Civil Protection 2.0: a Diagram-based Approach for Managing an Emergency Plan

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Abstract

A relevant goal of the Open Government paradigm is to align the actions per-formed by the Public Administration to the real needs of citizens through methods and tools that enhance their engagement and let them play a different and more aware role in the evolving scenarios that concern them. The project *Comune Sicuro* stems from a research collaboration addressed to improve those processes that can benefit from the user-generated content derived from existing intelligent community networks. The present paper is focused on *Comune Sicuro* procedures meant to support municipalities to draw up and manage the emergency plans. A diagram-based approach is introduced to model rules and behaviours of the different actors involved. Once the underlying datasets are populated through an intelligent census of available resources, it is possible to link the general-purpose result of the model to the instances of validated avail-able resources. This functionality is fundamental to guarantee that the adopted emergency plan is always updated, thus optimizing its efficacy.
Keywords: civil protection, emergency plans, territorial knowledge, UML diagrams.

1 Introduction

This paper introduces the project *Comune Sicuro* (CS) whose goal is to improve those procedures that, based on the requirement of a continuous monitoring of a territory, can benefit from the user-generated content derived from existing intelligent community networks.

The project is part of a wider initiative whose goal is to align the actions performed by the Public Administration (in particular the Civil Protection (PC) Department) to the Open Government paradigm's ones through methods and tools that enhance the citizens' engagement, and let them play a different and more aware role in the evolving scenarios that concern them. In particular, the authors' collaboration with people from the Italian Civil Defense Agency highlighted the need to further support cooperation within distributed teams of operators, providing tools to acquire, aggregate and share timely and updated information (Sebillo et al., 2016).

CS consists of a set of units each addressed to perform several functionality and provide (different categories of) users with them. In particular, the component *Municipal Emergency Plan* (PEC) focused in this paper is devoted to support municipalities to draw up and manage an emergency plan that complies with PC guidelines, known as the *Augustus* method (Galanti, 1997), and at the same time is constantly updated with respect to the real availability of resources present on a territory.

PEC is embedded into a partially sequential process that, starting from a resource census builds a sharable repository of data about them, and aims to build a territorial knowledge useful to the risk management activities (Codice Protezione Civile, 2018).

The paper is organized as follows. Section 2 briefly introduces CS, while focusing on tasks required for drawing up an emergency plan. In Section 3 the system for the digital census is described. Section 4 illustrates PEC and its underlying architecture. A use case is also depicted, which shows how PEC is included in the whole process and emphasizes benefits deriving from such an approach. Conclusions are drawn in Section 5.

2 Comune Sicuro

The general purpose of CS is to ease some tasks that different typologies of users involved in the PC context have to accomplish. The focus is on the identification of possible risks of a territory, the census of available resources, the planning of needs according to the risks, the dissemination of the emergency plan to citizens, and the establishment of itself as a geo-social service.

CS stems from a collaboration between the Department of Computer Science at the University of Salerno and the Institute of Methodologies for Environmental Analysis (IMAA) from the National Council of Research, Italy (CNR). Research in this domain has been stimulated by the awareness that although each municipality is required to draw up and manage an emergency plan for the possible risks associated with its territory, many of them are defaulting. Reasons are different. Possible causes are the lack of funds to be allocated to this activity, lack of expertise in this field, lack of a continuous monitoring of resources and information. The main aim of the project CS represents a solution to these issues.

The whole process starts by acquiring and storing data through an intelligent census based on a *Web of data* approach (Hitzler et al., 2009). An ontology of the PC domain is under construction by exploiting the Protégé[1] ontology editor (Musen, 2015). It allows modelling and validating resources in terms of metadata, state and behavior. Moreover, the ontology can be used also to aggregate subsets of resources to build *units* to which a composite state and a behavior can be

[1] https://protege.stanford.edu

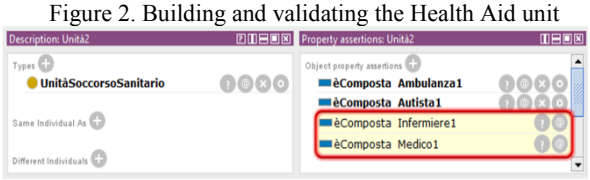
associated. Inference algorithms can obtain additional relationships among validated resources.

