

SocialEMIS: Improving Emergency Preparedness through Collaboration

Ouejdane Mejri
Dip. Elettronica ed Informazione
Politecnico di Milano
Via Ponzio 34/5 - 20133 Milan, Italy
mejri@elet.polimi.it

Pierluigi Plebani
Dip. Elettronica ed Informazione
Politecnico di Milano
Via Ponzio 34/5 - 20133 Milan, Italy
plebani@elet.polimi.it

ABSTRACT

The definition of the contingency plan during the preparedness phase holds a crucial role in emergency management. A proper emergency response, indeed, requires the implementation of a contingency plan that can be accurate only if different people with different skills are involved. The goal of this paper is to introduce SocialEMIS, a first prototype of a tool that supports the collaborative definition of contingency plans. Although the current implementation is now focused on the role of the emergency operators, the accuracy of the plan will also take advantage of information coming from the citizens in future releases. Moreover, the contingency plans defined with SocialEMIS represent a knowledge base for defining other contingency plans.

Categories and Subject Descriptors

H.4.m [Information Systems]: Miscellaneous

Keywords

EMIS, Contingency Planning

1. INTRODUCTION

The effects of the globalization that we have witnessed in the recent period affected several aspects of our life. Also the field of the emergency management has to deal with this phenomena for different reasons. On the one side, global communication systems can potentially make aware everyone about disasters happening anywhere the world. Especially in the most recent period, the information about a disaster is not only communicated through the traditional channels (i.e., television, institutional Web sites) but Social Networks are gaining more and more important role. On the other side, globalization also may increase the emergency scale. A disaster happening in a given region might affect, because of economical or social reasons, people living in distant places. For instance, the recent flooding in Thailand, with a limited impact in terms of victims, is having a considerable effect on the IT supply chains as most of the technology manufacturers for many IT big companies are settled in that area [2]. According to this scenario, it is now possible a domino effect that could interest different areas even if they are not geographically close. For this reason, in this paper we focus on the management of

multi-risk and multi-domain emergencies caused by natural disasters. In this field, current tools and methods are now not sufficient to deal with this kind of emergencies and need to be improved. In particular, we start from the assumption that a good way for improving the management of this kind of emergency requires a real collaboration among the operators that are involved in the emergency management since early phases. Indeed, this paper focuses on the preparedness phase, where contingency plans are defined and different competencies during its definition are required.

As a first result of our work, this paper introduces the prototype of a tool named SocialEMIS (Social Emergency Management Information Systems) that makes possible the collaboration and the cooperation among the operators in order to have a real information flows among the different countries in terms of contingency plans and best-practices. This tool is based on a Service Oriented Architecture that enable the integration among the different EMISs involved and it is also open for receiving information from social networks platforms. It is worth noting that social networks includes not only the general purpose ones, e.g., Twitter and Facebook, but can include also networks where only experts in some fields belong to, e.g., chapters in LinkedIn. In this way, we advocate the idea that social networks can be helpful not only during the response and recovery phases but also during the preparedness.

The rest of the paper is structured as follows. In Section 2 we discuss the existing approaches that leverage on the use of Web as a collaboration platform and that are close to our work. In Section 3 we introduce the role of the collaborative contingency planning during the preparedness phase. Section 4 gives a high level description of the SocialEMIS tool. Finally, Section 5 concludes the work with some hints for possible future work.

2. RELATED WORK

Some of the recent natural disasters with a big-scale impact witnessed the importance of the social network to share information during the emergency. Starting from those experiences, the IT research community started working on exploiting the potentiality of moving the citizens from a passive role to an active role in the emergency life cycle. In this way, the citizens involved in an emergency not only ask for information, but also might provide useful information to the authorities. Around this issue, the work done in [11] gives an overview of the potential of common social networks and the possible applicability of this paradigm to the emergency management especially in spreading information.

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Social networks are actually some of the possible channels through which relevant information can be published or consumed. In some cases, specific web-based information systems have been proposed to organize only the emergency related information and to provide tools for citizens and authorities to manage this information. An interesting experience in this direction is given by the Sahana project [8]. This project aims to provide an integrated set of pluggable, Web-based disaster management applications that offer solutions to large-scale humanitarian problems in the relief phase of a disaster. In particular, this architecture made available a set of registries, as for instance about missing person and available shelters, that can be freely accessed and possibly updated. This project highlights the important role of information in the emergency situation and the role of crowdsourcing. The availability of information, in fact, allows operators of an EMIS to better understand the situation in order to take the right decisions. In the same area, Ushahidi [10] is another interesting project about the crowdsourcing of information related to emergency management and crisis situation. This approach allows to collect and visualize geo-spatial information in area where a crisis is occurring.

