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Deliverable D4.4.2
Emergency Response Toolkit 2

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<td>PP Restricted</td>
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Executive Summary

Emergency Response Toolkit 2

This document presents Deliverable D4.4.2 (Emergency Response Toolkit 2) of project FP7-614154 | CNPq-490084/2013-3 (RESCUER), a Collaborative Project supported by the European Commission and MCTI/CNPq (Brazil). Full information on this project is available online at http://www.rescuer-project.org.

Deliverable D4.4.2 provides the results of the second iteration of Task 4.4 (Development of the Emergency Response Toolkit), which is concerned with the implementation of the Emergency Response Toolkit (ERTK), RESCUER component to be used by people in a command and control centre. ERTK assists a command and control centre in obtaining situational awareness of the emergency, using a set of visualisation features, and it helps the communication with the crowd at the place of incident. It consists of two subsystems: a standalone application and a Web portal.

The standalone application connects the ERTK to the RESCUER Integration Platform (described in D1.5.2 (Integrated Platform Demonstrator 2)) and receives messages from other RESCUER components (i.e., Mobile Crowdsourcing Solution and Data Analysis Solution). It processes messages and sends the results to the Web portal via REST (Representational State Transfer, an architectural style to transfer information over HTTP).

The ERTK portal is a web application implemented with the ASP.NET MVC Framework to be used by the dispatchers in the command and control centre, as well as by operation controllers, like the commanders of operations. Currently, it includes the following features: emergency map, emergency overview, reports browsing, report detail, incidents information, “extra information panels” for weather, traffic and statistics, and a coordination view for workforces’ management. Additional features will be added in the last iteration of this deliverable.

List of Authors

Silas Graffy – Vomatec (1st Version)
Matthias Breyer - Vomatec
Laia G. Pedraza - Vomatec
Paulo Roberto M. Simões Júnior – UFBA (2nd Version)

List of Internal Reviewers

Colin Greyer – Fireserv (1st Version)
Jose F Rodrigues Jr – USP (1st Version)
Vaninha Vieira – UFBA (1st Version)
Yehia Elrakaiby – Fraunhofer (2nd Version)
Ana Maria Amorim – (2nd Version)
Karina Villela – Fraunhofer (2nd Version)
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1. Introduction

1.1. Purpose

The RESCUER project aims at developing a smart and interoperable crowdsourcing-based solution for supporting emergency and crisis management, with a special focus on incidents in industrial areas and large-scale events. Both the concept and the objectives of the RESCUER project are described in the Description of Work (DoW), which is part of the EC Grant Agreement (Annex I).

The purpose of this document (D4.4.2: Emergency Response Toolkit 2) is to present the second prototype of the Emergency Response Toolkit, which has focused on the development of visualisation tools to support the coordination of operational forces and improving features of the first prototype.

1.2. Change Log

This deliverable is a living document to be modified and improved together with the prototype in the final iteration. The main changes presented in this iteration are:

- Changes in the user interface for the map, floating panels, incident and report browsers;
- Addition of new features: drawing annotations, incident merging, follow-up interaction, among others. Section 2.3 presents the new and updated features of this version;
- Addition of the coordination view.

1.3. Partners’ Roles and Contributions

Vomatec was responsible for coordinating the elaboration of this document and for the implementation of the Emergency Response Toolkit demonstrator.

UFBA contributed to the elaboration of this document and to the implementation of the Emergency Response Toolkit demonstrator.

1.4. Document Overview

The remainder of this document is structured as follows.

- Chapter 2 discusses concepts used in the ERTK, technical details, implemented features and the main challenges in the implementation.
- Chapter 3 presents next steps.
- Chapter 4 concludes this document.
2. Prototype of the Emergency Response Toolkit

2.1. Overview

The Emergency Response Toolkit is the RESCUER component used in the command and control centre that provides relevant information, in the appropriate format, and in time to support decision-making during an emergency.

