaluation objective: The spectrum can be very large, ranging from public acceptance or appreciation to legal compliance, from national preferences to EU policy implications, from national commercial interest to improving international standards.

4. Scenario: The basic PULSE scenarios have been defined in the deliverable D2.2, covering a pandemic and a public event crush.

5. Combinatorial calculation of all parameter variations will lead to too many evaluation setups. An intelligent selection will be made

A1.2.4 Preparing the Assessment Process

Evaluations with the EELPS methodology and underlying tool require a basic understanding of the principles of utility analysis and MCDA. This is mainly state of the art. A good discussion on strengths and weaknesses, myths and practical examples can be studied in [2]. This is particularly necessary for setting up a concrete evaluation session. The evaluation itself needs some introductory briefing of the evaluating persons but the can be done without detailed methodological knowledge. It is therefore recommended to do the parameter definitions of a session and setting the system by an experienced person or group separated from the evaluation round(s) which can then be done by "stakeholders" with less methodological knowledge. In [2], e.g. it is even suggested that the problem analysis and tool preparation and setup should be supported by a facilitator external to the decision maker's organization and the evaluation is done by the decision maker or people of his organization.

A1.2.4.1 Setting the system

Categories and criteria

Criteria are the "factors of influence, in our case qualitative factors out of the societal, individual and ethical, Legal and political domain. They are grouped into these

categories. Qualities of criteria

When structuring the criteria hierarchy, the following attributes should be followed . The criteria should

- Be complete (no important criterion missing)

- Not complex (Too complex criteria be better split into different independent simple criteria

- Measurable (Here not in physical or monetary scales but in a clear set of descriptors, the simplest one being e.g. "high, medium low".

- Be understood by all and operational (clearly defined and agreed)

- Be Decomposable (structuring in a tree)

- Have no or limited and identified redundancies (see "overlaps" and "dependencies below")

- Be as far as possible "judgmental independent" Be concise; have minimum size (cover all important aspects but don't get lost in too many details and fine-structuring)

The system offers a set of predefined categories and criteria described above. The user can choose those which appear relevant to the evaluation context which we have called "Session". The user can also insert additional categories and criteria if the available ones are not sufficient or exhaustive. So the steps necessary are:

1. selection of categories and criteria

2. Inserting new categories and criteria (optional)

3. (Specify overlaps of criteria)

4. (Specify dependencies between criteria)

Steps 3. and 4 are not yet implemented in the software

Figure 26: Categories and Criteria

ID	Categories and qualitative criterion	Evaluate	Description, comments, supporting material
3	Legal & Political (LP)	Yes	Legal and Political criteria
	# of Criterions	10	
3,01	Data protection	Yes	Does the measure enhance / endanger data protection & information privacy? Are private /
3,02	Legal comformity/compliance	Yes	Doe the SM comply with existing regulations and rule of law
3,03	International compliance	Yes	Does th measure comply with international guidelines, regulations, treaties etc.?
3,04	Responsibilities	Yes	Is a shift of responsibility needed to implement the measure? with pos./neg.
3,05	Strategy & political relvance	Yes	Does the SM fit into related security strategies (if existing); national, EU and other international
3,06	Media	Yes	How will the media respond to the SM upon its introduction?
3,07	Partnerships	Yes	Does the SM imply/ require special partnerships, particularly PPP including NGOs? Are risks of
3,08	Reputation	Yes	Will the SM improve or reduce political reputation (e.g. locally, nationally, internationally)?
3,09	Acceptance	Yes	What is the potential for the measure to be politically accepted or to produce
3,10	NGOs	No	How will NGOs or other societal groups react?

Utility functions and thresholds

The possible effects, in some literature also called the performance of a criterion with

regard to the problem to be evaluated, in our case the PULSE system in the specified evaluation session are described in verbal attributes. E.g. the user acceptance of a system may have the range: -not usable -difficult to use -needs extensive training – need some instruction-easy to self learn –perfect. The Utility Function transforms this verbal scale into a numerical scale between -10 and +10 (see Figure 27).

