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Improving Emergency Plans through Public Engagement

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Abstract

Emergency plans are fundamental for the speedy and effective response in disaster situations. Plans are often constructed by teams of experts, who apply their knowledge to define response procedures, but lack part of location-specific knowledge that can be very relevant to make decisions during responses. Such knowledge is, however, in the minds of people who use those spaces every day, but are not involved in the planning processes. In this paper, we advocate for citizens' involvement in emergency plan elaboration via Public Participation, a mechanism long time used in other areas of e-government. We define a process for the elicitation of citizen's knowledge via public participation, and present the results of a study on its potential impact, where individuals used different collaborative tools to volunteer knowledge to be used in emergency plan improvement.

Keyworks: Emergency Management, Collaborative Work, Public Participation, Knowledge Management

1. INTRODUCTION

Emergency response is one of the most critical activities performed by humans: it involves processes where decisions affecting lives and properties must be made in a short amount of time. These decisions are based on information coming from different sources, which must be accessed and combined adequately to avoid both information gaps and overload. Moreover, different decision makers may require different information elements or, at least, different views of them. For instance, decision makers at a control room may have more sophisticated means to access to the information than responders working at the emergency location, carrying mobile devices with reduced graphical capacity. Thus, information management is becoming a key aspect of modern emergency management systems [5] [9].

The basis of all decision making and action during emergency response is the emergency response plan (or emergency plan, for short), a document that includes procedures to be executed in response to the event of an incident, plus all the information required to make decisions (such as maps, pictures, videos, etc.) The plan directs responders towards the event location, defines the procedures to apply in response to each possible incident, and provides the information needed to perform the response actions.

However, having a plan may not be enough. As pointed out in [14], a critical part of the response efforts lies with the individuals affected by the emergency. As a matter of fact, in most cases the very first response actions are performed by in-place victims themselves. They are close to the site and their actions may make rescue efforts easier or harder depending on what actions they take. Unfortunately, and despite best efforts by emergency management teams, citizens are usually not well acquainted with emergency plans, missing knowledge that may be helpful in case of crises.

While respondents get from the plan technical knowledge of an emergency site and response procedures, the individuals living in the area have a different type of knowledge: as they inhabit these spaces on a daily basis, they will likely develop an instinctive response to emergency situations based on their daily interactions with the environment. In other words: they have knowledge different from, and possibly more accurate than, the knowledge contained in the plan. Thus, we believe that potentially valuable information for emergency response is available from the individuals involved in the emergency, and should therefore be gathered from them.

In this paper, we intend to fill the gap between the knowledge contained in the emergency plan and the one provided by individuals potentially affected by the emergencies described in the plan. Our goal is twofold: on one hand, to increase citizen's acquaintance with emergency plans; on the other hand, to investigate and devise alternative ways to obtain additional information during the planning process, via the participation of citizens in the early evaluation of the plans. To achieve this goal, we rely on principles of Public Participation, a mechanism to acquire knowledge from individuals, usually applied by governmental divisions to elicit the opinions or desires of the population using different strategies such as panels, surveys, public hearings, and others [1]. Specifically, we claim that the implementation of a public consultation process that exposes the content of the emergency plan to citizens, who, in turn, may generate information not included in the initial version of the plan, may lead to an overall improvement of the plan and a higher familiarity of individuals with it.

The knowledge provided by individuals may be very relevant in different settings. On one hand, during emergency response, affected citizens can generate fresh information from the very center of the incident. This type of contribution has shown to play a key role in large natural disasters such as the Katrina hurricane [14] or wildfires in the USA [20]. On the other hand, their contribution may also be very useful for improving response plans and overall safety conditions: those who inhabit the affected space on a daily basis can provide valuable feedback about the plan itself and its applicability. These individuals can generate important contextual information (called local knowledge in [4]) that, having a non-expert origin, may lead to improvement of the plans and safer conditions long before the occurrence of actual emergencies.

There are other advantages of public participation in the elaboration of emergency plans. The high diversity of contextual information sources makes it desirable to reduce their number to a manageable amount, thus reducing the information overload risk and simplifying the management of context during responses. Some information resources are considered contextual because they are not part of the abstract level emergency plans, but could be incorporated to the plans before the occurrence of any emergency. As an example, consider that a plan of a street is included in an emergency plan along with directions for mobile rescue teams to get to a specific building. These directions may be obtained from some navigation application. However, there may be some elements on the street (e.g. large recycling bins) that may make the route unsuitable for large firefighter trucks. If this issue is not checked by plan designers, it will surely arise as contextual information in the case of emergency, requiring reaction and decisions and their associated delays. Obviously, performing such exhaustive checks by planners is very difficult and costly, yet it can be very easily detected and signaled by any person residing in the area. Unlike the information generated during the response stages, this type of contextual information may be analyzed and eventually consolidated as formal knowledge in the revised version of the plan, reducing this way the amount of contextual information to be handled during responses. We believe that this knowledge and processes would be useful to support emergency plan improvement and update processes.

In this paper, we take the first steps towards a process for public participation for plan improvement. We devised a knowledge elicitation process that would also help participants reflect of the problem and learn something of the domain. We ran a case study using three different tools for gathering public feedback on emergency plans. Results show that regular individuals have relevant information pertaining to emergency plan improvement. Not only are they capable of providing useful information, but also, through interaction and reflection, they became aware of what they did not know, and suggested improvements for plan dissemination and security design, improving preparedness overall.

This paper is structured as follows. In the next section, we present background knowledge on the domains related to the paper, namely Knowledge Management in Emergency Response and Public Participation Processes. In section 3, we describe our proposal for improving emergency plans based on public participation, including the proposed knowledge elicitation process. The case study is described in section 4, which includes information about the studies conducted and results obtained. Finally, section 5 concludes the paper and outlines our future work in the area.

2. BACKGROUND KNOWLEDGE

In this section we introduce background knowledge relevant for our research. The point is not to present an extensive review of foundational work, but to provide a basis for the reader, grounding our research on prior theories.

2.1 Knowledge Management in Emergency Response

The response to an emergency starts when a dangerous situation needing immediate action occurs. Response teams, composed of well-trained members who may belong to more than one organization (for instance, firefighters and policemen) perform diverse activities oriented towards the mitigation of the effect of the emergency on people and property. The diversity of actors makes decisions mostly collaborative, as the different organizations involved must communicate with each other, creating a large body of shared knowledge and using it to make most decisions during the response process. From the knowledge managed during the emergency response, decisions are made that result in actions to mitigate the effect of incidents.

