



H2020 – Secure societies - Protecting freedom and security of Europe and its citizens
SU-DRS02-2018-2019-2020– Technologies for first responders – Research and Innovation Action (RIA)



Emerging technologies for the Early location of Entrapped victims under Collapsed Structures & Advanced Wearables for risk assessment and First Responders Safety in SAR operations

D4.13 DSS Validation, V2

Workpackage: WP4 – Data aggregation, Analysis and Decision Support

Authors:	CNR
Status:	Final
Due Date:	31/08/2022
Version:	1.00
Submission Date:	31/08/2022
Dissemination Level:	PU

Disclaimer:

This document is issued within the frame and for the purpose of the Search and Rescue project. This project has received funding from the European Union's Horizon2020 Framework Programme under Grant Agreement No. 882897. The opinions expressed and arguments employed herein do not necessarily reflect the official views of the European Commission.

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Search and Rescue Project Profile

Grant Agreement No.: 882897

Acronym:	Search and Rescue
Title:	Emerging technologies for the Early location of Entrapped victims under Collapsed Structures & Advanced Wearables for risk assessment and First Responders Safety in SAR operations
URL:	https://search-and-rescue.eu/
Start Date:	01/07/2020
Duration:	36 months

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	ESCUELA ESPAÑOLA DE SALVAMENTO Y DETECCIÓN CON PERROS (ESDP)	Spain

Document History

Version	Date	Author (Partner)	Remarks/Changes
0.10	01/06/2022	Simona Panunzi (CNR)	ToC
0.20	30/06/2022	Simona Panunzi (CNR)	Sections 1, 2
0.30	6/10/2021	Alessandro Borri	Sections 3.1
0.40	02/08/2022	Simona Panunzi (CNR), Marcello Pompa	Sections 4,5.1,6
0.50	04/08/2022	Kallia Angelaki (KT), Christos Angelidis (KT)	Revision Sections 1-6, drafting Sections 5.2, Annex III
0.60	05/08/2022	Simona Panunzi (CNR), Marcello Pompa	Revision Sections 1-6, drafting Section 7, Annex I, Annex II
0.61	13/8/2022	Athanasios Siouras (AiDEAS)	Internal review
0.62	23/8/2022	Gianluca Mandò (THALIT)	Internal review
0.63	23/8/2022	Simona Panunzi (CNR)	Corrections based on comments
0.70	26/08/2022	Christodoulos Santorinaios (NTUA)	Quality Control
1.00	31/08/2022	Christos Ntanos (NTUA)	Final Version to be submitted

Executive Summary

The aim of the present deliverable is to present the second version of the DSS validation process. It includes the description of the software verification process, the results from the first tabletop for the DSS validation, the results from the first S&R Use Case and the description of the simulated scenarios, object of the second tabletop. The second tabletop took place on July 23, 2022, and all the members of the panel of experts (instituted previously) were invited to participate with the task of identifying possible shortcomings or important user requirements not already considered in the development of the DSS in its current version.

The second tabletop will involve only the evaluation of the PHYSIO DSS, since the SOT DSS was already object of evaluation in two previous Use Cases (UC1 and UC5).

The PHYSIO DSS, even if partially integrated into the CONCORDE platform was not tested by the users, during the two previous use cases because at that time it required even more integration work to take full advantage of its functionality. On the other hand, the integration process of the various components and technologies developed during the S&R project will continue for the entire duration of the project. As in the first meeting with the Evaluation Committee, also in the second meeting various simulated scenarios were presented (described in Section 6) to illustrate the functionalities of the S&R PHYSIO DSS platform from the user's point of view.

Feedback gathered will serve to improve the component even if its second and final version has already been submitted. The upcoming real Search & Rescue Use Cases will be however an occasion to test the modified versions of the DSS.

Section 2, Methodology, summarizes the DSS validation approach, Section 3 details the software verification; Section 4 summarizes the results from the first tabletop; Section 5 shows the results from the SOT DSS validation (post-exercise phase) in the real setting of the UC1 and UC5; Section 7, Conclusions, summarizes the results achieved and their usefulness in relationship with future work to be performed.

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List of Abbreviations

Abbreviation /acronym	Description
EMS	Emergency Medical Services
DSS	Decision Support System
ETD	Expected Time to Death
PSV	Physiological State Variable
START	Simple Triage And Rapid Treatment
S&R	Search & Rescue
SOAP	Simple Object Access Protocol
XML	Extensible Markup Language
M2M	machine-to-machine

1 Introduction

One of the objectives of the Search & Rescue is that of designing and implementing a Decision Support System providing first responders with an instrument capable to support crisis managers and first responders in decision making about resources allocations and victim prioritizations taking into account the dynamicity (changes) proper of a crisis event.

The Decision Support System (DSS) component is constituted of two sub-components: the Strategical/Operational/Tactical (SOT) DSS component and the PHYSIO (PHYSIOlogical evolution of the victim) DSS component.

At the present stage of the project, the SOT and PHYSIO DSS have already been delivered in their final version (M22) and the SOT DSS was already evaluated during both the UC1 (April 2022, M22) and UC5 (June 2022, M24).

The SOT DSS assists and helps the coordination of the response activities, using data from multiple, heterogeneous sources (historical and real-time data) and provides the following Services:

- **Service 1** "*Recommendation of the most efficient allocation of resources to incidents*" concerns the recommendation of the most efficient allocation of resources to incidents by using optimization techniques. It depends on the demand of EMS units from the incident, the supply of EMS units (fleet size) from EMS stations and the location of the incident and EMS stations.
- **Service 2** "*Recommendation of the optimal allocation of patients to transport vehicles and first receivers (hospitals), based on given order of evacuation and triage results for present injuries*" concerns the recommendation of the most efficient allocation of patients to hospitals using optimization techniques. For this Service, an amount of information is used like the evacuation order the Physiological score of the patient, the location, the id of the patient and EMS unit, etc. All this information is combined in order to produce the most efficient allocation.
- **Service 3** "*Recommendation of allocation of tasks to available actors on the field, given demand pre-defined by the field commander*" concerns the recommendation of allocation of tasks to available actors on the field, given demand pre-defined by the field commander. Here again optimization techniques are used.
- **Service 4** "*the estimation of casualties*" concerns the estimation of casualties during the incident. In this Service at the current state, a solution to earthquake incidents has been implemented. A worldwide real-time earthquake catalog, the Advanced National Seismic System (ANSS) Comprehensive Earthquake Catalog (ComCat) is used. ComCat contains earthquake source parameters (e.g., hypocenters, magnitudes, phase picks and amplitudes) and other products (e.g., moment tensor solutions, macroseismic information, tectonic summaries, maps) produced by contributing seismic networks. Moreover, ComCat provides the onePAGER product, which is a summary document of the earthquake with estimated fatalities, economic losses, modified Mercalli Intensity Map and other information useful for the end-users. The information of this is open source and is provided through an API and is constantly updated.

Furthermore, the Deliverables D4.3 (M14), D4.5 (M14), D4.9 (M22), and D4.11 (M22) report all the details about the design and the implementation of the SOT DSS. As already mentioned in the deliverables above the SOT DSS is implemented by using Python v3.8. For optimization problems,

Pyomo (Optimization Modeling in Python) v5.7 is used as the main library which is able to give the right tools for symbolic modeling of linear programming problems. In order to endpoints and the web service of the SOT DSS to be established Flask v2.0 was also used. Finally, the application has been containerized with Docker in order to be deployed independently on the server.

The PHYSIO DSS component, instead, provides the following functionalities:

- **Simulation of different Crisis Scenarios:** the PHYSIO DSS component is composed of a set of interconnected functions, classes of objects and algorithms which implement a simulation environment where different crisis scenarios (from the Event class), along with the associated victims, are generated. Each victim presents a series of anatomical lesions (from the Lesion class) with different levels of severity.
- **Prediction, in terms of distributions, of the physiological status of the victim:** the lesions cause the occurrence of physiological impairments along some or all of the physiological dimensions (the Physiological State Variables, PSVs). The system computes therefore the a-priori distribution of the PSVs, based on the hypothetical lesions a victim has experienced, and the rate of worsening depending on the type of lesion.
- **Update the victim's distributional physiological status based on health measurements from the field and assigned treatments (Bayesian approach):** the system then computes the evolution over time of the distributions of each PSV. The evolution is determined by the delivered treatments (from the Treatment/Manouvres/Medication class). Treatments indeed have a positive effect on certain Physiologic State Variables. A matrix associating treatments to PSVs has been defined. PSVs distributions are updated also on the basis of the recorded measurements (from the Health measurement class) from the field by implementing a totally Bayesian approach. A set of relationships between PSVs and health measurement have been defined (see Figure 6-1)
- **Estimated Time to Death for each victim:** the PSV evolution forecasts provide the information necessary for the estimate of the Expected Time to Death (ETD) which provides information for the prioritization of victims.). In principle, the ETD can be very large, indicating that the victim is not in danger (in analogy with a green code).

Automatic computation of relevant indices and scores for the assessment of the victim's impairment and triage: the functions Glasgow_Coma_Scale_computation, Sort_Triage, Sieve_Triage, Start_Triage, and Jump_Start_Triage provide instead, from a series of symptoms and signs from the field, the automatic computation of the Glasgow Coma Score and of the triage scores from the SORT, SIEVE, START and JUMP START algorithm

- [1], [2], [3], [4], [5].