Figure 27: A typical Utility Function
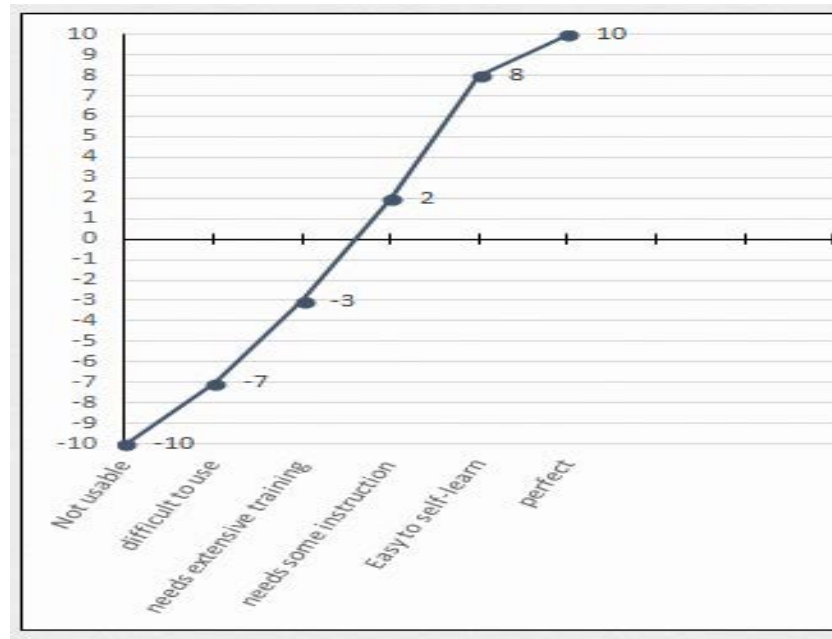
In addition, the user has the option to set a threshold. He marks the criterion as "Killer" Criterion and sets a value in the UF. The meaning of this function is that the effect ("utility" of this criterion must not lie below this threshold. During the evaluation (see 0), the user will get an alert when the "killer threshold is not achieved. There are different possibilities how to interpret and react to these occurrences, e.g. cancelling/refuting or modifying the solution.

Weightings

Weightings characterize the importance of a criterion relative to the other criteria, and the importance of a criterion relative to the other criteria within one category. The user can choose (using the slider) from a scale between 0 and 10. Weightings of all categories are automatically normalized to add up to 100%, weightings of all criteria within one Category also add up to 100% (right column in Figure 28).

There are two options of generating weights, depending on the cases set according to chapter 0:

(a) If the objectives and the evaluators are of similar type, it is suggested that weightings of categories and of criteria are the same across all cases.

(b) If we have different evaluators or groups of evaluators, each one may want to set his/her own weighting values because they have differing mind sets of preferences.

Figure 28:Weighting Input

Categories / Criterion	Weight (1-10)	Weight	%
1 Ethical €		8	38%
1,01 Social values		7	13%
1,02 Privacy		9	17%
1,03 Equality, discrimination		8	15%
1,04 Freedom		3	6%
1,05 Confidentiality		6	11%
1,06 Trust		5	9%
1,07 Transparence/ privacy		5	9%

A1.2.4.2 Evaluation

Evaluation is done for each "case" in a session (tight columns in Figure 29). Hitting the down arrow, a pop-um menu shows the verbal descriptors of the possible effects of a criterion. The evaluator chooses the descriptor he believes is appropriate. In the column to the right, the corresponding value from the UF appears. For explanation purposes he can view the UF (button Function). Do not re-iterate for purposes of manipulation!

Figure 29: Evaluation

Categories / Criterion	Weight	%	Function	Evaluation	Value	Evaluation	Value	
2 Societal (S)	6	29%						
2,01 Fundamental rights	9	17%	Function	causes some disputes	-7	causes some disputes	-7	nc
2,02 Technology intrusiveness to society	7	13%	Function	high intrusion llow cost	-8	high intrusion and cost	-10	nc
2,03 Culture of control	4	8%	Function	some potential	-8	Orson Wells potntial	-10	ne
2,04 Confidence or trust in institutions	5	10%	Function	highly improves confide	10	improves confidence	5	nc
2,05 Direct benefits to the needs of society	8	15%	Function	High	5	Very High	10	V
2,06 Perceived security	5	10%	Function	Very High	10	improved	5	nc

A1.2.4.3 View Results

Numerical results

Figure 30: Result numbers

		Measure 1	Measure 2	Measure 3
SCORE (weighted)		-1,79	-2,97	0,97
Categories	Weight	Score	Score	Score
1 Ethical €	38%	-4,13	-3,17	0,59
2 Societal (S)	29%	1,33	0,71	-1,15
3 Legal & Political (LP)	24%	-3,00	-5,75	3,96
4 Economic (Ec)	10%	1,25	-6,25	1,36
5 Category 5	none	0,00	0,00	0,00

Graphical Results

Figure 31: Result bar charts
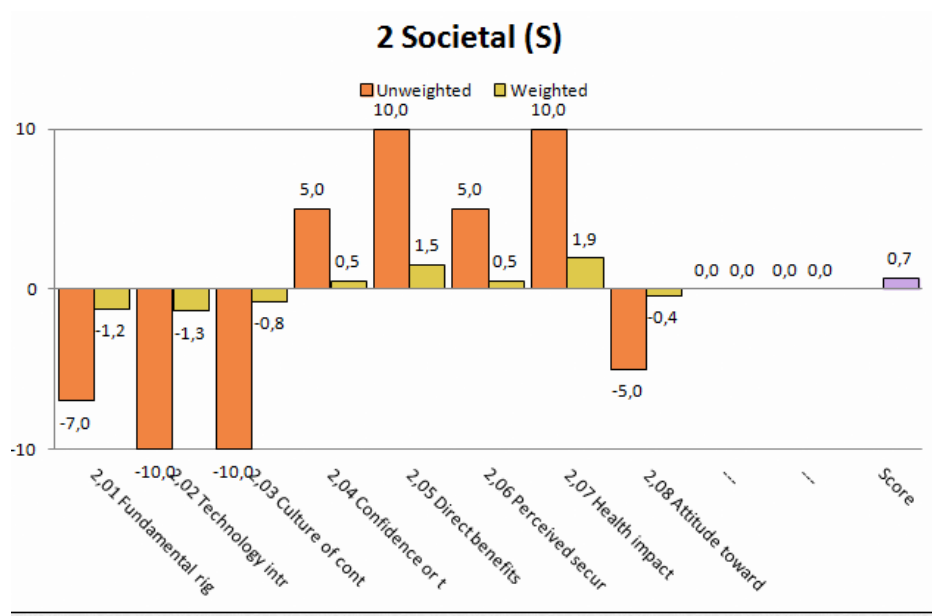
Threshold treatment