The first iteration presented the concepts of Emergency Map, Emergency Dashboard and Emergency Browser. These concepts have been updated in this iteration and new ones were added. The following list presents all concepts in which the features of the ERTK are built on:

- **Emergency Map**: Features that enable showing the location of the incidents, drawing and text annotations, and crowd density and behaviour visualisation.
- **Emergency Dashboard**: Features that show statistics related to incidents and reports, traffic and weather information.
- **Emergency Browser**: Features that allow to explore information about the emergency situation.
- **Coordination of workforces**: Visualisation of the location of workforces and features to create and manage their tasks.
- **Follow-up Interaction**: Features to send messages based on location and/or to specific profiles in the crowd.

In the current state, an emergency is defined by the reports sent from the Mobile Crowdsourcing Solution. The system processes these reports and identifies the incidents reported. The set of these incidents shapes the emergency.

In the first iteration, the ERTK development focused on information visualisation techniques. The development in the second iteration focuses on coordination of workforces, follow-up interaction, and the update and addition of new features. All implemented features fit in the concepts mentioned above. While for the concept of an emergency map a “map view” has been implemented, the emergency dashboard has been implemented using so-called “extra information panels”, which can show statistics, weather and traffic information on top of all other views. The emergency browser concept has been implemented by providing browsers for incidents and reports and preview panels with summarized information or detail pages about an incident/report. The coordination of workforces has been implemented through a feature that allows creation of tasks, management of workforces, among others. Finally, the follow up interaction has been added by including a chat service and a dedicated view. Details about the implemented features can be found in Section 2.3.

2.2. Main Challenges

The first challenge comes from the fact that the user interface should be clear enough so that the general commanders and other potential users can relate wordings and symbols with what they are used to work with. Therefore, the concepts and how they are visualised must be aligned to avoid misunderstandings.
The second challenge comes from the fact that incoming data should be translated to the ERTK data model and recognised in order to be understandable by the system. A module has been created to serialize the data.

A workshop was conducted in Linz, on the 12.02.2015 with four end users. The ERTK was presented and user tests performed. The goals were to validate the current version of the ERTK from the end user’s point of view, get feedback to improve it, validate new ideas before implementing, and get more involvement from the end users. The results were satisfactory. All workshop attendants were excited with the prototype and they found it useful. Some of the features presented in this deliverable have been implemented or modified following their concerns, e.g. the merging feature.

During the period from middle of March to end of September the detailed vision of the RESCUER system was refined (see D7.3 RESCUER Vision and D1.3 Requirements Specification). As a result of this process new requirements were elicited from end-users in Brazil and Europe. These requirements describe features that lead to changes in the ERTK (e.g. Emergency Browser). We have started implementing the changes in the ERTK in this iteration, but they are all not included in this deliverable as they were incomplete at the time.

Another challenge addressed in this iteration was the need for a new architecture for the RESCUER System. The implementation of the ERTK will change considerably and this has been done in parallel with the implementation of the new features.

2.3. Technical Background

Conceptual Overview

The architecture for the ERTK valid at this time is described in D1.2.2 (System Architecture 2). It presents a general view of the components and technologies used in the development of the ERTK, and their interactions with other components of the RESCUER system. This section gives a more detailed view of how the described architecture is currently implemented.

The ERTK was divided into two main components: a Web Portal and a component called Crowd Data Processor. The latter was responsible for implementing combined data analysis. This has been changed with the new architecture design (see D1.2.3 (System Architecture 3)). The ERTK is now a Web Portal and a Communication Handler. The Web Portal is a web application designed with the concept of the MVC pattern. This concept allows the user interface to be independent of the business logic. The end-user interacts with this component through a web browser. The Web Portal exposes an interface to receive data from the Communication Handler. The Communication Handler listens for incoming data, and sends this data to the Web Portal. Figure 1 visualizes the relationship between those components.
The decision to split the ERTK into two components aimed not to overload the Web Portal. Otherwise, it would have to listen to other components continuously, which could downgrade the performance of the application.

Implementation Details

The Web Portal has been developed using ASP.NET MVC Framework. HTML5 has been used for the implementation of the views; Twitter Bootstrap\(^1\), jQuery\(^2\) and jQuery UI\(^3\) have been used for general formatting of interaction features.

The Communication Handler is implemented as a Windows console application. The data it receives comes through a message-oriented middleware called “RabbitMQ” (for details see D1.5.2 (Integrated Platform Demonstrator 2)).