The first tabletop for the DSS Evaluation, took place on February 23 (M20), during which different use cases were presented to the Evaluation Committee (see Deliverable D4.7 DSS Evaluation, M16) to show the functionalities and the usefulness of both the SOT and PHYSIO DSS. The second tabletop took place on July 21 (M25). During this event, only the PHYSIO DSS was discussed, as during the two previous

use cases it was not tested because at that time it required even more integration work to take full advantage of its functionality. On the other hand, the integration process of the various components and technologies developed during the S&R project will continue to be developed for the entire duration of the project. As already mentioned above, the final version of the PHYSIO DSS was delivered on M22. Deliverables D4.4 (M14), D4.6 (M14), D4.10 (M22) and D4.12 (M22) report all the details about the design and the implementation. We recall that the PHYSIO DSS Component is based on a client-server architecture delivered as Web Services. The PHYSIO DSS Webservice runs on a LAMP (Linux, Apache, MySQL and PHP) server located at the CNR-IASI Biomathematics Laboratory, and exposes its functionalities via WSDL (Web Services Description Language), exploiting the SOAP (Simple Object Access Protocol) [6] messaging protocol, at the URL:

<https://biomatlab.iasi.cnr.it/SearchAndRescue/SearchAndRescue.wsdl>

SOAP is a neutral messaging protocol, based on XML (Extensible Markup Language) [7], which allows for exchanging structured information. The PHYSIO DSS Web Service natively supports interoperable machine-to-machine (M2M) interaction over a network, since its interface is described in a machine-processable format. No further interoperability constraints are imposed by our architecture. Virtually any language can be used to program a client, provided that it interrogates the server following the public interface of the webservice, respecting the SOAP specifications, with the requests and the response being exchanged in XML language. This means that the technology used is such that any changes made to the services offered, and which do not require changes in inputs and outputs, are completely obscure for the user calling them. This means that the suggestions collected during the first tabletop and those that could derive from the second tabletop will not affect the integration process. From this point of view, the PHYSIO DSS represents a tool totally adaptable to any platform that needs to exploit the services offered. The aim of the present deliverable, therefore, is that of presenting the work done in the framework of the DSS validation:

1. description of the SOT and PHYSIO DSS software verification process
2. description of the results from the first tabletop for the evaluation of the S&R DSS
3. description of the results from the UC1 and UC5 for the SOT DSS
4. description of the scenarios presented during the second tabletop for the evaluation of the S&R PHYSIO DSS

2 Methodology

2.1 Background

To the same extent as deliverable D4.7 “DSS Validation”, this deliverable deals therefore with two aspects related to an effective and correctly implemented Decision Support System (DSS) release: the verification and validation of the DSS. The Methodology of the DSS Validation framework has already been described in D4.7. We recall that Verification is the process of checking whether the software system meets the specified requirements of the users; Validation is the process of checking whether the software system meets the actual requirements of the users [8], [9], [10], [11], [12].

This means that Verification deals with the correctness from an implementation point of view, and its objective is that of verifying and confirming that the outputs of the software are conform to the inputs guaranteeing that the system behaves as expected, according to the system specifications.

Validation deals with building the right model from the point of view of the applicability domain, i.e. from the point of view of the stakeholders and could be a continuous activity that occurs both during and at the end of the software development life cycle and aims to ensure that all the requirements of the end users of the system have been met. Hence the importance of having planned tabletops aimed precisely at the validation of an important part, the DSS, of the S&R platform.

2.2 The panel of experts

As part of the validation of the DSS, a commission of experts was set up, made up of three people chosen on the basis of their expertise in the field of rescue and incident management. The role of the panel was that of providing meaningful input and suggestions to evaluate and improve the services offered by the S&R DSS.

Table below reports the names and the institutions to which they belong:

Table 2-1: Members of the DSS evaluation panel

Name	Organization	expertise	Type of Organization	Country of origin
Themistoklis Karafasoulis	Greek Fire Service	Critical control room digitization for communications and Command & Control	Fire Fighters (Hellenic FireService)	Greece
Cristina Gómez Usabiaga	Servicio de Urgencia Médica de la Comunidad de Madrid – SUMMA112	Out of hospital Critical Care Mobile Unit (Advanced Life Support ambulance)	Emergency Medical Service	Spain
Daniele Gui	Policlinico Universitario “A. Gemelli”	Emergency and Trauma Surgery	Medical (Hospital)	Italy

All the members of the Evaluation Committee participated in the first live S&R Use Cases. Following the first tabletop, they were asked to fill out a questionnaire. At the end of the second tabletop, they were asked to express an evaluation of the PHYSIO DSS in terms of comments and suggestions.

3 The DSS software verification

3.1 SOT DSS verification process, second phase

SOT DSS provides recommendations to the end-users for the Strategic, Operational, and Tactical Levels of the Emergency. The SOT DSS services are making GET requests to CONcORDE's services, such as the Incident MGT service (for SOT DSS Service 1), the Triage Service (for SOT DSS Service 2), Incident MGT and User MGT services (for SOT DSS Service 3) and the PAGER API (for SOT DSS Service 4).

The **second phase** of the evaluation of the SOT DSS was initially started during the execution of the two Use Cases, (Use-Case 1 and Use-Case 5), where the four services of the SOT DSS were tested during different exercises from the experts in the field and in the presence of the Evaluation Committee. Thus, due to the implementation of the actual Use Cases using the SOT DSS through the dedicated screen in the CONcORDE platform, the services became more understandable and user-friendly to the end users and to Evaluation Committee.

Finally, the end-user can see SOT DSS recommendations, as the following figure demonstrates.

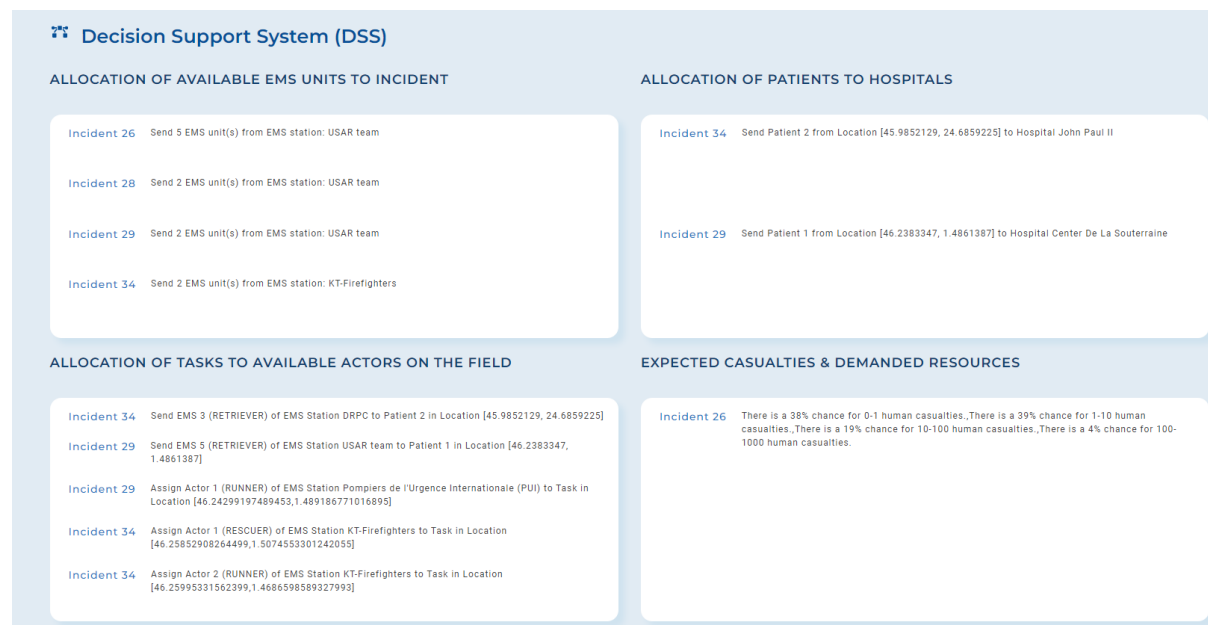


Figure 3-1 SOT DSS screen in CONcORDE platform

Additionally, during the second phase of the SOT DSS evaluation, additional functionalities have been evaluated. Especially, regarding Service 2 "optimal allocation of patients to transport vehicles and first receivers (hospitals), based on given order of evacuation and triage results from the occurred injuries", an extension that has been validated, is the allocation of EMS units to hospitals. Regarding Service 4 "Estimation of expected casualties", the Advanced National Seismic System (ANSS) Comprehensive Earthquake Catalog (ComCat) is used. Furthermore, through ComCat onePAGER product is provided. OnePAGER delivers information about an earthquake through an API, for instance, the estimated fatalities, economic losses, and other useful information for the end-users. More details about the development of the extension are provided in the "D4.11 Development of SOT DSS components V2".

Also, regarding Service 3 "optimal allocation of tasks to available actors on the field, given the specific requests by the field commander" the roles are defined based on the available actors of the CONcORDE platform are EMS Rescuer, EMS Retriever, and EMS Runner.

The evaluation of the SOT DSS will continue in the forthcoming S&R Use Cases, during the implementation of different Use Cases scenarios such as forest fire, terrorism attacks, chemical substances spill, etc. with the aim of improving the SOT DSS services.

3.2 PHYSIO DSS verification process, second phase

As already detailed in the previous project deliverables (for example D4.6), the development and test of the different software modules constituting the PHYSIO DSS Component employ different techniques and programming languages. In particular, CNR-IASI employs MATLAB® as a mathematical language and numerical simulation framework for prototyping functions and algorithms, which are later translated to C++ for fast code execution and prompt retrieval of results from the Web service.

In order to ensure full consistency of results when comparing the outputs resulting from the two implementations, an extensive simulation and validation campaign has been performed, in which the two software packages including the MATLAB® and C++ versions of the PHYSIO DSS modules are fed, each time, with the same set of inputs.

Since most of the algorithms employed in the development exploit randomized computation, in order to compute an accurate comparison, we required the two codes to employ the same sequence of pseudo-random numbers in each experiment.

To this end, we reimplemented a simple Linear Congruential Generator (LCG), defined by the following iteration

$$x_{n+1} = (ax_n + c) \bmod m$$

where a , c , m are given parameters. Starting from an integer seed $x_0 \geq 0$, such a sequence returns natural numbers bounded by $m-1$. We normalize the sequence by dividing each element by $m-1$, so that we obtain a pseudo-random generator in the interval $[0,1]$.