Managing and accessing knowledge during responses is not an easy task due to several reasons. First, the sources of knowledge are generally heterogeneous and distributed, which require the implementation of interoperability mechanisms as part of the emergency management systems. Second, the sources may be static or dynamic, depending on whether the information they provide is stable or may change during the response stage, with the development of the emergency. Third, the sources may be explicit or implicit. By explicit, we mean that the information source is identified (e.g. the emergency response plan) and access mechanisms provided; conversely, an implicit source is one that is not known in advance, and hence must be dealt with after its discovery.

Knowledge can be available in different forms, and may be of different natures, as pointed out by [9] and illustrated in Fig. 1, which summarizes the decision making process in emergency response. The experience and background of emergency responders constitute the so-called *Previous Personal Knowledge*. In general, a good *Previous Personal Knowledge* reduces the time needed to make decisions as autonomy of responders is enforced. However, it is difficult to handle as it is tacit, highly personal and hard to formalize [13]. As a complement to *Previous Personal Knowledge*, explicit knowledge is originated in some information sources, and may belong to two categories: on one hand, the *Formal Knowledge* is generated in advance, as a result of the prevention activities, and does not change during the development of the emergency; in general, *Formal Knowledge* is contained in the

emergency response plan. On the other hand, *Contextual Knowledge* is composed of all the information which cannot be compiled in advance because it is mostly generated during the development of the emergency, and may even change during the emergency evolution. Sometimes the *Contextual Knowledge* pieces are known to be needed (e.g. the location of a train catching fire while running through a tunnel), and hence some type of placeholder could be inserted in an emergency response plan (e.g. "…request the location of the train…"); other times, however, *Contextual Knowledge* elements are not known in advance as they are generated during the emergency (e.g. a responder may communicate to the command and control the presence of a toxic leak near a hospital, which requires immediate evacuation of the building).
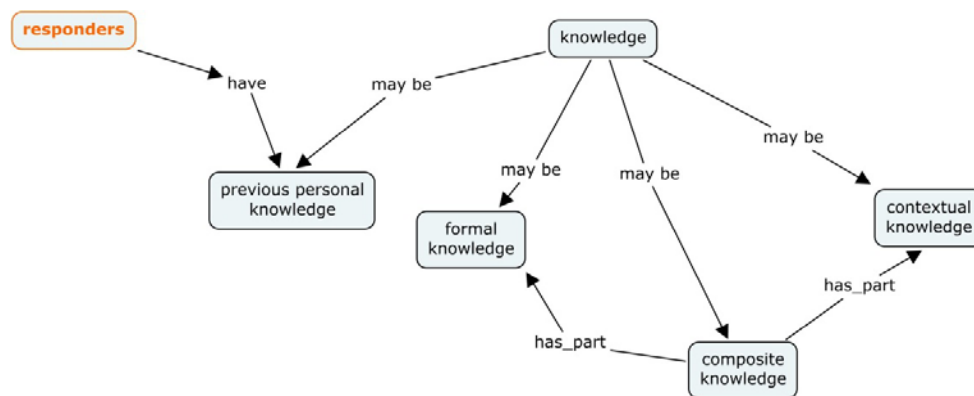
Fig. 1 Concept map of knowledge managed during an emergency response phase (adapted from [9])

In general, the *Contextual Knowledge* is complementary to the *Formal Knowledge*; that is, there are parts of emergency response plans considered contextual, and the plans include the necessary actions to gather such information and make it available to decision makers. In some cases, context overrides non-contextual information previously available. For instance, if a road is closed, some request should be sent to the route planner to recalculate and find a clear way to the place. In other cases, overriding is not recommendable, as previously recorded information can still be valuable. If a tunnel has collapsed, the video of the tunnel should not be shown as an optional escape way, but could be still available to look for valuable information such as possible obstacles, or just to analyze properties of tunnels similar to the damaged one for which there is no video recording available. To cope with this specific cases, in [6] we included the notion of *Composite Knowledge*, as information that is formalized, but may be replaced (or, at least, updated) with contextual information.

Managing *Contextual Knowledge* and *Composite Knowledge* can be difficult, especially due to the cost of maintaining and accessing to all the potential sources of context, in the former case, and the visualization challenges in the latter. In some cases, the dynamic nature of contextual information makes it unavoidable – a collapsed tunnel is a direct consequence of an earthquake. However, in other cases, contextual information does not come from the effect of the incident, but from some flaws in the *Formal Knowledge* compilation. Here, we recall the example given in section 1: a driving route to an incident is unusable by large vehicles due to obstacles in the street that either were there when the plan was generated, but not considered relevant by planners, or that were put there later. In this case, the simple observation of a resident may raise the inconsistency, making planners modify the

route and so reduce the amount of contextual information to be managed during responses. But there are two serious problems: on one hand, a resident has little or no acquaintance of the emergency plan; on the other hand, citizens' feedback is not gathered by planners, losing a valuable source of information that results in context overload during response.

Our goal with the work described in this paper is, to investigate public participation techniques as a means to overcome these problems. These techniques have been successfully employed in e-government contexts other than emergency management. In the next section, we introduce public participation techniques and studies.

2.2 A primer on Public Participation processes

Public participation has become a common practice in modern democracies as a way to collect public concerns into political decision making [8]. Increasing involvement of civil society in the governance of their countries fills the traditional gap between experts in a particular domain and the citizens affected by some decisions [10]. Generally speaking, a public participation process is started after the promulgation of a new law, the starting of a new policy in a given area of government, or any other decision that may affect the lives of individuals or be controversial in different ways. The goal of public participation processes is to analyze the impact of a political or administrative decision by capturing the subjective views of citizens that, usually, do not coincide with those involved in the initial decision. In commercial environments, market studies often include some type of public participation, although the term is generally applied in e-government settings.

As a consolidated trend in the social sciences, public participation has received much attention in the last 20 years, with numerous publications related with different aspects such as types of public participation processes [11][1][2][3], frameworks for the evaluation of the processes [15], and experiences in the definition and application of such processes in different fields such as environmental policy [8][7], or urban planning [4]. Several common characteristics of public participation processes have been identified by Creighton [8]. First, they are not intended to be mere information sources to the public; rather, they are interactive, creating a bidirectional flow of information to and from individuals. Second, they are not accidental: they are designed, planned and executed by organizations interested in knowing the public's opinion. And third, some relevant role is reserved to the feedback provided by public in the final decision being made by the organization. As a matter of fact, it helps law designers to realize about the importance that is given by the public to the different aspects of the law.