It is worth noting that most of the existing approaches, as the two presented, focus only on the response phase. Considering the preparedness phase, [5] presents how to model the information that are required for the decision process. Moreover, [3] proposes models and tools for designing service-based processes including the specification of the role of the human beings during the execution of the processes.

3. COLLABORATIVE PREPAREDNESS

Emergency preparedness is considered the first phase of emergency management, followed by response, recovery and mitigation [4] and refers mainly to emergency planning, training and exercising aspects [7]. This article focuses on the emergency planning process that aims to prepare all concerned organizations to face a given crisis when a disaster occurs due to an accident or a natural extreme. This process results in a document called *contingency plan*. Contingency plans may be categorized in single or multihazard plans whether they deal with one or more possible connected hazards (e.g. due to technological disasters initiated by a natural extreme defined as na-tech [9]). In this work, we consider the multihazard plans that are more likely to provide a complete reference for rescuers and concerned authorities as well as permit economies of scale in identifying stakeholders, personnel, means, and resources to be deployed in case of need [1]. A key aspect raised by Perry and Lindell in [7] is that emergency planning must be considered more like a process rather than a product. In fact, an contingency plan is usually compound of i) event scenarios, ii) available resources, iii) stakeholders, and should track each single upgrading of the information related to those three components through time. Indeed, emergency plans have to be continually updated according to changes in the environment to be protected, to the kind and severity of threats, to the amount and quality of available personnel, resources and means [1].

During crisis management, rescuers, authorities and temporary multiorganisations will collaborate around plans that should be designed as a common, shared and agreed platform for cooperation. It is compulsory to define into the contingency plan different scales related to the issues, the

resources and the possibilities as well as the responsibilities of the stakeholders. The event scenarios present in the plans are related to a spatial context correlated to one or more possible extremes including the natural and built environment, the strategic facilities and infrastructures that may be used in order to face the emergency. The event scenario should describe the modality with which a disaster will induce to a disruptive and/or a deadly and destructive outcome and may trigger derived damages exacerbated by vulnerabilities from diverse but overlapping environments [6]. Affected elements reported in the scenario may be people, buildings, roads, facilities, services, and networks. The particularity of each single disaster environment from different point of view (i.e., geographical, natural, social, economical, etc.) makes the related event scenario unique and context-related. Furthermore, the development of scenarios is strictly related to the expression of the knowledge of such context regarding the combinations of possible hazards, vulnerabilities and toughness of the natural, built environment and of the local population. This knowledge is actually shared among all the experts that participate to the development of the scenario as part of the whole process of emergency preparedness. As part of the same plan, a set of event scenarios may be specified considering diverse combinations of possible circumstances that correspond to the average case till the worst case. In this way the emergency planners are allowed to work through logistical, operational, financial, and administrative challenges without having to experience the event. In the same way, the information about the available resources, both human and material that may be employed in case of emergency, is hold by either the proprietary of the resource or by its main user and should be constantly updated as part of the contingency plan. In fact, not only the quantity of resources may vary but also their usage description and their owner.

We consider the general rule that the largest number possible of likely to be involved organisations in the emergency response, should be involved in the plan development. This cooperation activity will permit to create a organizational platform on which they agreed in "peace" time that constitutes a shared reference during crisis. According to these requirements, as discussed in detail in the next section, we are developing SocialEMIS to support the collaboration with two main goals.

First of all, the cooperation among the development of the contingency plan through the specification of different event scenarios, that the stakeholders consider likely, requires a collaborative work that will put together different expertises and heterogeneous languages. We consider the emergency planning as a process in which the planners will contribute to construct a vision of the hazard consequences as a set of data that will be organized in an EMIS, generating a more accurate and complete plan. Sharing the vision of the others stakeholders through sharing the same application and data during the phase of preparedness will also permit when the event will occur to have through the scenarios a picture of the situation closer to reality. Thus, it is like the operators sit around the same table, reading and updating the same plan. Here, Social Network can virtually add a lot of new chairs in this table where also citizens can take place to improve the contingency plan definition.