In the following, we report the Matlab code for the LCG function, called randBML, for a choice of parameters a , c , m ensuring maximum period length, where the period is defined as the number of samples required to observe a sample that was already returned previously. Notice that randBML can replace, whenever needed, the Matlab command rand, and returns random elements, vectors, or matrices according to the number of input parameters (0,1,2, respectively). The same function has been coded in C++ on the server side.

```

function randOutput = randBML(varargin)

% rand CNR-IASI BioMatLab
% last modified: Feb 16, 2022

global x0_rand randBML_bool;

a = 75;
c = 74;
m = 65537;

if isempty(varargin)
    nr=1;
    nc=1;
elseif length(varargin)==1
    nr=varargin{1};
    nc=1;
elseif length(varargin)==2
    nr=varargin{1};
    nc=varargin{2};
else
    fprintf('Error in the number of inputs!\n')
end

if randBML_bool==true
    randOutput=zeros(nr,nc);
    for i=1:nr
        for j=1:nc
            x0_rand=(mod((a*x0_rand)+c),m);
            randOutput(i,j)=(x0_rand/(m-1));
        end
    end
else
    randOutput=rand(nr,nc);
end

end

```

As an example of repeatable execution of a PHYSIO DSS module, we show next a sequential execution of the “Compute a priori” and of the “Expected Time to Death” (ETD) services both on the client (Matlab) and on the server (C++) side, in a simulation of an earthquake scenario.

If the Boolean variable `randBML_bool` is set to 1, the LCG algorithm is initialized with the same random number in Matlab and C++ (variables `x0_rand` and `x0_rand_server` are equal in the two environments) and simulations are comparable. The plot of the Time to Death distribution shows perfect matching between the two implementations for the same input set.

In the following Matlab code (blue boxes), the variables `A_PRIORI_PIE`, `extremeETD_priori`, `frequenciesETD_priori`, `central_measuresETD_priori`, `std_distr_priori` are computed locally, while the variables `A_PRIORI_PIE_remote`, `extremeETD_priori_remote`, `frequenciesETD_priori_remote`, `central_measuresETD_priori_remote`, `std_distr_priori_remote` are computed on the server and compared to the homologous ones, by means of the norm of the error vectors `PIE_err`, `extremesETD_err`, `frequenciesETD_err`, `central_measuresETD_err`, `std_distrETD_err`.

The results printed on the Matlab Command Window (yellow box) show negligible errors between the two computations, which allowed us to conclude that the repeatability test is successful. Notice also that the ETD execution is over 20 times faster in the C++ execution (0.66 seconds) with respect to the Matlab one (14.9 seconds).

```
%----- Simulation Parameters -----%  
% Type of event  
event_type=1;          % 1 x Earthquake  
idpat = 1; % ID patient  
date = 0; % posixtime(datetime);  
  
event_dimension=50;  
  
% Linear deviation [m] with respect to the event - uniform density over the  
% area of the event  
longitudinal_deviations=3;  
latitudinal_deviations=-1.6;  
affected_distances =sqrt(longitudinal_deviations^2+latitudinal_deviations^2);  
  
gender = 0; %1=male; 0=female  
age = 35;  
weight = 60;  
height = 165;  
demographic = [gender; age; weight; height];  
  
randBML_bool=1; % 1 for repeatable execution  
x0_rand=ceil(100*rand);
```

```

%----- A-priori distribution generation -----%
fprintf('Computing a-priori \n')
%----- Call the compute_a_priori service -----%
tic
x0_rand_server=x0_rand;
[A_PRIORI_PIE_remote,~] = compute_a_priori_remote(idpat, demographic,
longitudinal_deviations, latitudinal_deviations, event_type, event_dimension,
date);
fprintf(['      Remote execution time: ' num2str(toc,3) ' seconds\n'])

tic
A_PRIORI_PIE = compute_a_priori(idpat, demographic, longitudinal_deviations,
latitudinal_deviations, event_type, event_dimension, date);
fprintf(['      Local execution time: ' num2str(toc,3) ' seconds\n'])

PIE_err= A_PRIORI_PIE - A_PRIORI_PIE_remote;

%% ----- Call to ETD_PIE service -----%
fprintf('\n Computing a-priori ETD \n')
tic
%----- Call the ETD service -----%
x0_rand_server=x0_rand;
[extremeETD_priori_remote, frequenciesETD_priori_remote,
central_measuresETD_priori_remote, std_distr_priori_remote] =
ETD_PIE_remote(A_PRIORI_PIE_remote);
fprintf(['      Remote execution time: ' num2str(toc,3) ' seconds\n'])

tic
[extremeETD_priori, frequenciesETD_priori, central_measuresETD_priori,
std_distr_priori] = ETD_PIE(A_PRIORI_PIE);
fprintf(['      Local execution time: ' num2str(toc,3) ' seconds\n'])
end

extremesETD_err=extremeETD_priori-extremeETD_priori_remote;
frequenciesETD_err=frequenciesETD_priori-
frequenciesETD_priori_remote;
central_measuresETD_err=central_measuresETD_priori-
central_measuresETD_priori_remote;
std_distrETD_err=std_distr_priori-std_distr_priori_remote;

```

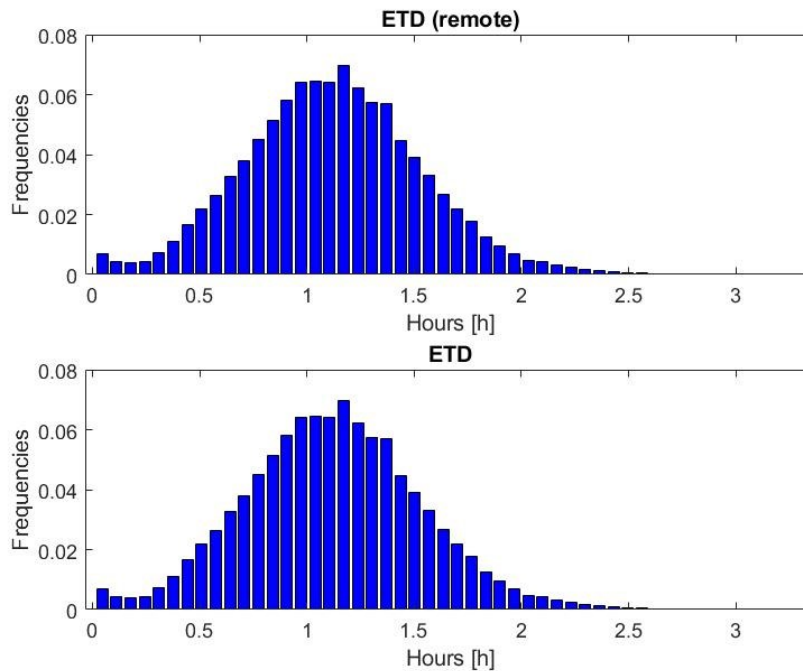


Figure 3-2 Remote and Local “Expected Time to Death” (ETD) distribution computation

```
Retrieving                                document                                at
'http://biomatlab.iasi.cnr.it/SearchAndRescue/SearchAndRescue.wsdl'
Elapsed time is 0.810994 seconds.
```

```
Computing a-priori
  Remote execution time: 5.87 seconds
  Local execution time: 11 seconds
```

```
The MAXIMUM COMPONENT-WISE ERROR between local and server computation
of PIE is 7.062e-09
```

```
Computing a-priori ETD
  Remote execution time: 0.666 seconds
  Local execution time: 14.9 seconds
```

```
The MAXIMUM COMPONENT-WISE ERROR between local and server computation
of extremeETD is 7.3275e-15
```

```
The MAXIMUM COMPONENT-WISE ERROR between local and server computation
of frequenciesETD is 0
```

```
The MAXIMUM COMPONENT-WISE ERROR between local and server computation
of central_measuresETD is 5.3291e-15
```

```
The MAXIMUM COMPONENT-WISE ERROR between local and server computation
of std_distrETD is 9.4369e-16
```

4 The 1st tabletop demonstration: results

During the first tabletop a set of Use Cases was prepared for the validation of both the SOT and PHYSIO DSS. A **Use Case** in the testing process is a description of a particular use of the software application or system by an actor or user. Each use case is planned to reproduce the actions a user can perform and the corresponding responses the software provides. For more details on the Use Cases, refer to deliverable D4.7. In the following table we report a summary of the Use Cases presented during the first tabletop.

The validation of the SOT DSS was executed through the implementation of simulated scenarios for each one of the 3 services. Each Service uses a number of specific variables as inputs and gives back an output. The presented SOT Use Cases were:

1. **Allocation of available EMS units to incidents:** allocation of available EMS units to incidents, depending on estimated needs. Use of the EMSAllocation package.
2. **Allocation of patients to transport vehicles and hospitals:** allocation of patients to EMS Units, depending on estimated needs. Use of the PatientAllocation package.
3. **Allocation of tasks to available actors on the field:** Allocation of tasks to available actors on the field. Use of the TaskAllocation package.

During the demonstration, simulated scenarios were run in order to present the functionalities of SOT DSS and their results in order to get feedback on how the SOT DSS operates from the users' perspective. The recommendations are taken into consideration in order to improve the functionality of the SOT DSS.

The live demonstration of the SOT DSS during the 1st tabletop evaluation process was implemented without the User Interface (UI). Instead, the demonstration of the simulated scenarios was executed by using Postman. It is an HTTP client that tests HTTP requests, utilizing a graphical user interface, through which we obtain different types of responses that need to be subsequently validated.