There are numerous types of public participation processes, which can be classified following different criteria [3][1][12]. Specifically, deliberative methods are those where a selected group of individuals are gathered to participate in meetings where discussions about a specific issue are held. Generally, a decision arises from the deliberations of the group. Examples of deliberative processes are citizen juries, panels, planning cells and deliberative polling. They differ from each other on the size of groups, the meetings schedule, and the type of outcome expected. Conversely, non-deliberative methods are those where individuals are not requested to reach a group conclusion, but to provide some feedback individually. Examples are surveys, public hearings, open houses, and citizen advisory committees, among others. The differences arise in the size of the group of study, the goal of the process and the way the interaction with the individuals is arranged.

According to [16], a public participation process can be designed following a number of stages. During the Preliminary Design, an analysis of the situation is performed that includes, among other actions, the identification of the stakeholders

and the information to be exchanged during the process. The process Plan Development includes the identification of the objectives, the major issues, the selection of the techniques to use, and the preparation of the mechanisms for providing and receiving information. The Implementation of the process consists of the application of the selected techniques for providing and receiving information, plus a continuous monitoring of the process. Finally, an evaluation is done in the Feedback Stage, generating reports to both the agency promoting the public participation process and the participants involved.

One of the major challenges of public participation processes has been for long time the ability to overcome the reluctance of citizens to attend meetings or simply to visit the physical repository where the documents open to public comment are available [7]. With the massive use of the Web, new digital repositories are replacing --or, at least, co-existing with-- the physical ones, making it easier for citizens to access the information sources. Moreover, collaborative tools may be used to support deliberative processes without need to hold physical meetings [10]. As a consequence, new models and implementations of public participation processes are arising. For instance, Brabham points out the suitability of crowdsourcing techniques to implement public participation [4][1716]. However, the goals of public participation are not as ambitious as those of crowdsourcing since the former seeks feedback from stakeholders about a decision, whereas the latter looks for the collective decision itself. Nevertheless, the process described by Brabham serves to illustrate how the Web and, more specifically, Web-enabled collaborative tools can support new implementations of public participation processes.

3. PUBLIC PARTICIPATION FOR EMERGENCY PLAN IMPROVEMENT

In their study of public participation methods for science and technology policy, Rowe and Freder [15] discussed the relevance of public feedback in risk identification and management. They pointed out that citizens' views of risks often were different that the one of risk management experts, and considered the alternative viewpoint that public feedback offers valuable in several stages of the risk management process. We have extrapolated this conclusion to the emergency management field, with the aim of taking advantage of citizens' contribution at the different stages of the emergency management lifecycle. So far, most of attempts to use public generated knowledge have focused on the response phase, with numerous studies about the use of social networks as the main communication channel (a selection can be found at the *idisaster 2.0* blog, *http://idisaster.wordpress.com/bibliography/*). However, public participation in other stages of the lifecycle, especially in planning, has been little explored.

We believe that non-expert, local knowledge can bring new insight to emergency planning processes. As a consequence, we want to study how citizens potentially involved in an emergency can cooperate in the improvement of emergency plans by providing feedback right after their elaboration. Doing so, we hope that significant pieces of previous personal knowledge become consolidated formal knowledge items, reducing the amount of context to be managed during emergencies.

Our approach is summarized in the Concept map of Fig 2. It extends the map in Fig. 1 in several directions. Firs, new actors are considered. On one hand, emergency planners, who design and implement emergency plans as the aggregation of formal and composite knowledge elements [6]. On the other hand, citizens that inhabit in the plan's area of influence, and are the main actors of the public participation processes. Like responders, citizens have personal knowledge that they use in the public participation activities. But this knowledge has a different nature of the one of responders. Actually, we have divided *Previous Personal Knowledge* in two types, namely *expert* and *naïve knowledge*. The former is mostly present in responders mind

due to their background and training on emergency responses, whereas the latter is mostly related with "local" aspects related to the specific area the citizens live in. Of course, both knowledge sets may overlap in some cases.
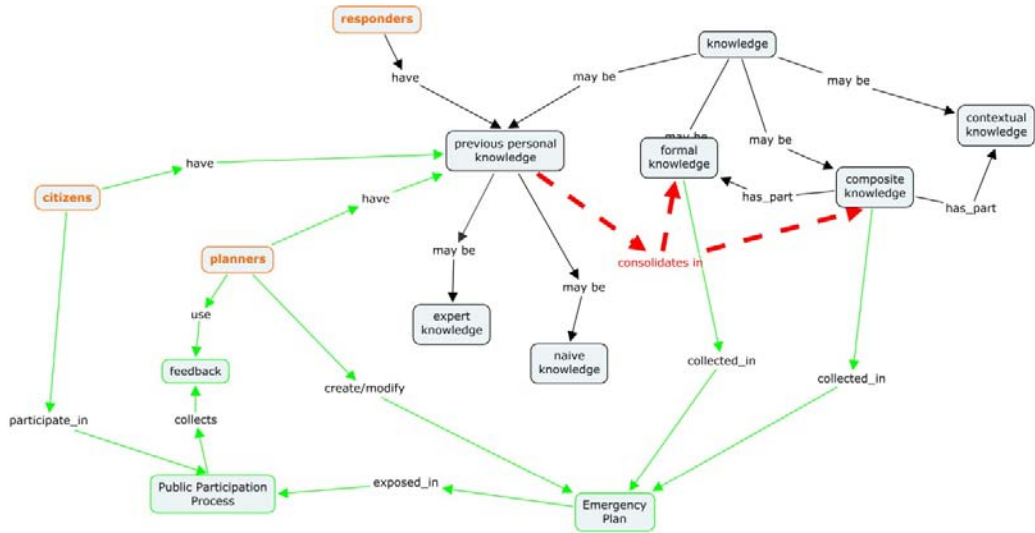

Fig. 2. Public participation processes in the improvement of emergency plans

The bottom part of Fig. 2 summarizes the outcome of public participation in emergency plan improvement. The emergency plan is initially built by planners, who integrate the formal and composite knowledge elements of the plan. Then, the plan is exposed to citizens who can, in turn, produce feedback that may eventually be used by planners to improve the plan. From a different perspective, a public participation process transforms citizens' knowledge into *formal* and/or *composite knowledge*, as the tick dotted line in Fig. 2 illustrates.