Thresholds for so-called "killer criteria" can be set in the specification of the utility functions. If the evaluation results in a score below the threshold, and alert is raised to the attention of the user of the tool.

A1.2.5 Explorational Analyses

The tool allows for a number of explorations to be setup with little effort. Depending on the need, explorations may include:

- sensitivity analysis e.g. of parameters which underlie high uncertainties
- parametric analyses. e.g. by (varying system parameters and related criteria
- varying parameters of the cases (give examples)

- allowing different weightings and evaluations by different users

parameters of the cases

- tuning of certain criteria

- Backtracking (e.g. if outcomes are too drastic and would jeopardize any solution because someone was over-ambitious)

All these explorations, depending on the motivation of the evaluator, bear the inherent risk of manipulating undesired results. Therefore, the evaluator needs to be aware of the difference between exploration and manipulation

- With exploration analyses (above), someone is interested in more detail, wants to see specific impacts, thinks he has forgotten something important,...

- With manipulation, someone wants to change results in the direction of his interest

An independent facilitator or controller may help avoid the risk of manipulation!

Annex2: EVD &MCI Trials - General Evaluation Questionnaire

The questionnaire was structured in sections with subsets of evaluation questions. Some of the questions could have been answered by evaluation criteria, selecting a rating between 1 – Not Satisfied and 5 – Fully Satisfied. Some questions could be answered by entering a free text.

The General Evaluation Questionnaire sections/questions/criteria are presented in the table:

EVALUATION CRITERIA	
1	**Setup and general approach**
	How do you rate the general preparation and setup of the Experiments?
1.1	Overall functionality of the PULSE trial
1.2	Transparency of the trial setup and preparation
1.3	Technical implementation
1.4	Technical presentation / run performance
1.5	Introduction/ training of the participants into the overall trial session
1.6	Description of the system application (was it clear and easily understandable?)
1.7	Clearness and appropriateness of the trial setup in respect to the PULSE's objectives
2	**Setup and general approach**
	How do you rate the general concept of the PULSE project - the objective, rational and system approach?
2.1	Meets basic requirements (relevance)
2.2	Meets a well identified gap in healthcare planning and decision making

2.3	Is comprehensive and well targeted
2.4	Is easy to understand
2.5	Innovative character
3	**Setup and general approach**
	Scenario: How do you rate the evaluation Scenarios and Use Cases in summary?
3.1	Adequacy to the problem
3.2	Degree of realism
3.2	Transparency of the underlying scenario
4	**Usability and acceptance/present status**
	Expected future acceptance by user groups: How do you think the finally completed PULSE toolset will be appreciated and used by different groups?
4.1	Gov. policy decision makers
4.2	Healthcare/ responder organizations
4.3	Hospitals
4.4	Private service providers
5	**Please briefly describe expected typical drivers and obstacles for future end-users to adopt and apply the PULSE system/ tools**
6	**Special recommendations** **Which were particularly positive/ convincing experiences/ findings from the trial?**
7	**Special recommendations** **What should be improved?**
8	**Special recommendations**
	Final/ summarizing comment(s) and rating
8.1	Summary evaluation of the Exercise in total
8.2	Your satisfaction with the experiments compared to your expectations

Sections 5, 6 & 7 could be answered by filling the allocated text box while for the rest of the questions / criteria the participants were asked to rate the answer by selecting a numeric value between 1 to 5.

Annex3: EVD Trial- Participant Types

EVD Trial General Assessment Questionnaire – Distribution of the results per participant type

EVD Trial General Evaluation results distribution per participants categories

How do you rate the general preparation and setup of the Experiments?

How do you rate the general concept of the PULSE project - the objective, rational and system approach?

Legend: Actor | Observer | Consortium member

Category	Actor	Observer	Consortium member
Meets basic requirements (relevance)	3.82	3.71	4.60
Meets a well identified gap in healthcare planning and decision making	3.55	3.86	4.70
Is comprehensive and well targeted	3.91	3.43	4.40
Is easy to understand	3.64	3.71	4.20
Innovative character	3.91	3.14	4.70

How do you rate the evaluation Scenarios and Use Cases in summary?