Figure 1 depicts the *Soccorso Sanitario* (Health Aid) unit. It aggregates 4 resources, namely *doctor*, *nurse*, *driver*, *ambulance*. When invoked, at least a doctor, a nurse and an ambulance are simultaneously activated as a whole in order to respond to a distress call. If necessary, the driver's role can be accomplished by the nurse himself.

Figure. 1. An example of the Health Aid aggregation unit

Figure 2 shows the reasoner that validates the *unit* construction. This implies that they are independent resources, but when aggregated they take a new meaning and accomplish a specific behaviour

Figure 2. Building and validating the Health Aid unit



3 The Census of Available Resources

As stated in the previous Section, the whole process starts by acquiring and storing data through an intelligent census based on a *Web of data* approach. The aim is to have a system that dynamically generates new cards for the data entry tasks and populates the available dataset, through procedures that are based on an effective territorial knowledge, where instrumental and human resources, rules, behaviours and interactions converge.

A fundamental feature of the system, which should be simple and intuitive to use, is the "dynamism of data", meant as a constant updating of resources and their possible interactions. A high-quality standard has also to be guaranteed in order to avoid duplications, inconsistencies, incompleteness and unreliability.

To implement the digital census, the following technologies have been chosen.

- Servlet and Java Bean for server side operations;
- MySQL for managing persistent data;
- JSP for the client-side operations, i.e., for the graphical interface with the user;
- HTML5 and CSS3 used in addition to JSP for structuring and modeling of web pages;
- JavaScript and jQuery, the former is scripting language oriented to objects and events, the latter is a JavaScript library of the same. Both are used in client-side Web programming for creating interactive dynamic effects through script functions;
- AJAX technology is also exploited to generate dynamic contents without the need to refresh the whole content of a Web page;
- Bootstrap is a collection of free tools for creating sites and Web applications. It provides templates based on HTML and CSS for the interface graphic components, such as modules, buttons and optional extensions implemented in JavaScript;
- Apache Tomcat 8 is a web server used for the system deployment.

We have identified a set of main classes covering different areas (e.g., attending and recovery areas), alert methods, buildings, streets, vehicles and equipment, that can be used in the definition of emergency plans. To this aim, the design of data starts from a set of 97 cards (each card has been created taking into account the identified classes) featuring a plan of an Italian Region, namely the Veneto Region (Figure 3).

Those cards along with the guidelines to perform the analysis of the limit conditions for the emergency (CLE) represented the basis for identifying metadata of the digital census.

Figure 3. Process for metadata and data definition

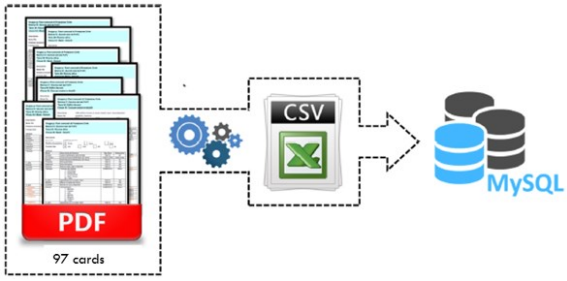


Figure 4 shows the interface available for the data entry activities. It classifies data in terms of Plan, Matrix, Class and Resources.