3.1 A process for eliciting information from the public

As mentioned before, public participation involves citizens in a process to elicit feedback from them, which can then be used by emergency planners. These citizens, however, may have little or no knowledge of the emergency domain. Thus, it is desirable to have them familiarize themselves with disaster situations, reflect on emergencies, in order to be better prepared to criticize and provide feedback to the planners. Additionally, given the potentially large number of people involved, it is desirable that this process be supported by appropriate tools. Collaborative tools that allow interaction between participants are better, as they enable participants to discuss and reflect about each other's suggestions. Therefore, we designed a four-step process to elicit information from naïve respondents, shown in Fig. 3.
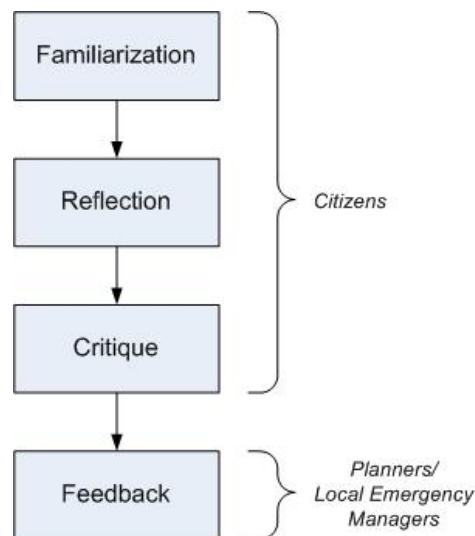
Fig. 3 Knowledge Elicitation Process

Our first concern was that naïve respondents would be unaware of the processes and potential emergency situations they may be faced with. A frequent issue with emergency response is that no one really worries about an emergency until it actually happens. This makes it harder for people to respond when it does happen.

Thus, our proposed process starts with a familiarization stage, in which participants should be led to think about emergencies and how they would act. It is closely followed by a reflection stage, where participants reflect about their chosen actions; think about alternatives and whether they should have done differently. Hopefully, these two initial stages should provide them with enough material to exercise criticism in the following stage: critique. Critique is the stage where participants actually provide feedback on the emergency plans. They use what they have learned and reflected about, and their newly acquired awareness of these situations, to give critical comments on the plan itself. These comments are translated into feedback (usually through some processing, aggregation or statistics) so they can be given to planners for improvement of the plans.

Given the amount of information that may be generated, it is highly advisable for this process to be supported by computational group interaction tools. Several types of tools exist, and a few different possible ways of gathering information from large groups of people exist, such as statistical, markets, deliberation and volunteerism [19]. Deliberation seems to be appropriate in this case, as it enables interaction between participants, enabling debate, improving reflection and collaboration.

In the next section, we describe the implementation of an experimental public participation study following this process. Our goal was not only to enrich the emergency plan, but also to test the process and its effect on participants. We engaged more than 40 Computer Science students of the Universitat Politècnica de València in the study and led them to provide non-expert comments on the emergency plan of the main building of the School of Computer Science.

4. A CASE STUDY

To verify the viability of using public participation for emergency plan improvement we designed an experimental study with a twofold goal: on one hand, to check the ability of individuals to provide feedback about emergency plans; on the other hand, to assess the usefulness of such feedback with regard to the plan improvement. Given

the length of the emergency plan, we decided to constrain the study to parts of the plan, involving emergency situations in only one building of a university campus.

A set of individuals was asked to comment on the information provided in the emergency plan. While they had extensive experience with computers, forms and internet usage, they weren't knowledgeable in emergency management. Thus, we divided the experiment in three parts: familiarization with the emergency domain, public participation to improve the emergency plan, and overall process evaluation. These are described in the next sections.

4.1 Study Design and Implementation

The public participation process was divided into three phases, following the process mentioned in section 3:

- Phase A had as an objective to familiarize participants with emergency situations, invoking their intuitive response to an emergency situation (based only on their own naive knowledge of the site).
- Phase B had as its main goal, to gather direct feedback on the plan itself. Additionally, we also tried out different collaborative tools for public participation.
- Phase C was a final assessment of participants impressions and comments on the activity.

It should be noted that the relation is not one-to-one of the phases to the process stages: during the phase A, the scenarios served to familiarize and questionnaires also led to reflection. In phase B, part of the questions led to reflection (whether they followed the plan and the development f a critical mindset), while in phase B and C critiques were also solicited. Collating and organizing responses into useful feedback for emergency planners is being done manually by the researchers involved.

A total of 45 undergraduate students from the Universitat Politècnica de València participated in the study. They were all Computer Science students, and provided feedback on the emergency plan of the main building of the School of Computer Science, where they usually attend class. There were 36 men and 9 women participants, aged between 21 and 26 years old.

Table I. Scenarios for phase A of the study

SCENARIOS	DESCRIPTION
S1. A fire starts in classroom 1.4	You are at the Software Engineering class with your classmates, and a short in the teacher's computer table provokes a fire in the classroom.
S2. You discover a fire at the ground floor Study Room	You arrive at the Study Room to work on exercises, and when you open the door you discover that a large fire is burning tables and shelves.
S3. A classmate faints	You and a classmate stay preparing a presentation in the classroom 1.7 until the school closing time. Your classmate faints, falling unconscious on the floor. Despite you call to request help from the clerks, nobody responds since they are checking all the rooms of the building before closing.
S4. The building's alarm rings	You are with other classmates in the classroom 1.4 waiting for the start of a lecture, and the building's alarm starts ringing.
S5. The building's alarm rings while you are in the lift	You are alone within the lift's cabin going up to the second floor, when the building's alarm starts ringing.
S6. Strong explosion in the building	Just get to school and while on the toilet on the first floor, you hear a loud explosion. You get out the toilet and see how the area near the classroom 1.7 has been severely damaged. You can see students wounded and a lot of smoke.
S7. Collective panic	You are with a colleague near the coffee machine on the first floor and begin to hear screams and see people, nervous and confused in a hurry running through corridors and stairways.

In phase A, the goal was to familiarize participants with emergency situations and response, and make them think about safety and protection. We designed an exercise in which participants were given scenarios to respond to. We provided seven scenarios, shown in Table I, and asked questions concerning their actions, which can be seen in Table II.