Legend: Actor | Observer | Consortium member

Category	Actor	Observer	Consortium member
Adequacy to the problem	3.82	3.29	4.50
Degree of realism	4.00	2.71	4.30
Transparency of the underlying scenario	3.91	3.86	4.60

Expected future acceptance by user groups: How do you think the finally completed PULSE toolset will be appreciated and used by different groups?

Gov. policy decision makers — Actor 3.45, Observer 3.00, Consortium member 3.70

Healthcare/responder organizations — Actor 3.64, Observer 3.14, Consortium member 4.30

Hospitals — Actor 3.45, Observer 3.00, Consortium member 4.30

Private service providers — Actor 3.36, Observer 2.71, Consortium member 3.80

Legend: Actor, Observer, Consortium member

Final/ summarizing comment(s) and rating

Summary evaluation of the Exercise in total — Actor 3.64, Observer 3.43, Consortium member 4.40

Your satisfaction with the experiments compared to your expectations — Actor 3.91, Observer 3.00, Consortium member 4.50

Legend: Actor, Observer, Consortium member

EVT Trial General Assessment Questionnaire – Distribution of the results per organization category

EVD Trial Evaluation results distribution per organization categories

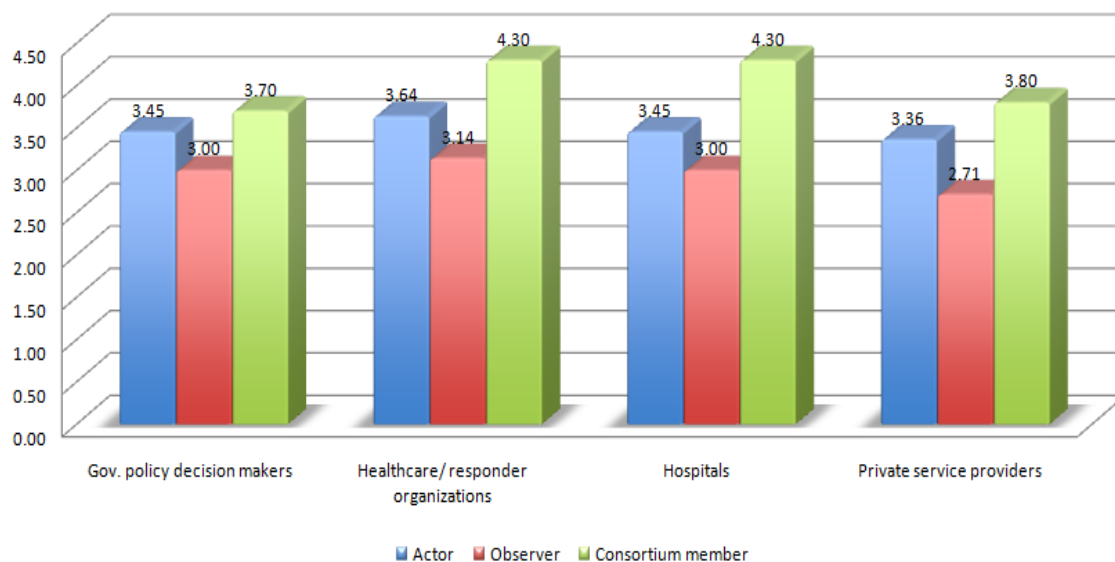- How do you rate the general preparation and setup of the Experiments?