Before the execution of the simulated scenarios, an introduction to the SOT DSS was presented through a PowerPoint presentation. As a next step, three simulated scenarios were run in order to demonstrate the three Services and their results. After the completion of the evaluation, a questionnaire was released in order for the evaluation committee to provide their feedback. The main purpose of the questionnaire was to extract conclusions regarding the usefulness of the services and how understandable the outcomes are.

The Use Cases prepared to show the different functionalities of the PHYSIO DSS component were the following:

1. **Generation of a-priori distribution for victims of an earthquake:** objective of the function is the generation of a certain number of victims each one presenting with several lesions which, on the basis of their severities, determine a defect on the physiological dimensions of the victims.
2. **Computation of a-posteriori distributions from measurements from the field:** computation of the a posteriori distributions of the physiological state variables given the values of one or more health measurements from the field.

3. **Computation of a-posteriori distributions from treatment administration:** update of the a posteriori distributions of the physiological state variables given the administration of one or more treatments.
4. **Computation of the Expected Time to Death (ETD):** computation of the expected time to death based on the values and rate of worsening of the physiological state variables of the victim.

Following the first tabletop, a questionnaire was sent to the members of the evaluation committee.

The tabletop was also attended by a colleague of Prof. Daniele Gui, Sabina Magalini, a chief surgeon on call, who also offered to answer the questionnaire.

When asked if during the meeting the **scope** and **usefulness** of the DSS were clear, and if the **explanation** of the **services** and their **use** was adequate, most of the evaluators replied with YES.

Below we report the questions and the average scores relating to the items aiming at understanding the opinion of the evaluators on the extent to which the S&R DSS could improve the performance of the some functions compared to similar situations where a DSS would not be used.

Table 4-1. Average scores from the DSS Evaluation questionnaire (1)

Item	Mean response on a score from 1 (strongly disagree) to 5 (strongly agree)
S&R DSS can improve the Emergency Medical Services (EMS) dispatch to the incident	4.25
S&R DSS can improve the patient allocation to transport vehicles and/or hospitals	4.5
S&R DSS can improve the task assignment	4.5
S&R DSS can improve victim prioritization on the basis of the output of the DSS	4
S&R DSS can improve Cross-organisational Human Resource Management (HRM)	4.25
S&R DSS can improve victim information (patient status, victim physiological evolution, worsening/improvements)	4.25
The functions of the S&R DSS can satisfy the Crisis Manager's needs	3.75
S&R DSS's capabilities fulfil its purpose and scope	4.5

A further question was:

Table 4-2 Average scores from the DSS Evaluation questionnaire (2)

Question	Mean response on a score from 1 (strongly disagree) to 5 (strongly agree)
In your opinion, the S&R DSS is an efficient (easy to operate, to learn) support to the rescue activities during an emergency situation?	4.25

Table 4-3 Improvements/complaints/deficiencies of two components (PHYSIO and SOT) of the S&R DSS from the DSS Evaluation questionnaire

SOT DSS	PHYSIO DSS
"It would be great if this tool integrates with the existing tools in the emergency call centers all over the different countries, as it is difficult to be accurate as so many different organisations work under Strategic, Operational and Tactical Decision Support. It would be a challenge to use this SOT DSS integrated with each country's SOT DSS."	"I have some doubts of the fact that modelling the patient's physiology without input of data from a second triage or a direct monitoring of vital functions can be the most modern solution to following the trauma victim in her/his journey from the field to the hospital. However the proposed system is surely helpful if compared with the systems we have at the moment."
"The users' practice and the technology of the sensors (accuracy of GPS and communication) and live data for traffic would be a challenge but the algorithm is clear and effective."	"Physiological parameters interact strongly between them and this makes the tool complex to be accurate. I think it is a great job to try to measure the prognosis of the patients following the tendency of these parameters. You may consider to establish fully interactions between PSV parameters before conclusions are taken. It is a really hard work and well done!"
	"As already mentioned in the meeting, the parameter of time in the algorithm can drive a huge change in the efficacy of the model. More parameters from sensors that are used on a victim can be connected and send data live to the system may also provide more accurate predictions."

Table 4-4 Suggestions and functionalities that should be added to improve the S&R DSS from the DSS evaluation questionnaire

1)	"To reduce time and burden for EMS: monitoring the physiological parameters with some technologies on the field and from the very beginning of the triage could improve the results and reduce the overtriage"
2)	"As I have never seen it, I would assume from my experience in such projects that the more the environment is friendly for the user, the better the system is in operation. And sometimes is a make or break parameter"

5 SOT DSS validation in a real setting

5.1 S&R Use Case 1: Victims trapped under the rubble (Italy)

The first S&R Use Case (S&R UC1) took place in Poggioreale, a small community in Sicily, Italy, on April 28th, 2022, and aimed at simulating an earthquake scenario. The exercise "Victim trapped under the rubble" had as object the demonstration of some of the technologies developed in the framework of the Search and Rescue project. The SOT DSS was one of the components tested during the UC1.

The evaluation was performed in the days following the exercise. A questionnaire for each one of the components tested was set up following the suggestions of the relevant technical Partners.

Partner KT provided the necessary questions for the evaluation of the SOT DSS component. All the questionnaires circulated among the First Responders and High commanders operating in the field and in the command center and belonging to different organizations:

- one Officer from Regional Department of Civil Protection (Field Commander),
- one Officer from Fire Brigade (Field Commander),
- four First Responders from Fire Brigade

The results from the collected questionnaires were presented to the three members of the Evaluating Committee during the second tabletop for the DSS evaluation.

The main concern relevant to the questionnaire evaluation has been related to the lack of a sufficient number of responses to SOT DSS questionnaire: in fact, only the two Field Commanders provided responses relevant the component, while the four First Responders omitted most of the answers, by concentrating on the aspects relevant to other technologies tested during the UC.

In a scale ranging from 1 to 4 (1 - Unsatisfying; 2 - Not very satisfying; 3 - Satisfying; 4 - Very satisfying) the SOT DSS component obtained the following mean evaluation:

- SOT DSS: 2.9

Figure 5-1 reports the responses provided by the two users in relationship to each item:

[SnR][WP8][UC1] Victims Under Rubble - USE CASE 1 - Poggioreale (TP) - Italy - 28/04/2022

Evaluation of tested Technologies/Components

Name	Bertucci	Gioia	Di Fiore	Di Marco	Lo Giudice	Zappalà
Date of compilation	05/07/2022	27/06/2022	01/07/2022	28/06/2022	04/07/2022	01/07/2022
Role	Team leader - Field Commander	Field Commander	First Responder	First Responder	First Responder	First Responder

Technology/Component

							Average score
SOT DSS							
Time when the recommendations appeared on the SOT DSS screen	0	3					3,00
Was the allocation of EMS UNITS to the incident right with the actual requirements of units?	3	3					3,00
Was the allocation of Patients to available Hospitals helpful?	0	3					3,00
Was the task allocation of the ems users helpful, in order to divide the tasks to the available ems actor on the field?	3	3					3,00
Was the expected casualties right and aligned with the actual one?	3	3					3,00
Did High Commander and Field Commander get help from the SOT DSS recommendations?	2	3					2,50
Additional comments							2,92


 Search & Rescue

Figure 5-1 SOT DSS evaluation results from UC1

The value 0 is in correspondence of a missing response and was not considered when computing the average score.

5.2 S&R Use Case 5: Victims trapped under the rubble (France)

The Use Case 5 took place in a small town called "La Souterraine", in the Creuse department (Nouvelle Aquitaine) in the center of France, on the 18th of June 2022, organized by PUI and supported by technical partners of the S&R. The exercise site consists of collapsed buildings close to abandoned hydrocarbon storage. The Use Case 5 had as an object to demonstrate the S&R technologies through a scenario of an earthquake.

Within the evaluation process, a questionnaire ([ANNEX III](#)) was distributed to the first responders after the end of the exercise. This questionnaire summarized the entire CONCORDE platform including SOT DSS services.

The results of the evaluation of SOT DSS are presented in the following Table in a scale ranging from 1 to 3 (1 - Unsatisfactory; 2 – Satisfactory; 3 - Very satisfactory;):

[SnR][WP8][UC5] Victims Under Rubble-USE CASE 5- Limoges-La Souterraine-France-18/06/2022
Evaluation of tested Technologies/Components


Name	Jacques Vande	Charlotte Coopmann	Jean François PONS	
Role	High Commander	EMS User	EMS User	
				
SOT DSS				
				Average score
Software speed, execution performance	2	2	3	2.33
Software Ergonomics, Ease of Use, Navigation between pages and between input fields	2	3	3	2.67
Help with input (date, single or multiple choice list...)	2	2	1	1.67
Easy understanding of the data to be entered	2	3	2	2.33
Features completion	3	2	2	2.33
Total Average				2.27

Figure 5-2 SOT DSS evaluation results from UC5

6 The 2nd tabletop demonstration: results

As already mentioned above, as the SOT DSS was tested in a real setting during the S&R UC1 and UC5, it was not the object of the validation during the second tabletop which took place on July 23th, 2022.

The PHYSIO DSS was instead presented again to the evaluators after some modifications have been implemented following the suggestions from the members of the Evaluation Committee.

Figure 2 shows for example, in blue and in red, all the changes made, and implemented in a new version, posterior to the final version released on M22. As mentioned previously, in fact, the technology chosen for the delivery of the product (webservices) allows changes to be made to the system that does not affect the way of calling the services offered by the component. The updates concerned in particular the relationships between each health measurement and the considered physiological variables (refer to Deliverable D4.10 and D4.12 for more details).