Each scenario simulated the occurrence of an incident in the building 1G of the School of Computer Science, and the participants were asked what they would/wouldn't do in each situation, where they would exit and whether they would use any safety means such as fire extinguishers or others. Scenarios were designed to be realistic, that is, events that could possibly happen. They were described in a simple way, so that participants wouldn't have trouble understanding them, and would provide their instinctive answer. Forms made with Google Docs[1] were used to implement the process of collecting information on each participant's individual actions.

Table II. Questions posed for each scenario

SCENARIO	QUESTIONS
S1, S2, S4, S6, S7	Q1. What would you do? What would not you do?
	Q2. Whom would you warn? How?
	Q3. Would you leave the building? What way would you use to escape?
	Q4. Would you use protective equipment (e.g. fire extinguishers or the alike)? Which ones?
S3	Q1. What would you do? What would not you do?
	Q2. Whom would you warn? How?
S5	Q1. What would you do? What would not you do?
	Q3. Would you leave the building? What way would you use to escape?
	Q4. Would you use protective equipment (e.g. fire extinguishers or the alike)? Which ones?

In phase B, participants were given parts of the current emergency plan of building 1G of the School of Computer Science that concerned the scenarios they had responded to. As the full emergency plan is far too large to provide students, we focused on the following sections: response procedures in case of fire, building collapse or explosions, and medical emergencies; emergency phone numbers; general evacuation rules and meeting areas, building maps by floor and situational map. Each participant, after revising the information provided about the emergency plan of the School, was asked to comment on them. Table III shows the questions that guided participants' comments.

Table III. Questions for Phase B of the study

QUESTIONS
Q1. What information would you add to or remove from the plan? Explain your answer.
Q2. What inconsistencies (if any) have you detected between the information in the plan and the actual building state (e.g. are maps up to date? Appropriate signage? Existence of extinguishers, alarms, etc.)?
Q3. Please feel free to add any comment about the plan you may consider important.

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[1] http://docs.google.com/

In this phase, we used different collaborative tools to implement the process of collecting information. This was done to test the viability of different tools for this end. Participants were divided into groups of 15, and each used a different tool. Information and feedback were provided in one of three ways:

- Blog: the first group was given the simplest tool. Information was pasted into a blog, built with Blogger[2], and participants could provide comments in response to what they read. Comments were identified and visible to others, who were allowed to respond.
- Annotations: the second group had an annotation tool, which enabled them to post notes containing their comments (similar to sitckies) onto images. Information was pasted as images and the stickies were pasted onto it. Notes were identified and visible by all participants, who could comment on each other's notes. The tool used was A.nnotate[3], an online annotation, collaboration and indexing system for documents and images.
- Spatial Hypertext: the third group used ShyWiki[4] [18], a wiki which uses spatial hypertext for representing its content. ShyWiki manages a network of wiki pages whose content is spatially organized: notes may be placed in different regions of the page, moved around, and may be different sizes and colors. The notes can contain text, hyperlinks, and images. Composite notes may be created form simpler ones, helping to organize knowledge hierarchically. Similarly to A.nnotate, the information was pasted onto the wiki and participants could post annotations onto them. Again, comments were identified and visible by all, so responses could be added.

Participants concluded the study by answering a global assessment. Table IV shows the questions and the multiple choice responses.

Table IV. Assessment Questions for Phase C of the study

QUESTIONS	POSSIBLE RESPONSES
Q1 to Q7. Did your reaction to scenario (1 to 7) agree with the specified in the emergency plan?	Yes, I acted according to the plan Yes, but I performed more actions than indicated No, I performed fewer actions than indicated No, I acted in a completely different way The plan does not include the incident of the scenario
Q8. Generally speaking, do you think that the information provided by the emergency plan is useful for the users of the building in case of emergency?	No, I disagree I rather disagree Don't know I rather agree I agree
Q9. After your participation in this exercise, and having had access to the emergency plan, do you feel safer and more prepared for the occurrence of incidents	No, I disagree I rather disagree Don't know I rather agree I agree
Q10. Do you think that your comments may help to improve the emergency plan?	No, I disagree I rather disagree Don't know I rather agree I agree

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[2] http://www.blogger.com/

[3] http://a.nnotate.com/

[4] http://gaia.lero.ie:8080/ShyWiki10/

Participants were also allowed to add comments after responding to the questionnaire. These comments proved very interesting and a source of important information to be discussed with emergency managers at the campus.

4.2 Analysis of Responses

In general, we were pleasantly surprised with how participants responded the questionnaires in Phase A: as a rule they were honest and sincere in their responses, and provided useful criticism later on. We'll be conducting an in-depth analysis of Phase A responses and levels of adherence to the plan, to be reported later.

In this section, we present an analysis of responses received using the three different tools in Phase B (a blog, A.nnotate and ShyWiki).

The Blog was put up on *http://experimentoparteb.blogspot.com/*, and a total of 57 comments were made about the emergency plan provided. Fig. 4 shows one of the screens that was put up, with users' comments (there were 7 in total in this page, regarding the first floor plan of the building).

Fig. 4 Screenshot of the blog with user's comments about the first floor plan.

In this case, comments regard the plan itself, in that it is not up to date, as there had been renovations and there is now a different distribution of classrooms, class names and numbers have been changed and are not the ones building personnel and daily building users know. Other comments were:

- Escape routes were not indicated
- Plans are too detailed, icons are not distinguishable
- Locations with electronic equipment or labs are not represented
- Many emergency exit doors are kept propped open
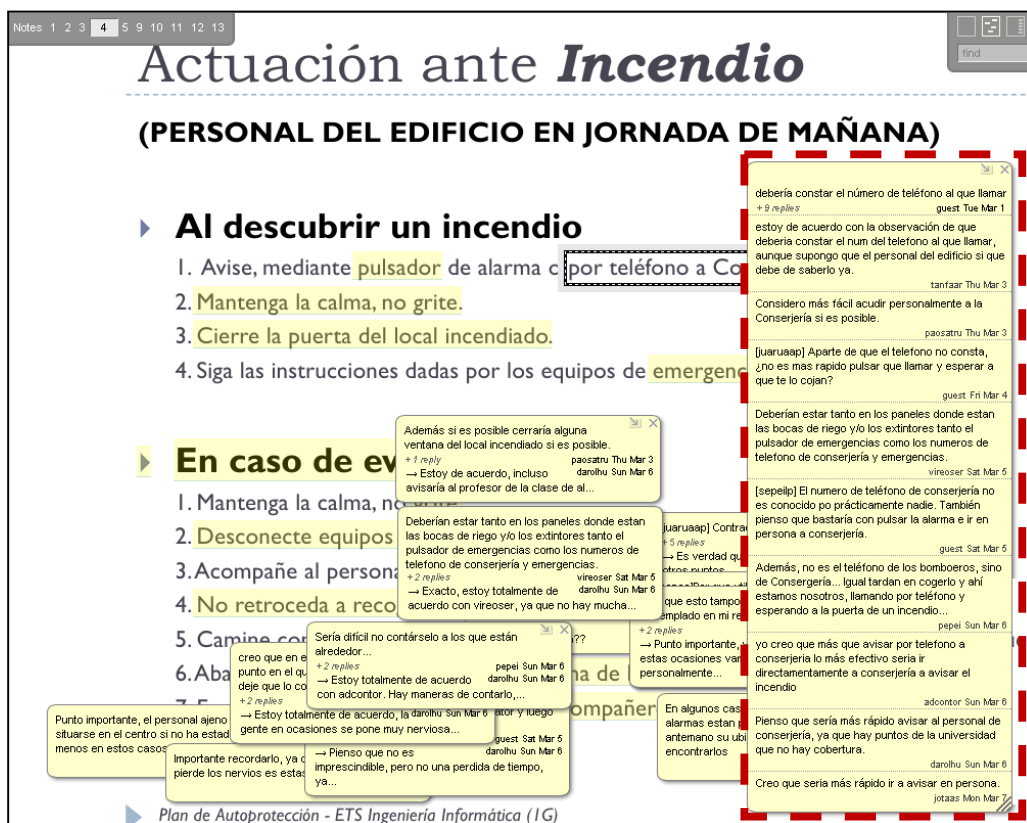- The meeting point in case of evacuation is not shown

Fig. 5 Screenshot of A.nnotate showing participants' comments about fire and evacuation response procedure

In A.nnotate, we shared with the participants the selected parts of the emergency plan at *http://a.nnotate.com/php/pdfnotate.php?d=2011-03-01&c=Nu4NgnDY*, and 88 comments were made. We show a screenshot in Fig. 5, which concerns the fire and evacuation response procedure. In this case, there are 51 comments grouped into 14 notes. The participants can reply to any note adding new comments about the some item. For instance, the expanded note framed in dashed lines in the right site is about the item "phone numbers of whom to call (clerks's desk, in this case) when a fire starts or is discovering". There are nine replies to discuss it. The general comment is that phone numbers of the clerks's desk are not clearly published in any public location. Since the participants don't know those numbers, their decision is frequently to warn in person at the clerks' desk. Some suggestions were that the

phone numbers, as well as the emergency alarm activation button should be in the panels placed near the fire hoses and extinguishers.

Another of the students' comments regarding the fire procedures in this page were:

- Alarms are not well signaled, one doesn't know beforehand its location; in an emergency situation it would be hard to find them.
- They would also add the following to the procedures contained in the plan:
    - Close classroom windows
    - Never take elevator or let others take it.
- In the evacuation instructions, the majority of comments focused on two points of the procedure: Point 2 reads *"Disconnect electricity or other heat generating equipment"* and, Point 4 reads *"Do not go back for personal objects or other people"*. In participants' view, point 2 is not recommendable especially in a stressing situation, and is contradictory with 4. Some textual comments were:

    "... does not want us to go back to collect personal belongings but to disconnect electrical equipment ... this is a bit contradictory. And instead, I think that if I see that someone is inside I would go back almost without thinking about it…"

    or

    "...with the stress of the moment, the last thing I think to do is to disconnect equipment, I just want to get away from the fire as quickly as possible…"

- Another relevant comment was that students do not know the meeting point after the evacuation, and it is not indicated in the procedure itself, but in another part of the plan

On ShyWiki, a total of 55 comments was made, many of which chained together (comments of previous comments), as we perceived in A.nnotate. A screenshot can be seen in Fig. 6, which shows the emergency phone numbers (central note framed in dashed lines) and 11 comments made about it, grouped into 4 notes.

Comments coincided in many ways with those of the other groups. Participants noted that:

- The information is not visible in any sign around the buildings,
- Campus safety phone was not published. One of the issues raised was that only internal extensions were given, which made it impossible to use cell phones to call in case of an emergency (which was the first action of many respondents)
- There should be phone numbers or internal phones with predefined settings, and that they take into consideration accessibility issues.
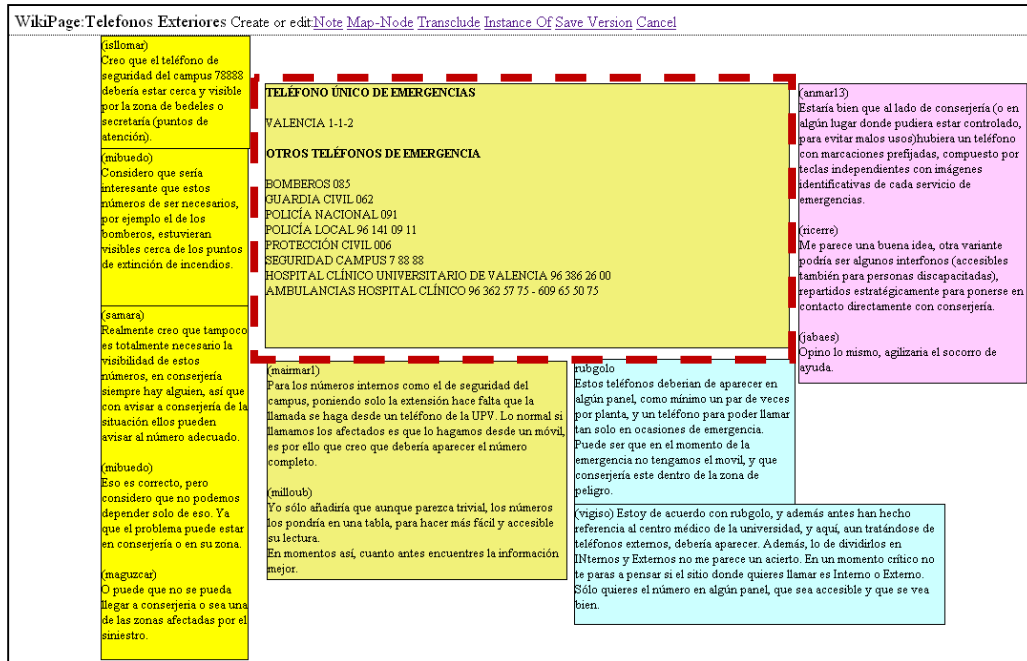
Fig. 6 Screenshot of ShyWiki showing participants' comments about emergency phone numbers

As a whole, the nature of comments did not vary widely between the different tools, but the type of interaction did. In blog style comments, there were fewer interaction and comments on other comments, while in annotation based tools, comments were plentiful and better organized in threads. We speculate that may be because participants can more easily see the annotations displayed over the plan and respond to them, creating annotation threads. A.nnotate users made significantly more comments, we assume because the tool is better finalized and easier to use.