2.4. Features

This section presents the features implemented in the ERTK Web Portal in this second iteration. D4.2.2 (Visualization Mechanisms for Emergency Coordination 2) already showed some of the updates done to the first prototype. This document details the new functionalities and updates.

Emergency started warning

Upon arrival of the first report in the current RESCUER monitoring session, the system starts a new emergency. This new feature is intended to warn the user with a red panel, see Figure 2. This warning panel is not removed until the user opens the incident detail view. An alternative for this feature to be tested with ERTK end users is to directly show the details of the first incident report of a RESCUER monitoring session as soon as it arrives, with the same idea of warning the command centre that an emergency started, but already providing to the ERTK end users the information that they should see.

\(^3\) jQuery UI: [http://jqueryui.com/](http://jqueryui.com/).
Map View

The Map View shows an overview of the emergency situation. It shows the area where the emergency is taking place with several layers of information: incidents, crowd density and movement, workforces, traffic, user annotations and vector maps.

A floating menu provides access to the different functionalities (see more details in D4.2.2 (Visualization Mechanisms for Emergency Coordination 2)). The features available in this view are:

- Layers control
- Map centre positioning
- Navigation tables for incidents, reports, and workforces
- Drawing feature

The new features implemented in the map view are the crowd movement layer, traffic layer, the drawing feature with labels, and the vector maps. A view of the current state of the ERTK map view is shown in Figure 3.

Map Layers

Figure 4 shows the map with all available layers activated. These layers are explained in Table 1.
Figure 3: Map view of the ERTK Web Portal showing a crowd density heat map, workforces, drawn areas and incidents markers (blue and numbered marks)

Table 1 – Map Layers

<table>
<thead>
<tr>
<th>LAYERS GROUP</th>
<th>FEATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Layers</td>
<td>These layers visualise the real area. There are three types available: satellite, hybrid and road.</td>
</tr>
<tr>
<td>Incidents layer</td>
<td>It shows incidents as blue markers. A click on any mark will show preview information (e.g. type of incident, timestamp).</td>
</tr>
<tr>
<td>Area Info Layers</td>
<td>It shows the information extracted from the open data source OpenStreetMap⁴. The available layers in ERTK are buildings, hospitals, police stations and routes. The layer routes show the routing from an incident to the closest hospital. This layer only contains one routing at a time and this route is shown when clicking on an incident.</td>
</tr>
<tr>
<td>Workforces</td>
<td>It shows the position of the workforces.</td>
</tr>
<tr>
<td>Crowd Data</td>
<td>They show the behaviour of the crowd extracted from the crowd sensing subcomponent. The crowd density shows the amount of people. The crowd movement is depicted with arrows for the average direction and with arrow size for the velocity (the bigger the faster).</td>
</tr>
<tr>
<td>Traffic</td>
<td>This layer shows where there is a traffic incident registered.</td>
</tr>
<tr>
<td>Drawing</td>
<td>This group contains the list of layers created by the user. By default, there is always one, but the user can remove it and add new ones.</td>
</tr>
</tbody>
</table>

⁴ https://www.openstreetmap.org/
Figure 4: Map View with workforces, incidents, drawn annotations, map info and crowd density and movement

Vector Maps
A new ERTK feature is the Area Info layers which add extra information about the surrounding area using vector maps. OpenStreetMap\(^5\) offers open vector map data. This data contains information about roads, buildings, public transport, shops, among others. The information is not complete since it represents data added by the community. Nevertheless, it is quite precise.

The interesting information in the RESCUER context are hospitals, police stations and buildings.

A use case, which has already been implemented in order to show the potential of vector maps, is the routing from one incident to the closest hospital.

This feature is in the early stage of implementation and it will be further improved during the last project iteration.

Drawing Feature
D4.2.2 (Visualization Mechanisms for Emergency Coordination 2) shows the first version of the drawing feature. This feature has been updated with the following additions and improvements:

- Text annotation feature: In the current version, a text can be placed anywhere on the map.
- Colour Picker: The colour of the annotations is now selectable.
- Modification Tool: The annotations can be removed or its properties can be changed.
- Layer Tool: The users can create new layers and name them. They can also remove the layers under the group drawing. The annotations created can be added to the desired layers.