- How do you rate the general concept of the PULSE project - the objective, rational and system approach?
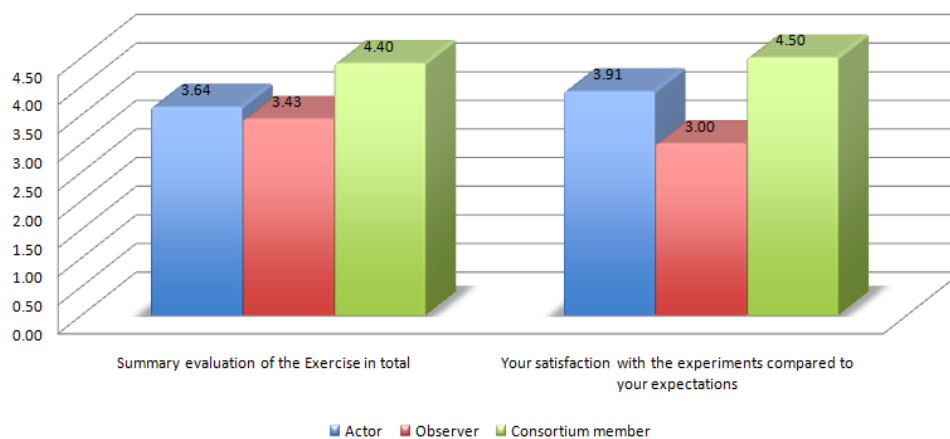- Scenario: How do you rate the evaluation Scenarios and Use Cases in summary?
- Expected future acceptance by user groups: How do you think the finally completed PULSE toolset will be appreciated and used by different groups?
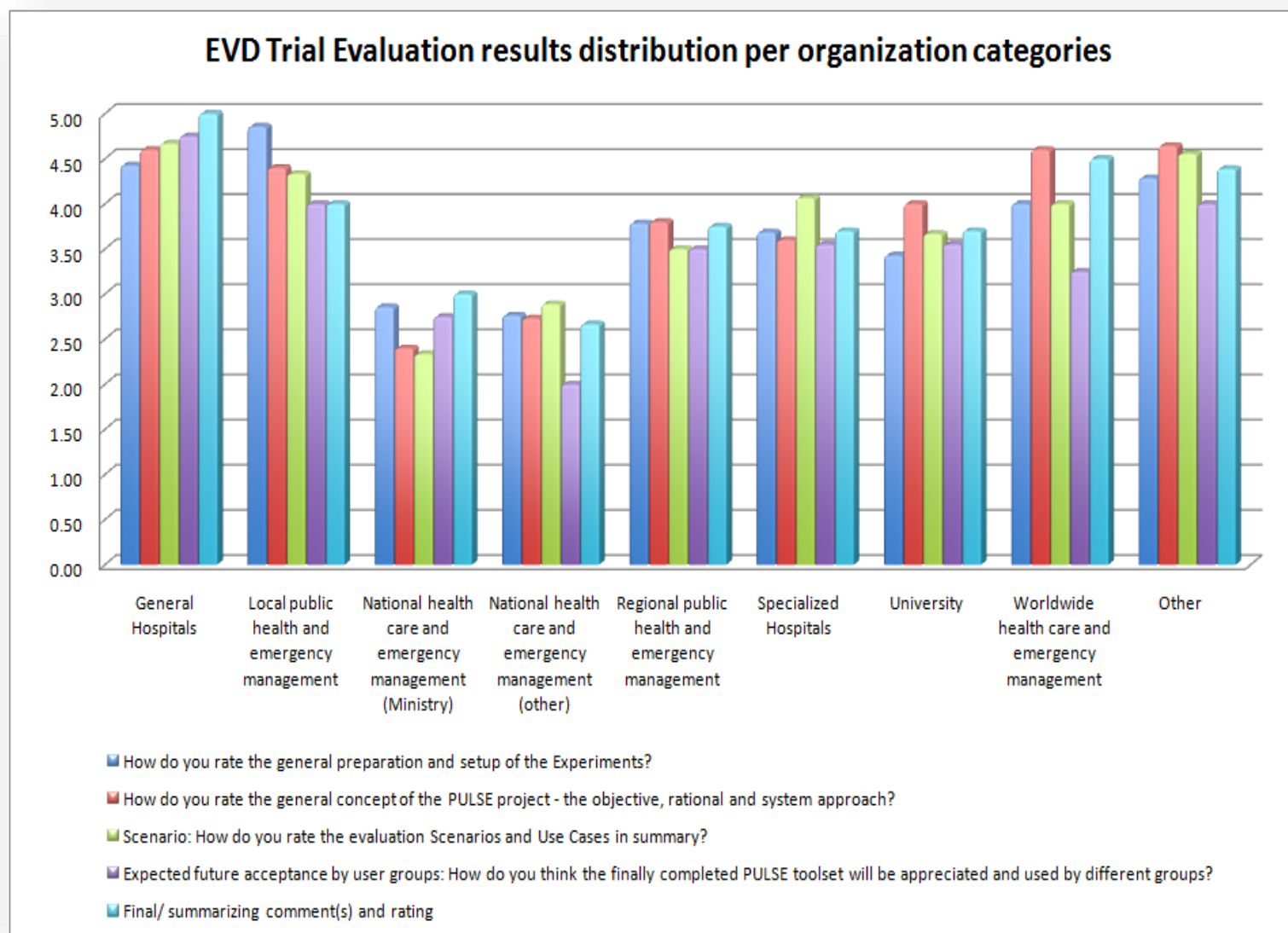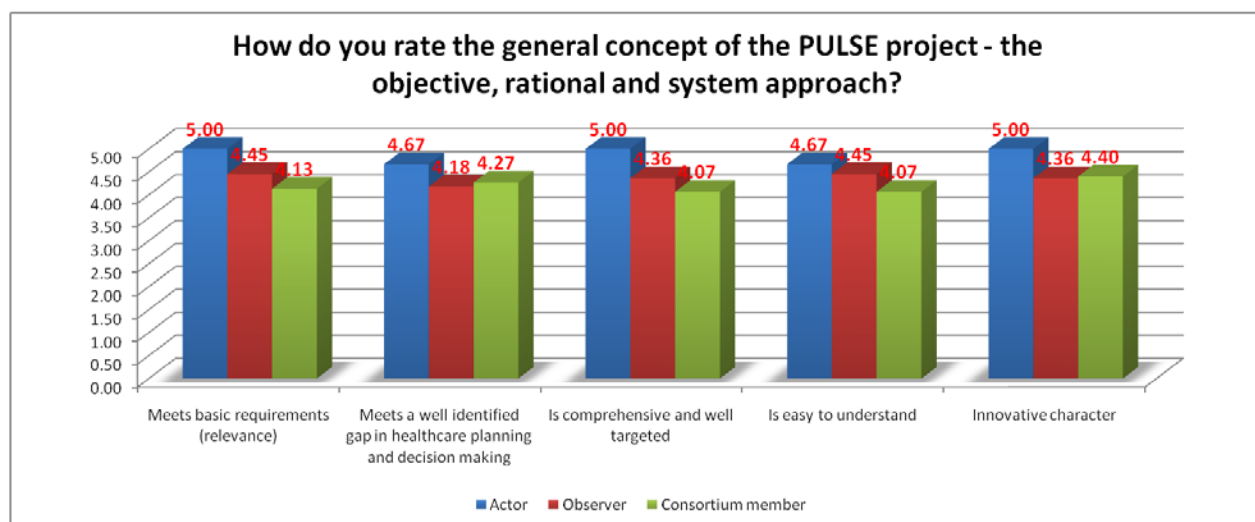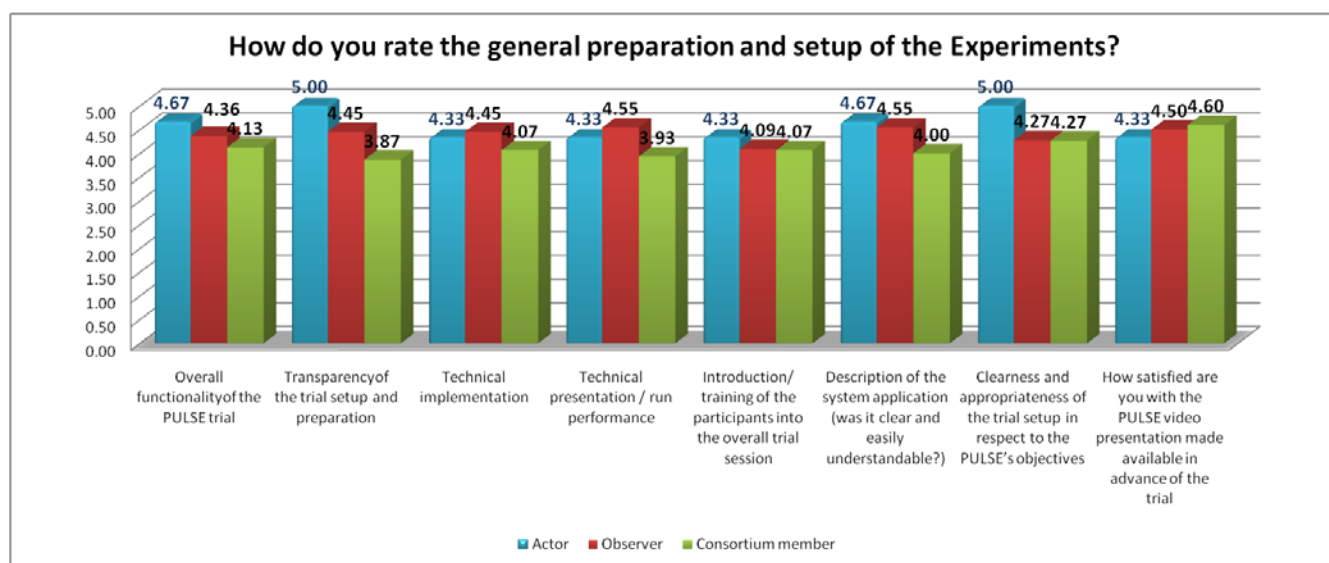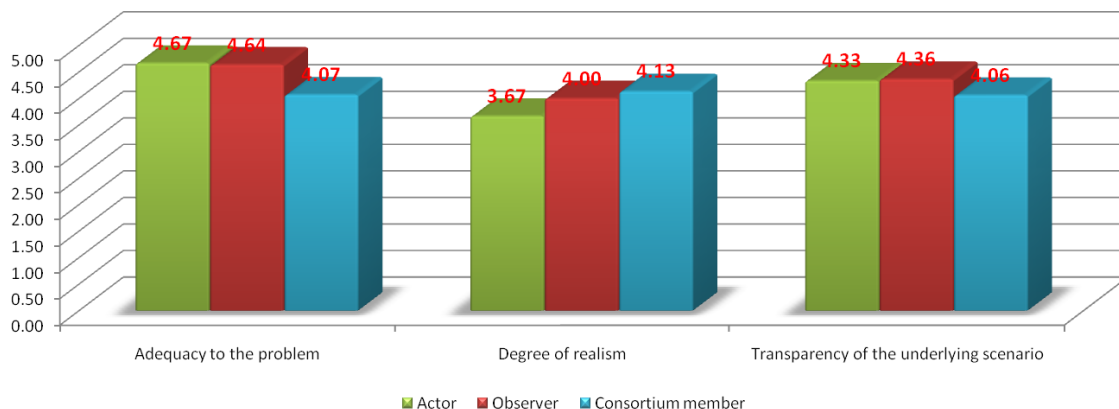- Final/ summarizing comment(s) and rating