Secondly, constructing shared contingency plans permit to keep collective memory alive, to store it and make it

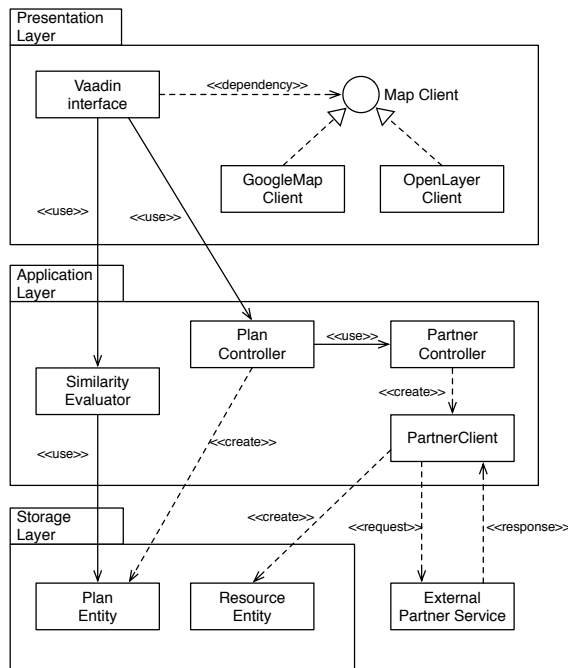


Figure 1: SocialEMIS architecture

available to the largest number of stakeholders in charge of a crisis. Moreover, event scenarios which describe specific contexts hugely increase the potential for knowledge reuse, a major need in emergency management. Indeed, a contingency plan may be accessed as a knowledge reference if an emergency planner is looking for stored plans related to a specific geographical context and a specific hazard (i.e., repository of historical knowledge). A planner may also access also this repository, looking for how other emergency planners dealt with the same category of hazard in other geographical environment, considering the repository as a set of references or best-practices. A further use of this shared repository may also be related to the research of some event scenario that describes the effects of a disaster that is part of the chain of hazards (i.e., domino effect) that involve the harm the planner is dealing with. In this way a contingency plan may be used as a departure point in order to develop or correct another one if they are related to connected hazards in the same geographical context or to an interscalar reality.

4. SOCIALEMIS

SocialEMIS is a Web-based tool that allows the collaboration of emergency operators in the definition of the contingency plan. Even if we are in the early stage of the development process, the design of the overall architecture is defined.

Figure 1 shows the architecture of the SocialEMIS platform that is based on a three-layers architecture. Starting from the topmost, the *presentation layer* is based on a Web interface that allows to show the contingency plan on top of a map. An example of how the application appears to the operators is shown in Figure 2. The background of the map can be created using either GoogleMaps API or OpenLayers API. On top of this map, the user can define the contingency

plan in terms of managed emergency, sensitive areas (i.e., polygons), available resources (i.e., markers). The interface has been implemented using the Vaadin framework¹ that makes available a set of libraries and plug-ins to easily create Rich Internet Applications. In this current implementation, we assume that the user of SocialEMIS are emergency operators that might belong to different emergency authorities. In future implementation, we plan to make available some functionalities also to citizens especially in case of contingency plans related to small-scale emergencies (e.g., to warn of potholes or unsafe buildings).

The *application layer* includes the modules that provide the two main functionalities of the system: (i) the contingency plan definition, and (ii) contingency plan similarity. On the one hand, the contingency plan definition allows the users to create new contingency plans and, attached to them, all the relevant information that also appear in the map as discussed before. Because of the collaborative perspective of our work, different users can operate on the same plan by adding or removing elements. On the other hand, the contingency plan similarity provides mechanisms to select, among the contingency plans that have been defined up to a certain point, which are the plans that satisfy some requirements. It is worth noting that in the current solution, we do not refer to the part of the contingency plan that should include a description of the actions and responsibilities of its stakeholders, but consider only the description of who they are and how they developed the contingency plan.

The highlighted area of the screenshot in Figure 2 reports the result of this similarity function. In this case, the requirements are expressed by the contingency plan defined in the main map. As discussed in the previous section, SocialEMIS can support the management of the contingency plan as a knowledge base. At this stage, the similarity algorithm returns three kind of results: (i) the contingency plans that refer to the same area and the same type of emergency; (ii) the contingency plans that refer to the same type of emergency but in different areas with similar amount of available resources (i.e., best practices); (iii) the contingency plans that refer to emergencies that can be caused by the initial contingency plan (i.e., domino-effect).