\(^5\) [https://www.openstreetmap.org/](https://www.openstreetmap.org/)
Figure 5 shows the drawing tool: a floating window with the features to create or select the layer to add the drawing, and to choose the colour. Figure 6 shows the drawing feature for modifying the colour of a drawing or for removing it. The feature to apply modifications is shown when clicking on the element. The elements can also be labelled to set it as a specific area of the emergency: hot, warm, cold; or the whole emergency area. These zones will be used in the algorithms to send follow up messages or to prioritize reports. However, only the visualisation is implemented up to now. Therefore, the fully description of this feature will be provided in next iteration.
The Statistics Panel has been updated since the first iteration. It shows different graphs according to the choice of the user. Figure 7 shows an example of a graph depicting the distribution of incidents depending on its keyword.

![Figure 7: Statistics floating window](image)

**Traffic and Weather Services**

The Traffic and Weather Panels present information coming from public web services. The information is updated every 30 minutes, when the panel is opened or when the centre of the map moves more than 30km away.

Figure 8 shows the Traffic Panel with a table to browse through the traffic incidents. The Traffic Panel shows traffic incidents around the surrounding area of the incident. For each traffic incident, it shows whether it has been visually verified or otherwise officially confirmed by a source like the local police.

![Figure 8: Traffic incidents for a region](image)
Figure 9 shows weather information like temperature, humidity or wind speed, among others. The Weather Panel works like the Traffic Panel, showing weather information at the place of the incident. If it is not raining or snowing, the fields are just empty.

![Weather Information Table]

**Figure 9: Weather in the site of the emergency**

**Emergency Overview**

The Emergency Overview presents an overview of the information related to the emergency. This information should enable the ERTK user to quickly become aware of the major facts of the emergency. For completeness’s sake, Figure 10 shows the current screen of the emergency overview, but this screen has been completely redefined to provide aggregated data analysis results about the emergency.

![Emergency Overview Screen]

**Figure 10: Emergency View**
Incident Browser

The Incident Browser has been updated using the feedback of users and is currently being implemented. It shows the list of the incidents with key information obtained from the reports of the given incident. Reports and incidents define a many-to-one (n:1) relationship (many reports related to one incident).

Figure 11 shows the Incident Browser, where each row of the table is an incident and contains its main characteristics. In this example, three incidents have different colour to show the events that have happened. In this case there is a merging and a new incident in the system.

![Figure 11: List of incidents in the Incident Browser](image)

The user can easily merge incidents using drag and drop feature. Figure 12 shows how this merging is performed. When the user selects an incident, a new screen shows it in detail.

![Figure 12: Merging Feature](image)

Incident Detailed View

The Incident Detailed View shows the available information about an incident. Currently, changes are being applied to this view in order to improve it with the feedback received from end users and the requirements described in the deliverable D1.1.3 (Requirements Specification 3). The current state of this view is presented in D4.2.2 (Visualization Mechanisms for Emergency Coordination 2).
Report Browser

The Report Browser shows a table of the reports sent from the crowd. This screen will also be modified to allow the ERTK users to better focus on the relevant information. D7.3 (RESCUER Vision) presents the dynamic sorting criteria for data visualization that are intended to be used to this end. More information about its new features can be found in D1.1.3 (Requirements Specification 3). In the current table, each row is a report with the summarized information. It includes an identification of the report, whether has been marked as important, the keyword, which type of user sent the report, how many text messages were sent, and the media and the already analysed content that it contains. Figure 13 shows a Report Browser with nine reports, some of them differently coloured to highlight that they are new ones. By clicking in one of the reports, a preview of the report shows up to the user with the attached media and messages. Figure 14 depicts an example of a report preview with its text messages, media and form data. In addition, from the preview panel, the user can send requests to the reporter or mark the report as important.

By clicking on “Show Detail” link (see Figure 13), the user can see all information related to the report, which is explained in the following section.

![Report Browser of the ERTK Web Portal showing several reports](image)

Figure 13: Report Browser of the ERTK Web Portal showing several reports
The Report Detailed View (Figure 15) gives the user all information about a specific report. It also has all features from the Preview Report. This way, the user is able to mark this report as important, start a follow-up interaction using the predefined forms or the chat feature.
Follow-up Chat

The ERTK user can send text messages using the chat available in the Report Detailed View (Figure 15). The chat is used to support follow-up interaction between the ERTK user and the person who sent the report. Figure 16 shows the chat feature, where the white bubbles show the Mobile Crowdsourcing Solution user’s messages and the bubbles in green, the ERTK user’s message.