Annex5: Detailed Total EVD Trial Evaluations

Provided as a separate EXCEL-file

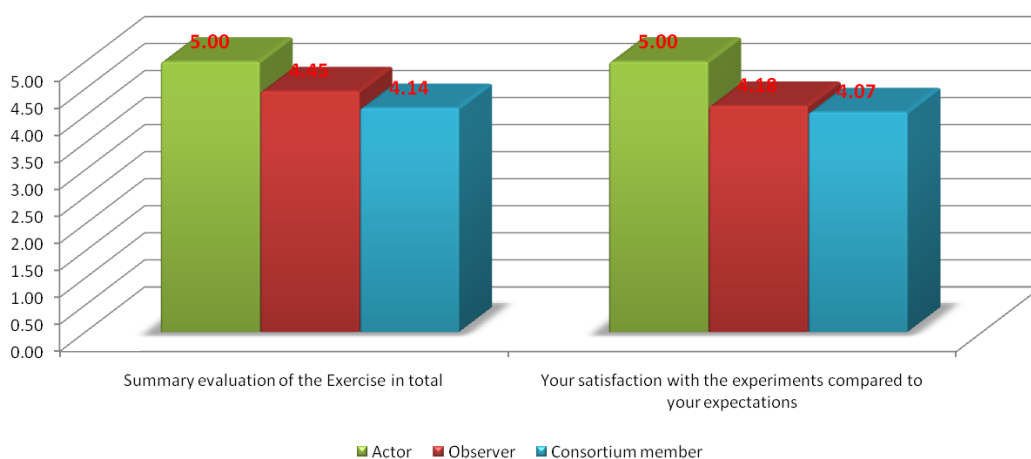# Annex6: MCI Trial General Assessment– Distribution by participant type

How do you rate the general preparation and setup of the Experiments?

How do you rate the general concept of the PULSE project - the objective, rational and system approach?

Scenario: How do you rate the evaluation Scenarios and Use Cases in summary?

Adequacy to the problem: Actor 4.67, Observer 4.64, Consortium member 4.07
Degree of realism: Actor 3.67, Observer 4.00, Consortium member 4.13
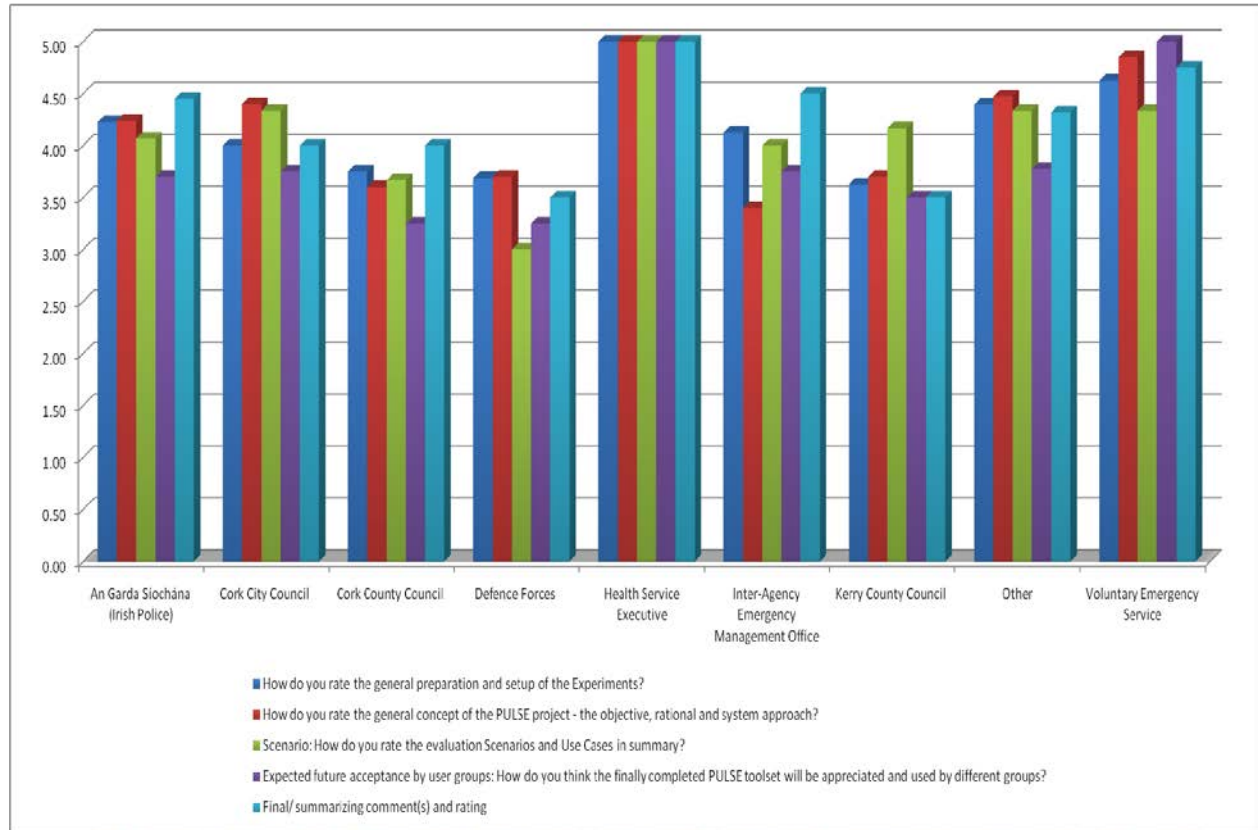Transparency of the underlying scenario: Actor 4.33, Observer 4.36, Consortium member 4.06