An important aspect is how these comments are translated into feedback to planners for improvements of the plans. Annotation based tools are better than the blog, because all the related comment are in the same annotation threads and it is easier processing. Further analysis and experiments are planned in this respect.

4.3 Global Assessment

Through participation in the activity, participants learned about emergency plans, and realized how much they knew about emergency situation. This shows that our activity in Phase A reached its goal of familiarization. Students became more aware of the problems and issues of emergencies and were able to make useful comments and suggestions that would lead to improvement of emergency plans. More than 82 % of participants felt safer and more prepared after performing this activity, as can be seen in Fig. 7. This goes to show that public participation is not a one-way street, where citizens provide information or complain about a given issue, but can also serve as a two way learning experience for participants, as it induces reflection and thought.
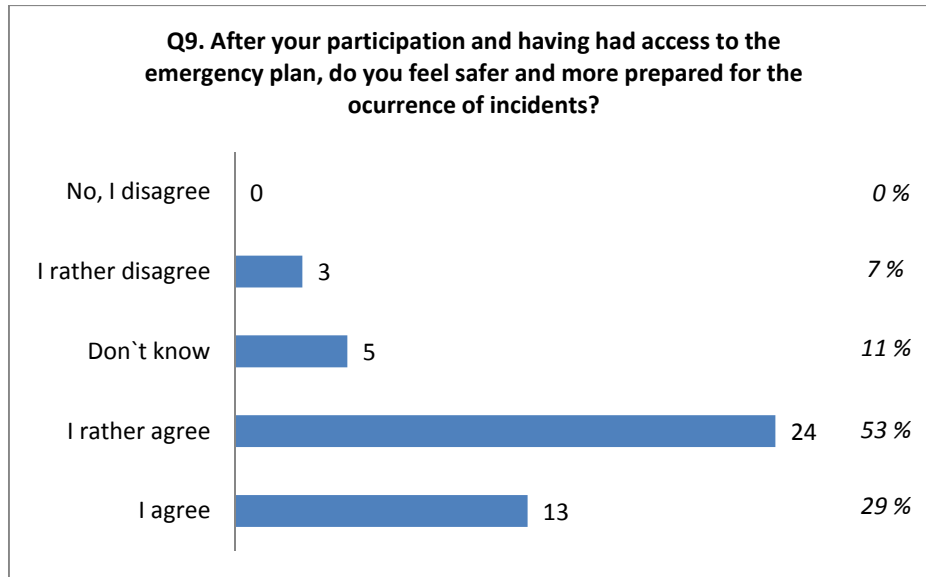
Q9. After your participation and having had access to the emergency plan, do you feel safer and more prepared for the ocurrence of incidents?

Response	Count	Percentage
No, I disagree	0	0 %
I rather disagree	3	7 %
Don`t know	5	11 %
I rather agree	24	53 %
I agree	13	29 %

Fig. 7 Responses to Question 9

Comments reflected their learning experience:

> "Regarding preparation, I learned things I did not know, such as, for instance, where the meeting point for an evacuation was … by looking at the maps and walking through the building to answer in as much detail as possible, I now know with more certainty where certain extinguishers and alarms are..."

They also felt that the plan was useful for responders and building personnel:

> "This plan is very good, not only for us but for other colleagues that may see it, as we will know what to do if faced with an emergency such as the ones mentioned... "

This is reflected in their responses to question 8, which can be seen in Fig. 8. The vast majority (91%) of students believed that the plan was useful for the people in the building.

However, comments show that, while participants believed the emergency plan to be useful, they also felt they did not have enough knowledge of it. Comments very directly indicated that fact:

> "…for plans to be useful they must be well known by building personnel. In the case of students, I would say that the vast majority has never read an emergency plan (I had never read one in my life)…"

Another student commented:

> "In my opinion, students are not sufficiently informed on how to act in case of emergency…"

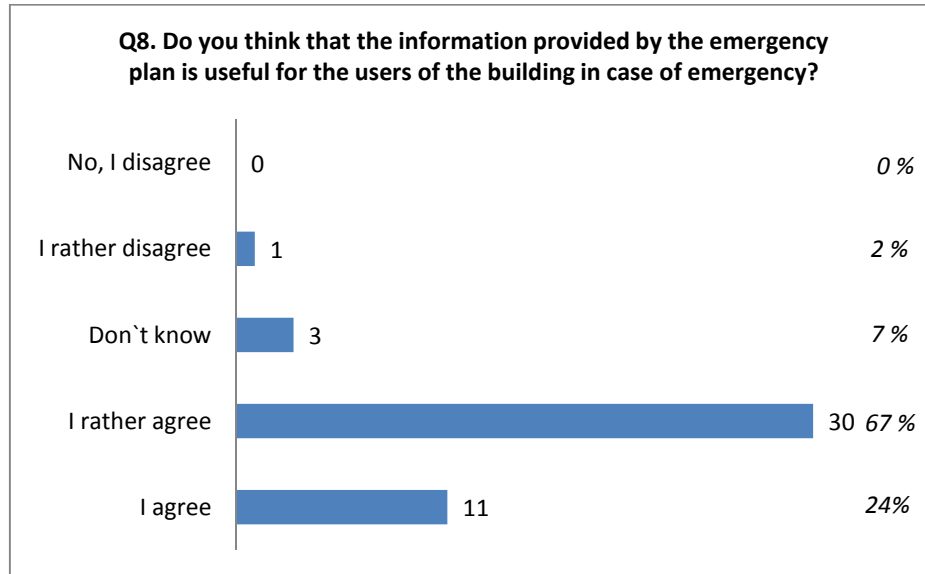"…there has been a general ignorance of the existence of emergency services numbers of the campus…"

Q8. Do you think that the information provided by the emergency plan is useful for the users of the building in case of emergency?