![Chat feature](image)

Figure 16: Chat feature

Follow-up with Predefined Forms

Instead of a free text message, a predefined question with predefined answers can be used. D2.3.1 (Group-targeted Follow Interaction 1) gives more details about the questions and the possible replies. A predefined form can be sent to a Mobile Crowdsourcing Solution user, who already sent a report, or to a target group. For the first use case, the predefined form must be opened from the Report Detailed View. Otherwise, it is done through the Follow-Up View. Figure 17 shows the first panel to send a predefined form. It classifies the questions by the subject of the question: situation overview, incident and person situation. In case no one of these categories fits the intended question, the user can define a new question. Figure 18 shows the panel after selecting a category, with the questions and replies. Figure 19 shows the layout in case the category is “Free Text”, where the user defines the question, and the type and content of the answer. We are going to rename the category “Free Text” to “Free Form” in order to better reflect the provided functionality.
Figure 17: Follow-up forms feature – Selection of the type of question

Figure 18: Follow-up forms feature – Selection of the question
Follow up View

The Follow-up View allows performing follow-up interaction with a group in the crowd. The group can be filtered by area, by role, or both. Figure 20 shows its layout. Currently the implementation is not finished; therefore more details will be given in the next iteration.
Coordination View

The Coordination View (Figure 21), whose scope was to allow the creation and management of tasks, as well as the management of workforces, has been taken out of the project scope as a result of the refinement of the detailed project vision (D7.3: RESCUER Vision).

Figure 21: Coordination view
3. Roadmap for Future Work

The next steps are to improve and finalize the current set of features, e.g. labelling of drawn areas on map, the follow-up with a group in the crowd, or the vector map data usage.

Improvements in the Emergency Overview, the Incident Detailed View and Report Browser are also expected to align them to the new project vision (D7.3: RESCUER Vision). In addition, the prototype to perform public communication, detailed in D4.3.1 (Public Communication of Emergencies 1), should be linked to the ERTK prototype.

Figure 22 shows a first proposal for the Incident Detailed View. It shows the incidents navigator bar (A); a floating menu for fast navigation (B); and the incident summary (C), which should contain aggregated information from reports, a status time line, and others. The Incident Detailed View will refined in the next iteration.

The main step for next iteration is the crowd steering integration to allow the ERTK user to send instructions and warnings to the crowd.

Finally, performance tests will be conducted. They were planned for this iteration, but the need for revision of the RESCUER architecture stopped this task until the ERTK reflects the updated status of the architecture.

Figure 22: Incident detailed view
4. Conclusion

This document described the second version of the Emergency Response Toolkit prototype. The visualisation of crowdsourcing information has been improved. Follow-up interaction has been included. New features like drawing or incidents merging allow the user to work with the crowd data and not only visualise it. Furthermore, features like chat creates the possibility of bidirectional communication with the Mobile Crowdsourcing Solution.
Glossary

Terms

**Command and Control Centre:** Group of people assigned to evaluate risks and make decisions in an emergency and/or crisis in an industrial area or at a large-scale event.

**Emergence Response Toolkit:** Component of the RESCUER platform that is intended to support command and control centres and operational forces in performing their emergency and crisis management activities.

**Incident:** Natural or man-made occurrence that interrupts the normal procedure or behaviour in a certain situation. It causes a critical situation or emergency situation that requires measures to be taken immediately to reduce adverse consequences to life and property. In terms of the Emergency Response Toolkit, an incident is usually derived from a collection of reports that are closely related in terms of type of incident, position of incident and approximate time of occurrence.

**Emergency situation:** Several (similar or different types of) incidents reported in different locations and time that may occur in an industrial area or large-scale event and require the reaction of the command centre.

Abbreviations

EC – European Commission
EU – European Union
CNPq – Brazilian Counsel of Technological and Scientific Development
MCTI – Brazilian Ministry of Science, Technology and Innovation
DoW – Description of Work
RESCUER – Reliable and Smart Crowdsourcing Solution for Emergency and Crisis Management