Expected future acceptance by user groups: How do you think the finally completed PULSE toolset will be appreciated and used by different groups?

Gov. policy decision makers: Actor 5.00, Observer 3.64, Consortium member 3.93
Healthcare/ responder organizations: Actor 5.00, Observer 3.82, Consortium member 4.20
Hospitals: Actor 5.00, Observer 3.64, Consortium member 3.80
Private service providers: Actor 5.00, Observer 3.64, Consortium member 3.73

Final/ summarizing comment(s) and rating

Summary evaluation of the Exercise in total: Actor 5.00, Observer 4.45, Consortium member 4.14
Your satisfaction with the experiments compared to your expectations: Actor 5.00, Observer 4.18, Consortium member 4.07

Annex7: MCI-General Eval.; Distrib. by Org. Category

Annex8: Detailed Total MCI Trial Evaluations

Provided as a separate EXCEL-file

Annex9: Platform and Tools Functionalities

The PULSE platform is composed of a set of tools providing a complete range of functionalities that can be exploited during the different phases of an emergency.

These functionalities have been divided in two groups and have been shown during the EVD and MCI trials, according to the desired nature of support asked to the PULSE platform (e.g. (1) real-time support during a big incident in the MCI trial and (2) more long-term support during the EVD trial).

In the following Table 14 a summary and a brief description are shown of how these functionalities (and their related tools) come into play in the two scenarios. Please refer also to D7.2 for a better understanding of the platform features and their usage during the trial.

Table 14: PULSE platform functionalities

Scenario	Tool	Functionality	Deliver-able
EVD	DSVT	• **Operational overview** During the trial the tool has been used to manage all the information regarding the persons under investigation, the probable and the confirmed cases. • **Weak Signal classification** The tool provided the possibility to monitor and analyse the weak signals generated by the IAT tool. • **Simulation** The tool showed the possible evolution of an epidemic according to customizable parameters and through the invocation of the ENSIR tool • **Recommendations** The tool sends real-time recommendations to the user according to the status of the crisis • **Risk assessment** Automatic assessment based on the number of Twitter messages received (as explained above) and the number of person that are currently under observation in the hospitals' emergency departments	D4.1
	IAT	• **Weak signal generation** It provides the generation of weak signals indicating the possible presence of an epidemic flu's breeding ground. In the context of the EVD trial, the generation of a weak signal is based on the monitoring of the number of Twitter messages containing keywords related to the influenza symptoms	D4.2
	LT	• **Resources management** Real-time storage and retrieval of the emergency resources	D4.3
	SCGT	• **Surge Capacity evolution** Assesses the number of additional beds and vaccines that are required to efficiently handle the emergency	D4.4
	PCET	• **Storage and analysis the crisis information** Elaborates the available historical data to calculate post crisis statistics	D4.6

	ENSIR	• **Epidemic evolution** Computes the expected time evolution of the spread of the disease	D4.7
MCI	DSVT	• **Operational overview** During the trial the tool has been used to manage and visualize the information regarding first responders, casualties, ambulances and hospitals • **Screen sharing** The tool can be decoupled in two separated applications: (1) Maps can be projected on a separate screen and can be shared by the users accessing the platform (2) Dashboard can be shown on the user's PC, smart phone or tablet. The user can control the map (e.g. move or zoom it, add/remove layers)	D4.1
	Smartphone app	• **First responder support** The first responders are able to send live data (e.g. triage code, audio messages, photos and notes) directly from the field and to notify his/her own availability	D4.1
	LT	• **Resources management** Real-time storage and retrieval of the emergency resources	D4.3
	Training tools	• **MPORG** Training platform for personnel involved in crisis management • **LMS** Learning management system tailored for emergency and health services with access to training courses from a wide variety of mobile devices	D4.5
	PCET	• **Storage and analysis of crisis information** Provides a detailed history of all the actions performed on monitored persons and resources	D4.6