Figure 4. The initial selection for data classification

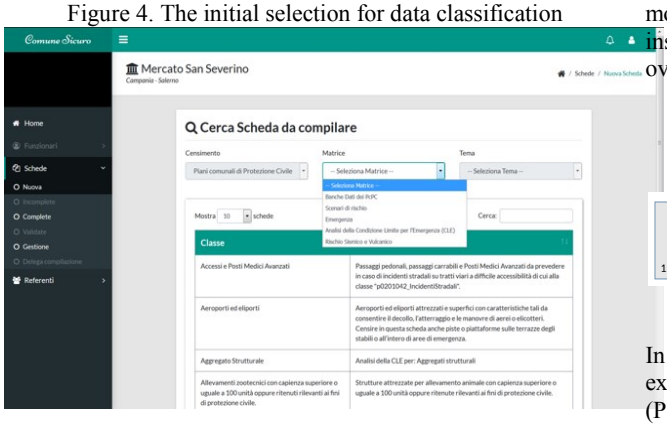
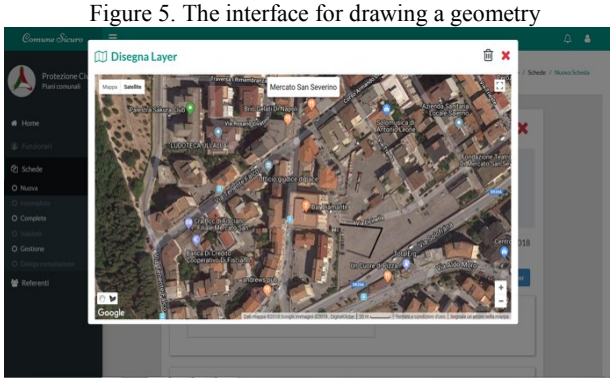


Figure 5 illustrates a relevant step of data acquisition, namely the association between a resource and its spatial location expressed as a vector geometry. To this goal, Google Maps API[2] have been used, in particular the Drawing Tools that exploits the *DrawingManager* class. In particular, this tool is used to select and assign a phisical area to a card.

Figure 5. The interface for drawing a geometry



Once a card is filled out, an official (i.e., a municipal employee appointed in the emergency management staff) must validate it. This step is fundamental to guarantee that responsabilities are properly distrbuted and managed among the different actors involved into an Emergency Plan.

4 Drawing up & managing an Emergency Plan

In order to demonstrate how the Web-based PEC component can support users in their activities, a prototype has been developed. It is embedded into a process that, starting from the census previously described builds a territorial knowledge useful to the risk management activities. In particular, this component represents the final step of a 4-step procedure through which it is possible to connect the guidelines modelled in terms of UML diagrams and the validated instances of the available resources. Figure 6 shows the overview of the process.

Figure 6. The process overview

In the first step, the guidelines of the *Augustus* method are expressed in terms of UML class and interaction diagrams (Pooley and Stevens, 1999). The former characterizes resources and actors involved within a plan; the latter describes the interactions among them during the diverse operation phases, namely Attention, Alert, Alarm.

By interacting with the interface of the UML diagram editor, the rules of the method can be easily modified and the updating is automatically applied to the whole process. The second step translates those diagrams into SVG files that are then parsed to extract information about classes, relations, interactions and activities. These two phases achieve the first CS goal, namely to express the rules as a series of elementary and interoperable data representing the relevant concepts of the domain. We have realized that the development of an emergency plan ends with a validation phase aiming at facing possible exceptions caused by both human factors and temporary objective impediments, such as a work in progress on a road network. During that phase targeted training activities are scheduled which may contribute to tune the involved parameters (residents, personnel and tools) of the underlying protocol, by taking into account both general requirements set by national regulations and local availability and supply. Results consist of modifications and instructions to be integrated within the initial intervention model (Ginige et al., 2014).

Step 3 is addressed to aggregate the above data according to precise data structures elaborated to be then easily used in various functionalities. At this stage, a fundamental requirement is the interoperability since it allows integrating data coming from any other parsed sources.

Figure 7(a) shows the interface by which SVG files can be downloaded, whilst Figure 7(b) shows a selected class and classes to which it is related. Finally, Figure 7(c) displays the activities involving the selected class.

Figure 7(a). The interface to download SVG files

[2] https://cloud.google.com/maps-platform

Figure 7(b). Classes related to the selected one

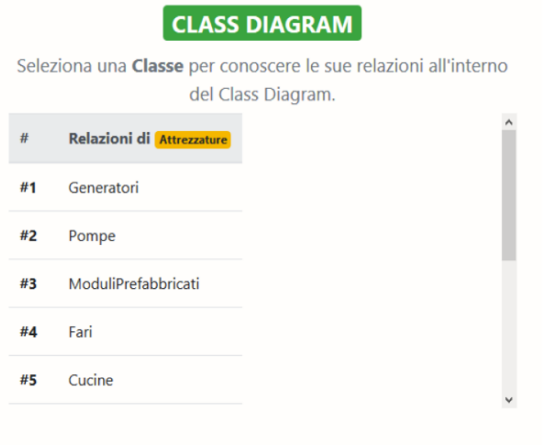


Figure 7(c). Interactions referring to the selected class

The selected class can be also highlighted both in the Class Diagram (Figure 8(a)) and in the Interaction Diagram (Figure 8(b)) interface.