Relationship between Health measurements and PSVs				
Type of data	Physiological Variable	Probability of interaction [%]	Informative	Relation Type of data and Y
<u>Hr</u>	< Normal - C1, B3 > Normal - C1, B3, C2 Normal - E1	C1 (100%) B3(100%) C1(100%), B3 (30%), C2 (90%) E1 (50%)	Yes	- C1 (0 -> 1) - B3, C2 (0 -> 1)
<u>O2</u>	Normal - A1, C1, C2 Always - B1, B2, B3, D1, D2 Normal - E1	A1(100%), C1(30%), C2(50%) B1 (70%), B2(80%), B3(80%) D1,2(100%) E1(30%)	Yes No	
<u>Temperature</u>	> Normal - E1, C1, B3, D1, D2 < Normal - E1, C1, C2	E1 (50%), C1(100%), B3(100%), D1,2(100%) E1 (50%), C1,2 (100%)	Yes Yes	(35 -> 30) - E1 (0 -> 1), C2 normal - 0 pale - 0.5 flushed - 0.5
<u>Skin</u>	Flushed - E1 Not Flushed - C2	E1 (10%) C2 (100%)	Yes (Pale / Flushed)	
<u>Breathing</u>	Normal - A1, B1, B3 Always - B2, C1	A1(100%), B1(100%), B3(50%) B2 (100%) C1(100%)	Yes	normal - y = 0 Labored - B2 = 0.5 Shallow - B2 = 0.5 Abnormal Sounds = 0.3
<u>GCS</u>	Always - D1, D2 GCS<8 - A1, B1, B3	D1,2 (100%) A1(100%), B1(100%), B3(100%)	Yes	
<u>Rr</u>	Normal - A1 < Normal - B1, B3 > Normal - B2, B3 Normal - C2	A1 (100%) B1 (100%) B3(100%) B2 (80%), B3 (50%) C2(100%)	Yes	
<u>Bp</u>	> Normal - D1, C1, B3 < Normal - C2, C1, B3	D1 (10%), C1(100%), B3(100%) C2 (100%), C1 (60%), B3(100%)	Yes	
<u>rightPupil + leftPupil</u>	< or > Normal - D1, D2	D1(100%) D2(100%)	No (Normal), Yes (out of normal range)	out of range - 0.7
<u>Airway</u>	Always - A1, B3	A1 (100%), B3(100%)	Yes	0 (false/blocked) - PSV1 = 1 1 (true/open) - PSV1 = 0
<u>capillary</u>	Always - C1	C1 (100%)	Yes	0 (false/blocked) - PSV1 = 1 1 (true/open) - PSV1 = 0

Figure 6-1 Changes to the relationships between Health measurements and PSVs

The most important suggestion that emerged from the evaluation questionnaire after the execution of the first tabletop, was related to the possibility of connecting multiple parameters from sensors positioned on the victim so that it was possible to send data to the system in real time to provide more accurate predictions.

The PHYSIO DSS is a service that can in principle be called in successive instants of time with various parameters. The choice of the type of measurements that the system currently handles was dictated by the real possibility of measuring those parameters in the field. There is nothing to prevent the system from providing continuous updates of the probable physiological state of the victim in a situation of continuous monitoring of vital parameters. The data from the sensors should be sent to a system capable of calling up the PHYSIO services in real time and showing the output.

During the tabletop different scenarios were prepared. For each victim, we performed subsequent calls to PHYSIO service. In each call, a different health measurement was passed as input, and results were

shown as a movie displayed at each time of the simulation period, and for each measurement, the currently observed value and the corresponding computed a-posteriori PSV distributions along with the continuous updating of the distribution of the Expected Time to Death. Figure 6-3 - **Error! Reference source not found.** show the values of the health measurements observed on three different victims. Red values in the tables are out of the normality range.

Patient 1 presented with all the measurements in the normal range. Figure 6-3 highlights how the a-priori distributions of eight PSVs changed to concentrate on physiological values (they shifted towards 1). The figure shows the frame of the movie at the twentieth second from the start of the simulation, where all measurements were made except the left pupil size and temperature.

PATIENT 1: NORMAL	
Event	2 - <u>Earthquake</u>
Size	150
Gender	Male
Age	70
Lat [m]	80
Long [m]	80
hr	80
O2	99
temp	36
skin	0
breathing	0
eyeOpening + verbalResponse + motorResponse	[4,5,6]
Triage Score [Glasgow Coma Scale]	15
respiratory rate	16
Systolic pressure	130
Diastolic pressure	70
rightPupil	4
leftPupil	4
airway	1
capillary refill	1
pain	0
DESCRIPTION	<u>normal</u>

Figure 6-2 Data for Simulation 1: Patient in normal condition

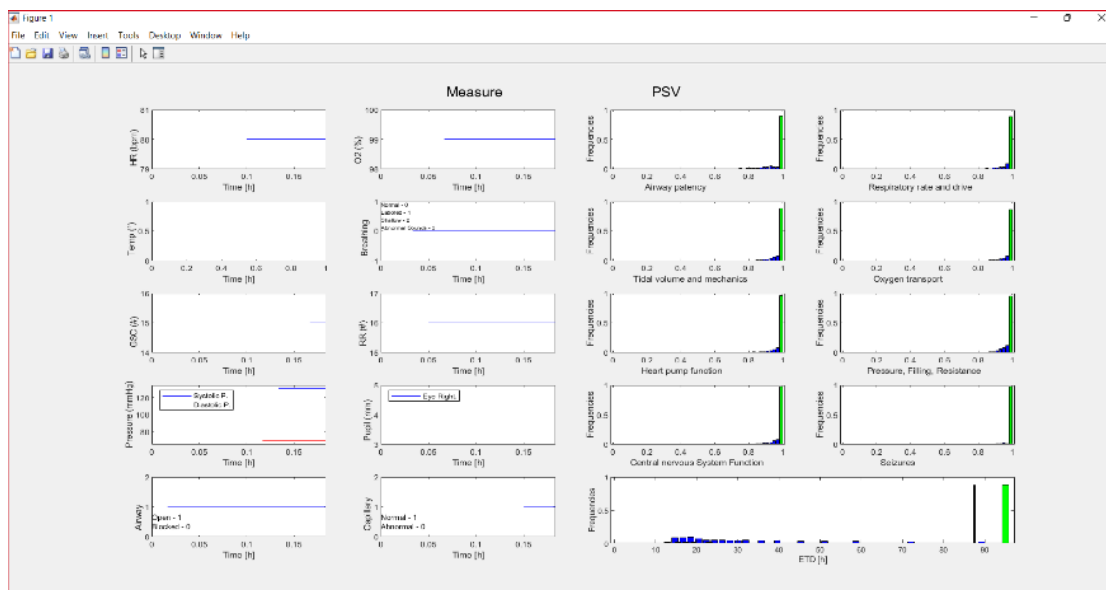


Figure 6-3 Simulation 1: Patient in normal condition

Figure 6-5 shows one of the last frames where some of the a-posteriori distributions move towards lower values of the PSVs with the distribution of the ETD concentrating around 10 hours.

PATIENT 2: HEAD TRAUMA	
Event	2 - Earthquake
Size	150
Gender	Female
Age	30
Lat [m]	10
Long [m]	10
hr	90
O2	98
temp	36,1
skin	0
breathing	0
eyeOpening + verbalResponse + motorResponse	[2,3,2]
Triage Score [Glasgow Coma Scale]	7
respiratory rate	15
Systolic pressure	180
Diastolic pressure	120
rightPupil	8
leftPupil	4
airway	1
capillary refill	1
pain	0
DESCRIPTION	head trauma

Figure 6-4 Data for Simulation 2: Patient with head trauma

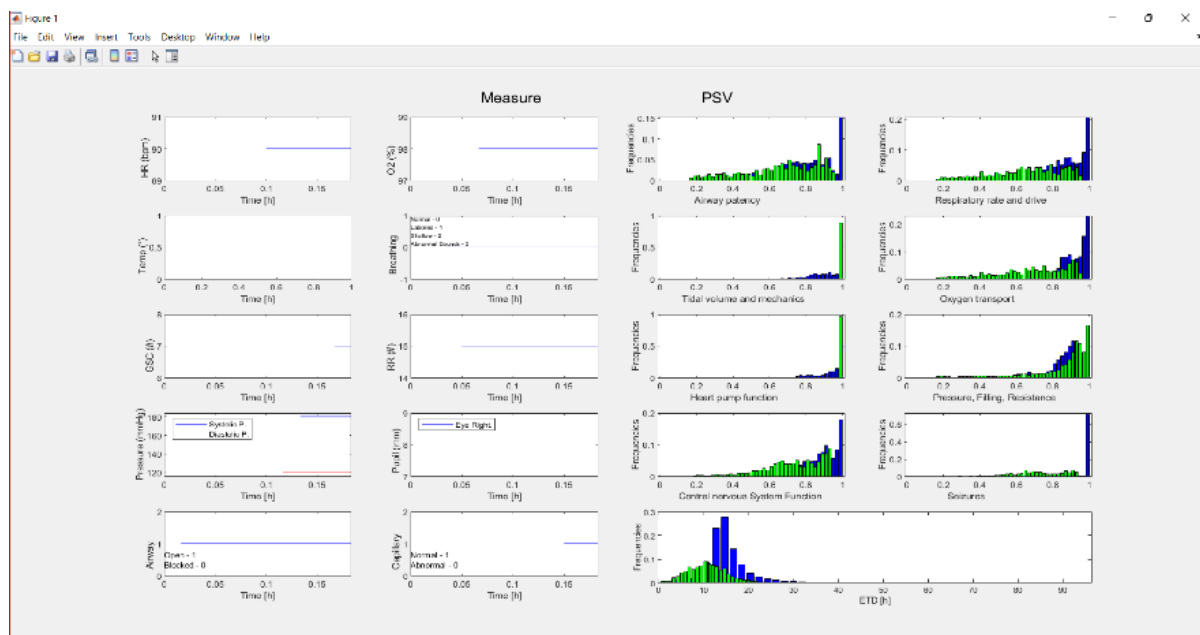


Figure 6-5 Simulation 2: Patient with head trauma

Patient 3, with bone fractures, gets worse and the final average ETD will settle down around 22 hours (final frame, not shown)