No, I disagree	0	0 %
I rather disagree	1	2 %
Don`t know	3	7 %
I rather agree	30	67 %
I agree	11	24%

Fig. 8 Responses to Question 8

It is interesting to note that a few participants (18%) do not feel safer or more prepared for the occurrence of incidents, and 9% don't think the information provided is useful for building personnel (of the 4 who did not feel the information was useful, 3 also did not feel safer). If we analyze the comments provided by these participants, they feel that, to be really useful, response procedures should be more detailed, and state that, to really feel safer, training and emergency drills or simulations would be required.

From their responses to question 10 (shown in Fig. 9), we can see that participants believe not only that there are improvements to be made, but that they can contribute to this improvement by providing feedback to the plan. However, a few (11%) remain skeptical as to whether their contributions would be considered by planners. Some comments were suggestions for how to better disseminate information, as can be seen below.

> "I believe that the information provided by the emergency plan is very useful information, but lacks a little more specificity in some respects…after renovations of the building, the plan should have been updated..."

Quite a few participants suggested ways to better disseminate emergency response information:

> "It would be very useful, if, during the course of the first four months we had a talk and / or class on how to react in an emergency. And also to perform some drills along the course. If not once a year, at least every 3 years or so, so that every student would have been involved in a situation of this type…"

"…it would be important to centralize services in a single emergency number for the university, as it is difficult to remember all numbers..."

"…This activity was positive but a short talk should be given at the beginning of one's studies at the school, to explain the emergency plan and how to act in these situations…"

"…distribute some type of brochure with this information, or put it in the agenda, for example, or even both..."

"…would be nice to have training related to these issues and others, such as first aid or how to use each emergency response item properly…"
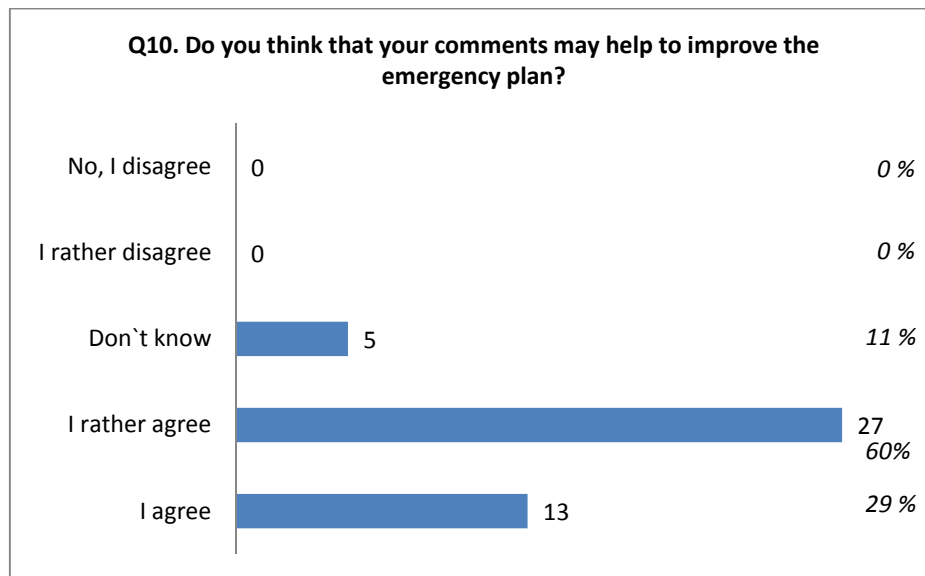

Fig. 9 Responses to Question 10

These responses show that, through the application of the process presented before, we were able not only to obtain useful feedback, but to induce a learning experience in participants. This shows that the process of familiarization and reflection is a useful one for eliciting information when the domain is not well known by citizens.

At the end of phase B (the critique stage), we analyzed scenarios and comments provided relating to each section of the emergency plan. Looking at the number of comments and their distribution through the emergency plan, we could observe that there was greater involvement in the response procedures relating to more concrete incidents, such as fire or medical emergencies. These procedures were associated with scenarios S1, S2 and S3, and participants suggested improvements in many directions. However, for building collapse and explosions, response procedures are

more complex and there may be many causes for an incident, so participants provided less feedback and suggestions for improvements. Participants can deal better with more concrete situations and instructions, and emergency plans should follow these guidelines.

5. CONCLUSIONS

In this paper, we explored the use of public participation techniques to improve emergency plans. Citizens are the first affected in any emergency situation, as they are the ones on site at the time of the event. However, they are frequently unaware of existing emergency plans and act according to instinct instead of following guidelines.

Through a study with 45 participants, we noticed that they indeed had useful comments regarding the plan. For instance, some noticed changes that were unknown to planners (renovations in the building). These changes mean that the plan should at the very least be revisited and revised, and safety conditions checked. These are easily spotted by regular population, but are harder for emergency planners to keep track of.

Participants also realized that their actions are highly dependent on their knowledge of emergencies, and noted this fact in their comments.

> "...when I discover a fire, there will be no emergency team providing instructions to follow. The correct or incorrect behavior will depend on each person's previous knowledge…"

This reinforces the need to involve the public in emergency planning. It is fundamental that they be well informed so they can react appropriately in case of emergencies. Some of the comments were particularly insightful and emergency planners would do well to observe them:

> "…any plan should be pretty straightforward, intuitive and useful. If its construction does not follow these principles, it is very likely to be totally useless, and personal instincts will be followed instead of emergency signage in emergency situations…"

We have not yet extracted and analyzed all responses to questionnaires, which we believe are very valuable. We are in the process of coding and analyzing scenario responses from Phase A. We already know that most participants did not act as expected in the plan, and that some scenarios were completely unexpected for them.

The adoption of three different tools allowed us to see how effective they were for this end. While this study was not specifically designed to evaluate or compare them, we could already notice that there were certain differences in responses and the way in which participants interacted. For instances, blog users interacted much less with each other's responses than those using annotation based tools, who responded to each others' comments. This is an important observation, as it indicated that certain tool characteristics will better fit public participation. Based on these observations, we will design new studies and experiments to assess different tools, their strengths and weaknesses.

The next step in our research will be to meet with emergency planners and respondents and show them comments and responses sent by students, to elicit what types of changes could be made by the plan. Improving previous knowledge of emergency procedures can be very important at times of emergency. Also, making emergency plans accessible (in terms of both reachability and friendliness) to citizens appears to be a key issue in the forthcoming years: recent events show how a well-prepared society can reduce effects of a large disaster such as the earthquake that struck Japan. A well prepared society is better equipped to handle emergencies and reduce loss.

ACKNOWLEDGMENTS

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