As discussed in the previous section, a contingency plan needs to store information about the available resources in a given area that could be used during the emergency. Examples of these resources are: number of ambulances, number of medical staff, number of fire-hoses. The timeliness of this kind of information is crucial to make a contingency plan really effective. Indeed, only having a correct information about resources makes possible for the operators, during the emergency, the proper organization of the emergency response. For this reason, the management of the information about the resources are handled according to a service oriented approach. This requires that the involved (e.g. fire departments, hospitals) stakeholders, that we generically call *partners*, make available the Web services that SocialEMIS periodically calls to have up-to-dated values of the available resources.

Finally, the *storage layer* interacts with the databases where all the information defining a contingency plan and the last read values of the resources are stored.

¹<http://vaadin.org>

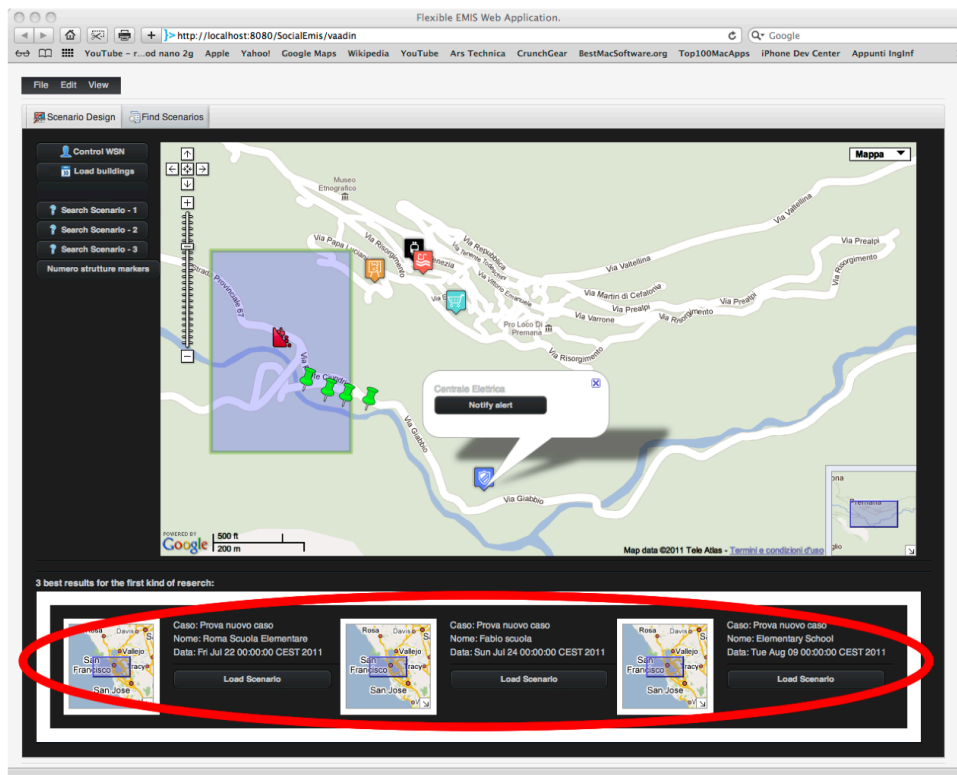


Figure 2: SocialEMIS interface (contingency plan similarity)

5. CONCLUDING REMARKS

This work presents an approach and a tool to improve the definition of the contingency plans during the preparedness phase. This approach appeals to the experience of the use of collaboration tools implemented for the emergency response phase and can also include the use of Social Networks to improve the number of information stored in the plan.

Future work mainly focus on the improvement of the SocialEMIS implementation to provide a better coverage of the operations that can be done on a contingency plan. First of all, we plan to implement access control mechanisms that allow/deny some modifications of a contingency plan or a part of it. To improve the flexibility of the system and to update the SocialEMIS resource database only when required, a message-oriented middleware will be adopted, instead of the currently adopted request-response pattern. Finally, the sections of a contingency plan that refer to the responsibilities and actions the stakeholders should take, will be included too.

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