PATIENT 3: BONE FRACTURES	
Event	2 - Earthquake
Size	150
Gender	Male
Age	30
Lat [m]	40
Long [m]	40
hr	85
O2	98
temp	35
skin	1 (pale)
breathing	2 (shallow)
eyeOpening + verbalResponse + motorResponse	[4,3,6]
Triage Score [Glasgow Coma Scale]	13
respiratory rate	18
Systolic pressure	115
Diastolic pressure	60
rightPupil	4
leftPupil	4
airway	1
capillary refill	1
pain	8
DESCRIPTION	bone fractures

Figure 6-6 Data for Simulation 3: Patient with bone fracture

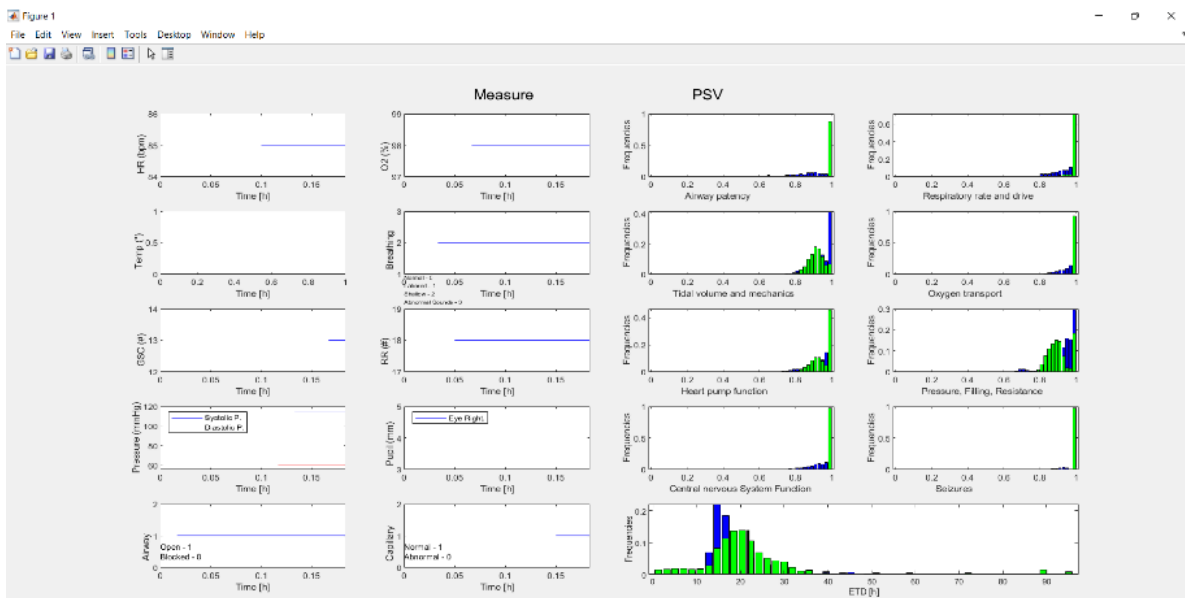


Figure 6-7 Simulation 3: Patient with bone fracture

The following figure, shows the last frame of the movie, where a progressive worsening of the physiological status of the patient occurred: after the initial measurements, all in the normal range, which produced a picture like that reported in Figures 6-5, further measurements were then made, most of which outside the normality range. The new measurements shifted the distributions of some PSVs towards low values so to determine a final average ETD of about 3 hours.

PATIENT 1: NORMAL --> BLOOD LOSS		
Event	2 - Earthquake	
Size	150	
Gender	Male	
Age	70	
Lat [m]	1	
Long [m]	1	
hr	80	125
O2	99	90
temp	36	37
skin	0	1
breathing	0	1
eyeOpening + verbalResponse + motorResponse	[4,5,6]	[4,4,6]
Triage Score [Glasgow Coma Scale]	15	14
respiratory rate	16	24
Systolic pressure	130	80
Diastolic pressure	70	40
rightPupil	4	4
leftPupil	4	4
airway	1	1
capillary refill	1	0
pain	0	4
DESCRIPTION	normal	blood loss

Figure 6-8 Data for Simulation 4: Patient initially in normal condition with progressive worsening due to a blood loss

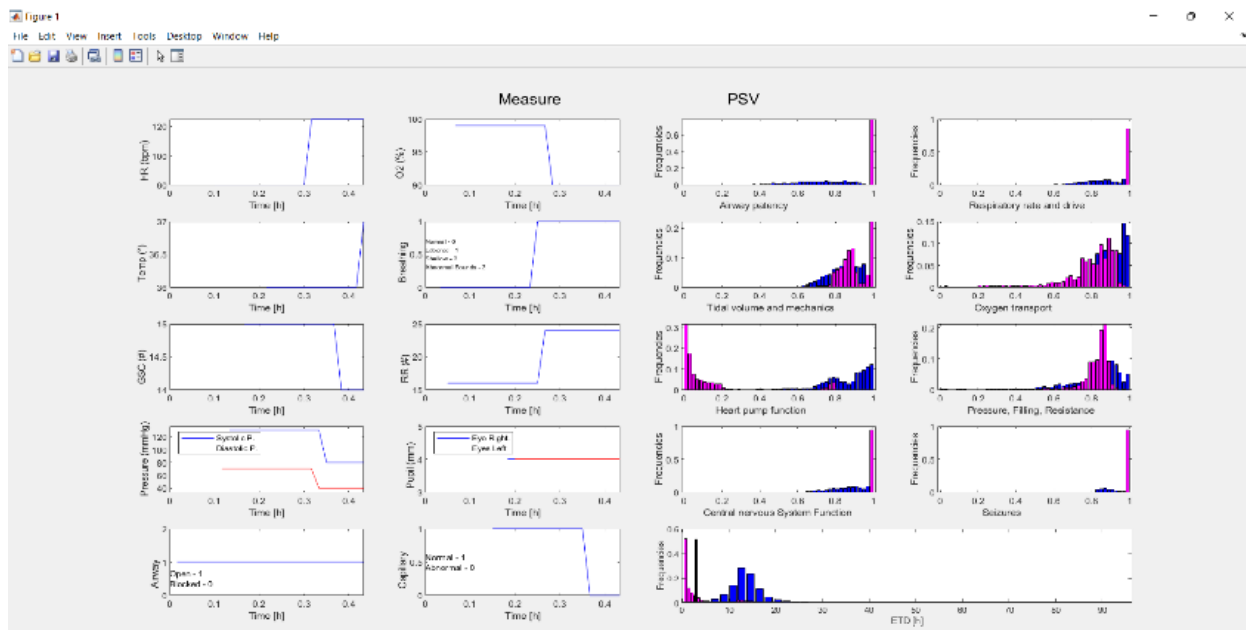


Figure 6-9 Simulation 4: Patient initially in normal condition with progressive worsening due to a blood loss

Following the second tabletop, the members of the evaluation committee were asked to give comments and further suggestions about this improved version of the PHYSIO DSS. Table below reports the responses obtained:

Table 6-1 Comments and Suggestions on the PHYSIO DSS from the second tabletop

1)	<p>"PHYSIO DSS as far as presented to us in these highly detailed tabletop demonstrations in my opinion is a very ambitious project with very prospectfull impact on self learning automatic systems for search and rescue situations. In details, the approach of feeding a dss physio algorithm with data coming out as results and experts from this Horizon project can make the algorithm 'smarter'. The efficacy to produce a tool which can provide added value to the function of first responders in big incidents is clear and its implementation is valuable. The team of dss seems to advance in knowledge quickly as it already implemented some differences to the algorithm since the last Use Case. Hopefully, more data from use cases will arrive in order to make the algorithm even better."</p>
2)	<p>"I see two problems, that I also expressed during the presentation.</p> <p>The first is that not all the patient's data can be inserted inside the algorithms since many are difficult to acquire on the field. However, I think the system can work anyway even if with less accuracy.</p> <p>The second consists in the fact that the algorithm should be tailored with the implementation of many measurements performed on real victims, so as to refine the estimate it makes which at the moment seem based o theoretical patterns.</p> <p>One factor that I find positive is that the algorithm can readjust its estimates of patient severity in function of each new parameter it acquires, allowing in this way a continuous o rub-continuous re-triage. The availability of sensors for vital parameters to apply on the victim will integrate very well with the function to which I am referring to."</p>
3)	<p>"I really think it is a very helpful tool to be implemented in emergency situations, medical service as our moreover. It is such a helpful tool to be integrated in emergency call centers that could give physiological information about victims and kind of evacuation priority tool from mass casualty incidents. It could be used to prioritize evacuation between all red colour triage victims, which are, usually, the first to be evacuated.</p> <p>For these reasons I find very important to improve the way of measuring these physiological parameters on the field. To obtain the maximum benefit of the PHYSIO DSS it becomes necessary to get periodic measurements that feed the system with information to make the algorithms work. This way, medical services like us, could have physiological trends, what gives us decisive information for the crisis management response.</p> <p>Suggestions on the PHYSIO DSS:</p> <ol style="list-style-type: none"> 1.- Carry out a pilot study in an emergency call center to validate the tool. 2.- To work together with the sensors technological providers in order to be sure the information from the victims in the field is properly acquired. If you don't get the physiological information, you can't work with the PHYSIO DSS. Sensors to be used with victims under rubbles usually give functional disorders (because the difficulty in approaching the victims, sensors breakage, extremely conditions of hypothermia, hot and warm temperatures...). Medical services in the field, can be a plan B for these complicated measurements: sometimes it is possible to put a bracelet in the wrist of the patient, and if it is not possible to place sensors to the patient, we

	could take the variables by hand and enter them in the patient's bracelet manually, could be an option. This way the PHYSIO DSS can get the trends and help us for the crisis response to our patients.
--	---