Figure 8(a). Interacting with the class diagram

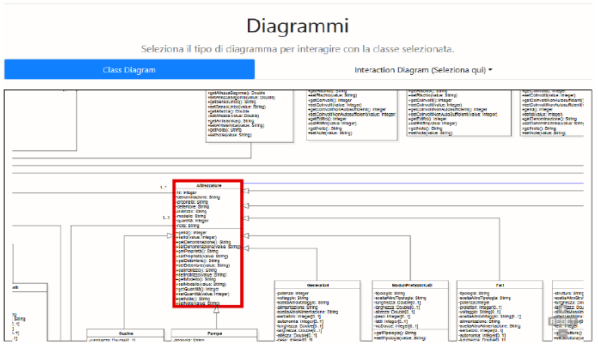
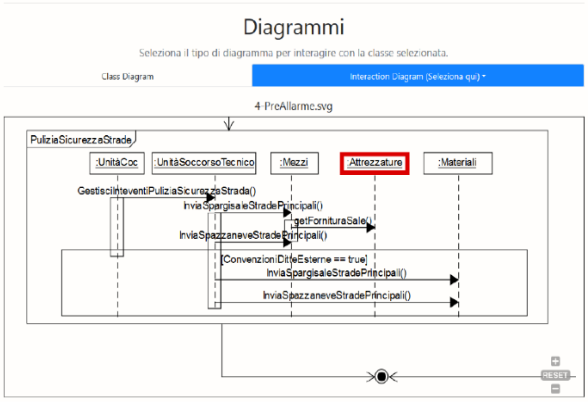
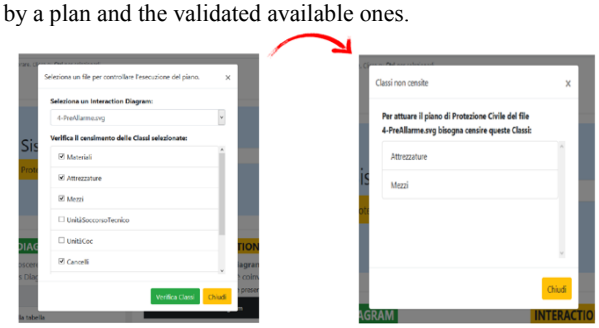


Figure 8(a). Interacting with the class diagram



Once the census has been completed, it is possible to link the general-purpose result of this process to the instances of validated available resources (Figure 9). This functionality is fundamental to guarantee that the adopted emergency plan is always updated. Each change to the resource set is automatically reflected during the plan management, thus optimizing the efficacy of them.

Figure 9. The module invoked to match resources requested by a plan and the validated available ones.



5 Conclusions

Italy has 20 Regions, 7955 Municipalities, over 117600 function managers, 44000 associations, 6 million active volunteers. A real peaceful army that can contribute to make municipalities safer as it knows how to react when critical situations arise.

This paper has been addressed to show how CS represents the way to optimize the management of the available resources for the risk management. The essential condition to let it work well is the initial intelligent census of the territory of interest. It implies to collect data about objects, such as tools, buildings and means of transport, and people, such as professionals and volunteers. Once a territorial knowledge is obtained, much of the work has been accomplished be-cause ICT tools can contribute significantly to automate most of the subsequent steps.

Generally speaking, CS has been conceived as a geo-social environment by which users' daily activities (citizens and families) can be supported and eased.

A set of facility are under construction whose goal is to assist people while per-forming tasks that are related in some way to the territory. A mum, who receives a notification on her smartphone when the school bus is at a given distance from her house, exemplifies such a support. This geo-social characteristic is important because the usage of the system in daily activities ensures a good level of familiarity necessary for a citizen to use its functions even in case of emergency

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