7 Conclusion

This document describes the results obtained from the Verification and Validation process of the S&R Decision Support System. The SOT DSS evaluation occurred both in the first tabletop demonstration and in a real setting, during the execution of Use Case 1 and Use Case 5. The PHYSIO DSS validation was instead performed during the first and second tabletop due to the fact that, even if partially integrated into the CONCORDE platform, at the time of the UC1 and UC5 implementation, it required even more integration work to take full advantage of its functionality. All the validation phases (Use Cases and tabletops) allowed to collect feedback and suggestions, through the administration of questionnaires to the users and to members of the Evaluation committee, with the aim of individuating ways of improvements and of verifying whether the system met the actual needs of users and stakeholders. Results from the questionnaire highlighted that the DSS represents a useful instrument with "prospect full impact" in search and rescue situations. In particular, as regards the SOT DSS, it emerged that if the tool could be integrated with existing decision support systems, this would constitute an added value. Also, if real-time traffic data were used, it would improve the system. The evaluators found the SOT DSS to be a "clear and effective" tool. Answers from the post-exercise questionnaires highlighted an average user score between "Satisfied" and "Very satisfied". Regarding the PHYSIO DSS, the evaluators highlighted the usefulness of the tool for first responders in the field. They also underlined how the integration with sensors that detect vital parameters on the victim, can be an added value in order to obtain continuous monitoring of the patient and a continuous forecast of his physiological state. Even if both the SOT and the PHYSIO DSS have been already delivered in their final versions, validation allowed to identify possible improvements for future version that could be implemented into the present project or in future projects.

ANNEX I: References

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ANNEX II: DSS evaluation results from the 1st tabletop



H2020 – Secure societies - Protecting freedom and security of Europe and its citizens

SU-DRS02-2018-2019-2020– Technologies for first responders – Research and Innovation Action (RIA)



Search & Rescue

**Emerging technologies for the Early location of Entrapped victims under
Collapsed Structures & Advanced Wearables for risk assessment and First
Responders Safety in SAR operations**

DSS Evaluation Questionnaire

Questionnaire from Prof. Daniele Gui

DSS Table-Top Evaluation questionnaire

Specify to which Organization/Agency you belong to

☐ Emergency Medical Service

xMedical (Hospital)

☐ Military

☐ Police

☐ Fire Fighters

☐ Public Institution

☐ Rescue organization

☐ Academic Institution

☐ Civil Protection

☐ Other (specify _____)

Please, specific your role in your Agency

Gender

xMale

☐ Female

Age

☐ Less than 30 years

☐ Between 31 and 40 years

☐ Between 41 and 50 years

xGreater than 50 years

During the meeting the two components of the S&R DSS were presented.

Did the presentation for the Physio DSS:

Make its scope clear? ☒ YES ☐ NO

Make its usefulness clear? ☒ YES ☐ NO

Explain adequately the services it provides? ☒ YES ☐ NO

Explain adequately how it's used? ☒ YES ☐ NO

Did the presentation for the SOT DSS:

Make its scope clear? ☒ YES ☐ NO

Make its usefulness clear? ☒ YES ☐ NO

Explain adequately the services it provides? ☒ YES ☐ NO

Explain adequately how it's used? ☒ YES ☐ NO

If necessary please add any comment

Contribution of S&R Decision Support System (DSS)

Please rate from 1 (strongly disagree) to 5 (strongly agree) to express your opinion on the extent to which the S&R DSS could improve the performance of the following functions compared to similar situations where a DSS would not be used (NA=Not Applicable)

Rate	1	2	3	4	5	NA
S&R DSS can improve the Emergency Medical Services (EMS) dispatch to the incident	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve the patient allocation to transport vehicles and/or hospitals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve the task assignment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve victim prioritization on the basis of the output of the DSS	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve Cross-organisational Human Resource Management (HRM)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve victim information (patient status, victim physiological evolution, worsening/improvements)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The functions of the S&R DSS can satisfy the Crisis Manager's needs	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S&R DSS's capabilities fulfil its purpose and scope	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

In your opinion, the S&R DSS is an efficient (easy to operate, to learn) support to the rescue activities during an emergency situation?

1	2	3	4	5	NA
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please list improvements/complaints/deficiencies of two components (PHYSIO and SOT) of the S&R DSS.

PHYSIO: _____

SOT: _____

Please suggest one or more functionalities that should be added to improve the S&R DSS:

_____ *take in to account it's important to reduce time and burden for EMS*

Monitoring the physiological parameters with some technologies on the field and from the very beginning of the triage could improve the results and reduce the overtriage

Questionnaire from Dr. Cristina Usabiaga

DSS Table-Top Evaluation questionnaire

Specify to which Organization/Agency you belong to

- ☐ **Emergency Medical Service (SUMMA 112)**
- ☐ Medical (Hospital)
- ☐ Military
- ☐ Police
- ☐ Fire Fighters
- ☐ Public Institution
- ☐ Rescue organization
- ☐ Academic Institution
- ☐ Civil Protection
- ☐ Other (specify _____)

Please, specific your role in your Agency

____ Emergency physician, emergency call center too, member of the CBRN group of SUMMA 112 _____

Gender

- ☐ Male
- ☐ **Female**

Age

- ☐ Less than 30 years
- ☐ Between 31 and 40 years
- ☐ **Between 41 and 50 years**
- ☐ Greater than 50 years

During the meeting the two components of the S&R DSS were presented.

Did the presentation for the Physio DSS:

- | | | |
|--|-------------------------------------|-----------------------------|
| Make its scope clear? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Make its usefulness clear? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Explain adequately the services it provides? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Explain adequately how it's used? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |

Did the presentation for the SOT DSS:

- | | | |
|--|-------------------------------------|------------------------------------|
| Make its scope clear? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Make its usefulness clear? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Explain adequately the services it provides? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Explain adequately how it's used? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |

If necessary please add any comment

_____The presentation of the Physio DSS was fully developed and with a few questions could be easy to understand. Meanwhile the presentation of the SOT DSS was a little bit more unclear and difficult to understand. I think we may understand it better once we do the training of it and understand how it works.

Contribution of S&R Decision Support System (DSS)

Please rate from 1 (strongly disagree) to 5 (strongly agree) to express your opinion on the extent to which the S&R DSS could improve the performance of the following functions compared to similar situations where a DSS would not be used (NA=Not Applicable)

Rate	1	2	3	4	5	NA
S&R DSS can improve the Emergency Medical Services (EMS) dispatch to the incident	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve the patient allocation to transport vehicles and/or hospitals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve the task assignment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve victim prioritization on the basis of the output of the DSS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve Cross-organisational Human Resource Management (HRM)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve victim information (patient status, victim physiological evolution, worsening/improvements)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The functions of the S&R DSS can satisfy the Crisis Manager's needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
S&R DSS's capabilities fulfil its purpose and scope	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

In your opinion, the S&R DSS is an efficient (easy to operate, to learn) support to the rescue activities during an emergency situation?

1	2	3	4	5	NA
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Please list improvements/complaints/deficiencies of two components (PHYSIO and SOT) of the S&R DSS.

PHYSIO: ____ Physiological parameters interact strong between them and this make the tool complex to be **accurate**. I think it is a great job to try to measure the prognosis of the patients following the tendency of these parameters. You may consider to establish fully interactions between PSV parameters before conclusions are taken. It is a really hard work and well done! _____

SOT: ____ *It would be great if this tool **integrates** with the existing tolls in the emergency call centers all over the different countries, as it is difficult to be accurate as so many different organisations work under Strategic, Operational and Tactical Decision Support. It would be a challenge to use this SOT DSS integrated with each country´s SOT DSS.*

Please suggest one or more functionalities that should be added to improve the S&R DSS:

Questionnaire from Themistoklis Karafasoulis

DSS Table-Top Evaluation questionnaire

Specify to which Organization/Agency you belong to

- ☐ Emergency Medical Service
- ☐ Medical (Hospital)
- ☐ Military
- ☐ Police
- ☐ Fire Fighters (Hellenic FireService)
- ☐ Public Institution
- ☐ Rescue organization
- ☐ Academic Institution
- ☐ Civil Protection
- ☐ Other (specify _____)

Please, specific your role in your Agency

_Officer (Fire Captain)_Engineer in Telecommunication Department_____

Gender

- ☐ Male
- ☐ Female

Age

- ☐ Less than 30 years
- ☐ Between 31 and 40 years
- ☐ Between 41 and 50 years
- ☐ Greater than 50 years

During the meeting the two components of the S&R DSS were presented.

Did the presentation for the Physio DSS:

- | | | |
|--|------------------------------|-----------------------------|
| Make its scope clear? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Make its usefulness clear? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Explain adequately the services it provides? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Explain adequately how it's used? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |

Did the presentation for the SOT DSS:

- | | | |
|--|------------------------------|-----------------------------|
| Make its scope clear? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Make its usefulness clear? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Explain adequately the services it provides? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Explain adequately how it's used? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |

If necessary please add any comment

Physio-Dss is a component that has a complex architecture. You should have a medical education in order to understand its full functionality. It's highly detailed and its major importance is based on details that can not be easily estimated from personnel with my education. SOT DSS was clear and would be easily adoptable from dispatch centers. Even if its presentation was a little shorter, the subject for my expertise was clearly presented.

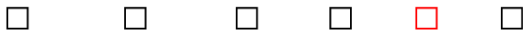
Contribution of S&R Decision Support System (DSS)

Please rate from 1 (strongly disagree) to 5 (strongly agree) to express your opinion on the extent to which the S&R DSS could improve the performance of the following functions compared to similar situations where a DSS would not be used (NA=Not Applicable)

Rate	1	2	3	4	5	NA
S&R DSS can improve the Emergency Medical Services (EMS) dispatch to the incident	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve the patient allocation to transport vehicles and/or hospitals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve the task assignment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve victim prioritisation on the basis of the output of the DSS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve Cross-organisational Human Resource Management (HRM)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve victim information (patient status, victim physiological evolution, worsening/improvements)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
The functions of the S&R DSS can satisfy the Crisis Manager's needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S&R DSS's capabilities fulfil its purpose and scope	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

In your opinion, the S&R DSS is an efficient (easy to operate, to learn) support to the rescue activities during an emergency situation?

1 2 3 4 5 NA



Please list improvements/complaints/deficiencies of two components (PHYSIO and SOT) of the S&R DSS.

PHYSIO:

As already mentioned in the meeting, the parameter of time in the algorithm can drive a huge change in the efficacy of the model. More parameters from sensors that are used on a victim can be connected and send data live to the system may also provide more accurate predictions.

SOT:

The users' practice and the technology of the sensors (accuracy of GPS and communication) and live data for traffic would be a challenge but the algorithm is clear and effective.

Please suggest one or more functionalities that should be added to improve the S&R DSS:

As I have never seen it, I would assume from my experience in such projects that the more the environment is friendly for the user, the better the system is in operation. And sometimes is a make or break parameter.

Questionnaire from Dr. Sabina Magalini

DSS Table-Top Evaluation questionnaire

Specify to which Organization/Agency you belong to

☐ Emergency Medical Service

☒ Medical (Hospital)

☐ Military

☐ Police

☐ Fire Fighters

☐ Public Institution

☐ Rescue organization

☐ Academic Institution

☐ Civil Protection

☐ Other (specify _____)

Please, specify your role in your Agency

_____ Chief Surgeon on call _____

Gender

☐ Male

☒ Female

Age

☐ Less than 30 years

☐ Between 31 and 40 years

☐ Between 41 and 50 years

☒ Greater than 50 years

During the meeting the two components of the S&R DSS were presented.

Did the presentation for the Physio DSS:

Make its scope clear?	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
Make its usefulness clear?	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
Explain adequately the services it provides?	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
Explain adequately how it's used?	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO

Did the presentation for the SOT DSS:

Make its scope clear?	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
Make its usefulness clear?	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
Explain adequately the services it provides?	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
Explain adequately how it's used?	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO

If necessary please add any comment

Contribution of S&R Decision Support System (DSS)

Please rate from 1 (strongly disagree) to 5 (strongly agree) to express your opinion on the extent to which the S&R DSS could improve the performance of the following functions compared to similar situations where a DSS would not be used (NA=Not Applicable)

Rate	1	2	3	4	5	NA
S&R DSS can improve the Emergency Medical Services (EMS) dispatch to the incident	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve the patient allocation to transport vehicles and/or hospitals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve the task assignment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve victim prioritization on the basis of the output of the DSS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve Cross-organisational Human Resource Management (HRM)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S&R DSS can improve victim information (patient status, victim physiological evolution, worsening/improvements)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
The functions of the S&R DSS can satisfy the Crisis Manager's needs	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S&R DSS's capabilities fulfil its purpose and scope	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

In your opinion, the S&R DSS is an efficient (easy to operate, to learn) support to the rescue activities during an emergency situation?

1	2	3	4	5	NA
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please list improvements/complaints/deficiencies of two components (PHYSIO and SOT) of the S&R DSS.


PHYSIO: ___ I have some doubts of the fact that modelling the patient's physiology without input of data from a second triage or a direct monitoring of vital functions can be the most modern solution to following the trauma victim in her/his journey from the field to the hospital. However the proposed system is surely helpful if compared with the systems we have at the moment.

SOT: _____


Please suggest one or more functionalities that should be added to improve the S&R DSS:


___ *Would add the possibility of performing a second evaluation or the input of some real life date with a new calculation of the trends*

ANNEX III: SOT DSS evaluation results from UC5

USE CASE 5 - France - 18/06/2022 - Evaluation of equipment					
Logiciel/Software CONCORDE Date: 18/06/2022 Evaluator/Evaluateur: Jc Pui + High cd Fonction dans l'équipe/Function in the team: Appareil testé/Device tested : CONCORDE					
User Profile	Command Post	USAR	Medical	Logistic	
Sur quel support avez-vous utilisé le logiciel	<input checked="" type="checkbox"/> Computer	<input type="checkbox"/> Tablet	<input type="checkbox"/> Smartphone		
ERGONOMICS	Très satisfaisant/ Very satisfying	Satisfaisant Satisfactory	Peu satisfaisant/ Unsatisfactory	Insatisfaisant	Commentaires / Feedback
Software speed, execution performance / Rapidité du Logiciel, performance d'exécution		X			journal événements lent
Software Ergonomics, Ease of Use, Navigation between pages and between input fields / Ergonomie du Logiciel, Facilité d'Utilisation, Navigation entre pages et entre champs de saisie		X			Satisfaisant mais peu intuitif.
Help with Input (date, single or multiple choice list ...) / Aide à la saisie (date, liste à choix simple, multiple ...)		X			Appuyé sur la documentation est trop succincte.
Easy understanding of the data to be entered / Compréhension aisée des données à saisir		X			
Features completion / Exhaustivité des fonctionnalités	X				
Difficulties met / Difficultés rencontrées	compréhension des fonctions High et field cd (interactif)				
Axes of improvement / Axes d'amélioration	Joc + précise - Logigramme des processus				
Quels sont selon vous les applications possibles pour ce produit? What do you think are the possible applications for this product?					
<input checked="" type="checkbox"/> Militaire / Military	<input checked="" type="checkbox"/> Pompier / Firefighter	<input checked="" type="checkbox"/> Industrie/ Industry	<input checked="" type="checkbox"/> Secours-Sauvetage / Rescue	<input type="checkbox"/> autres? / Other?	
Quel est votre niveau de satisfaction global (1 à 10)? What is your overall satisfaction level (1 to 10)?					
Avantages / Benefits:			Inconvénients / Disadvantages:		
suivi en direct des remontées informations			manque de maîtrise pour nous.		

* Signification des acronymes.
 Affichage SSS différente sur high cd^r/et field cd^r

USE CASE 5 - France - 18/06/2022 - Evaluation of equipment					
Logiciel/Software CONCORDE					
Date: 18/06					
Evalueur/Evaluator: Charlotte					
Fonction dans l'équipe/Function in the team: Nurse					
Appareil testé/Device tested : CONCORDE					
User Profile		Command Post	USAR	Medical	Logistic
Sur quel support avez-vous utilisé le logiciel		Computer	Tablet	Smartphone	
ERGONOMICS	Très satisfaisant/ Very satisfying	Satisfaisant Satisfactory	Peu satisfaisant/ Unsatisfactory	Insatisfaisant	Commentaires / Feedback
Software speed, execution performance / Rapidité du Logiciel, performance d'exécution		X			
Software Ergonomics, Ease of Use, Navigation between pages and between input fields / Ergonomie du Logiciel, Facilité d'Utilisation, Navigation entre pages et entre champs de saisie	X				
Help with Input (date, single or multiple choice list ...) / Aide à la saisie (date, liste à choix simple, multiple ...)		X			
Easy understanding of the data to be entered / Compréhension aisée des données à saisir	X				
Features completion / Exhaustivité des fonctionnalités		X			
Difficulties met / Difficultés rencontrées					
Axes of improvement / Axes d'amélioration					
Quels sont selon vous les applications possibles pour ce produit? What do you think are the possible applications for this product?					
<input type="checkbox"/> Militaire / Military		<input checked="" type="checkbox"/> Pompier / Firefighter	<input type="checkbox"/> Industrie/ Industry	<input checked="" type="checkbox"/> Secours-Sauvetage /Rescue	<input type="checkbox"/> autres? / Other ?
Quel est votre niveau de satisfaction global (1 à 10)? What is your overall satisfaction level (1 to 10)?					
Avantages / Benefits :			Inconvénients / Disadvantages:		
Pratique - Petits			Limite des données		

USE CASE 5 - France - 18/06/2022 - Evaluation of equipment					
Logiciel/Software CONCORDE Date: 18/06/22 Evaluator/Evaluateur: MEDICAL LEADER Fonction dans l'équipe/Function in the team: LEADER Appareil testé/Device tested: CONCORDE					
User Profile					
Command Post	USAR	Medical	Logistic		
Sur quel support avez-vous utilisé le logiciel					
	Computer	Tablet	Smartphone		
ERGONOMICS	Très satisfaisant/ Very satisfying	Satisfaisant/ Satisfactory	Peu satisfaisant/ Unsatisfactory	Insatisfaisant	Commentaires / Feedback
Software speed, execution performance / Rapidité du Logiciel, performance d'exécution	X	X	X		
Software Ergonomics, Ease of Use, Navigation between pages and between input fields / Ergonomie du Logiciel, Facilité d'utilisation, Navigation entre pages et entre champs de saisie	X	X	X		
Help with input (date, single or multiple choice list ...) / Aide à la saisie (date, liste à choix simple, multiple ...)			X		PAS DE CHOIX POUR LES PATHOLOGIES
Easy understanding of the data to be entered / Compréhension aisée des données à saisir		X			
Features completion / Exhaustivité des fonctionnalités		X			YOU CAN MAKE MORE
Difficulties met / Difficultés rencontrées					
with GLOVES IT'S NOT EASY					
Axes of improvement / Axes d'amélioration					
Quels sont selon vous les applications possibles pour ce produit? What do you think are the possible applications for this product?					
<input checked="" type="checkbox"/> Militaire / Military	<input type="checkbox"/> Pompier / Firefighter	<input type="checkbox"/> Industrie/ Industry	<input checked="" type="checkbox"/> Secours-Sauvetage / Rescue	<input type="checkbox"/> autres? / Other?	
Quel est votre niveau de satisfaction global (1 à 10)? What is your overall satisfaction level (1 to 10)?					
Avantages / Benefits:			Inconvénients / Disadvantages:		
2/10			2/10		