Jobst Löffler
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LNCS 4458

Mobile Response

First International Workshop on Mobile Information Technology for Emergency Response, Mobile Response 2007
Sankt Augustin, Germany, February 2007
Revised Selected Papers

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Volume Editors

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Preface

The interest in mobile information technology for emergency response (ER) comes from the simple fact that an important part of this work is done in the field. With little or no infrastructure to rely on, ER operatives have to make do with the tools they bring along. Of course, ER organizations build, invest in and do rely on infrastructure for their operations and this includes sophisticated stationary information technology. The systems used for dispatching ER units are a good example for this. While such systems are very important to support strategic planning and decision making, the effects of emergency response work eventually have to be created on site. And this includes both obtaining the information required for taking informed decisions as well as implementing decisions through targeted actions in the field. All of this is of course not new. The trade-off between responding quickly with the available resources to the situation at hand and responding with more deliberation to strategic goals and constraints is not inherent to the use of information technology but to responding to emergencies in general. What is new is that current and foreseeable innovations in mobile information technology have the potential to offer substantially better support for emergency response field work, resulting in better solutions for this trade-off. By providing better gathering, communication and processing of relevant information between all actors involved, we believe that mobile information technology can be a valuable tool in the hands of ER professionals to increase the speed, precision, efficiency and effectiveness of their operations.

But we are also aware that new technologies not only solve problems but frequently create new ones. Examples in this case are reliability, dependency, and the need for adapted operational procedures, to name but a few. So it is because of this double characteristic, the great potential benefit that usable mobile IT could yield in the domain of emergency response and the specific design challenges for such technologies in this particularly unforgiving domain, that we decided to create a new venue for researchers and practitioners from different disciplines and backgrounds; a venue for a focussed exchange on how mobile information technology can be effectively used to the benefit of ER.

The call for papers for the first Mobile Response workshop attracted over 30 submissions from 13 different countries, including international submissions from Australia, Brazil, Japan, Korea and Russia. An international Program Committee with experts on mobile information technology, ER, and ER equipment selected 16 submissions for presentation during the workshop, which was held February 22–23 at Schloss Birlinghoven in Sankt Augustin, Germany. These presentations offered not only an interesting overview of how different disciplines address the design of mobile IT, but also provided insights into the perspectives from different countries as well as the different perspectives of scientists, industrial representatives and practitioners.

The workshop was concluded by a panel discussion on some of the points that had been raised during the presentations, three of which we would like to briefly present here. Firstly, the relation between standardization and innovation was discussed. It was pointed out that standardization might help in building solutions from well-proven technologies and that it would also foster interoperability which is of particular importance for international cooperation as well as for creating bigger markets. On the other hand, it was stressed that standardization can become a severe obstacle to innovation. Especially for a quickly developing field like mobile IT it is important to maintain sufficient space for innovation. Secondly, the question of how all the information that might be obtained from mobile information technology could be made accessible and usable in something like a joint operational picture was discussed. It was stressed that not all the information is needed by everybody, but that specific actors need information that is relevant for their current task, corresponding more to a common relevant operational picture. It was pointed out that the concept of situational awareness is likely to be helpful in understanding what information is actually needed. Thirdly, the importance of understanding and designing for the actual work of emergency response professionals was stressed. This includes considering everyday problems and informal processes that might not be visible at first glance. Jokingly, one ER professional remarked that it is insufficient to paint some system red to turn it into a solution for fire services. On a more serious note it was stressed that empirical studies to understand the actual work and needs of ER professionals is one of the weak points of current research and development that needs to be extended.

We would like to thank the members of the Program Committee who were very helpful in attracting attention to the event and reviewing the submissions. We would like to thank everybody who was involved in the preparation of the event, particularly our colleagues from Fraunhofer IAIS and Fraunhofer FIT. Most importantly we would like to thank everybody who submitted papers to Mobile Response 2007, all the presenters and all the participants who contributed to a lively and intriguing exchange during the event. Special thanks go to our keynote presenter Kees Nieuwenhuis, who not only gave a most interesting talk, but was also kind enough to promote our event in the ISCRAM community. Finally, we would like to thank the European Commission for their support to the EU projects Share and wearIT@work and for providing us with the context to organize this event. We plan to continue with Mobile Response in 2008 and would like to invite everybody interested to check www.mobile-response.de for announcements on this event.

March 2007

Jobst Löffler
Markus Klann

Organization

Mobile Response 2007 was organized by the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS and the Fraunhofer Institute for Applied Information Technology FIT.

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Wearable Computing

Communication Technology

Information Systems for Crisis Response and Management

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Abstract. Improving our knowledge of and capabilities to handle disasters and crises is not simply a matter of more information processing and more reliable communication and computation. It needs the exchange of information between many different scientific and technology disciplines and a much better understanding of engineering complex C4I systems-of-systems. This discussion paper will address the need for and purpose of an international community and how to obtain focus and transfer of scientific results.

Keywords: Decision Support, Crisis Response and Management, crisis taxonomy.

1 Introduction

Even without understanding any of the details behind terms like disaster management, crisis management, crisis response and command & control, most people can claim to have some basic understanding of what managing a disaster or a crisis may encompass. They would be able to explain that managing for example a major road accident or airplane crash is a process which involves many different organizations, working together with some common intent and that there is a need to share information and, based on that information, decide on something to do with the purpose of improving a situation that got out of control.

In 2003 a number of scientists from different organizations decided to set up an international community to stimulate the exchange of views and information on the design and use of information systems for crisis response and management. It was appropriately entitled the ISCRAM Community. Muray Turoff and Roxanne Hiltz from the New Jersey Institute of Technology, Bartel Van De Walle from Tilburg University and Benny Carlé from the Belgium Nuclear Research Centre were among the initiators. Already working together with researchers and professionals from many institutions and for many years, the realization that more and continuous communication over a broad range of scientific and technology disciplines and with the professionals of disaster prevention, response and rehabilitation, translated into establishing the ISCRAM Community. ISCRAM is (to be) for scientists what TIEMS (The International Emergency Management Society) is for professionals in the field of disaster and crisis management, but with a focus on Information Systems aspects.

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1.1 Purpose of the Community

ISCRAM wants to promote research in all relevant scientific fields, from computer science, information science, economics, business administration, cognitive science and many more. But the purpose of the ISCRAM community is to apply a context or focus by formulating and addressing question from a particular application domain, namely disaster and crisis management. At the same time, we also want to promote the development and deployment of information systems that use the results of the research and discuss the experiences of the professionals that use these applications. Feed back from the field is of vital importance and can help us direct future research in multiple areas of knowledge and technology.

The community is also the mechanism to facilitate and promote cooperation between scientists, the institutions that they work for and the researcher from for example industrial research departments and technology providers. And of course across the globe. It will allow people with similar interest to collaborate but it will also facilitate the much needed multi-disciplinary approach.

And last but not least, because the community also counts solution providers and end-users among its members we explicitly address dissemination and establishing a conduit from research-to-market. Which helps us to show that there are clear societal and economic benefits form the scientific labor that is put in research in many different disciplines.

1.2 Organizing Exchange, Dissemination and Transfer

To promote and facilitate research and the exchange of information between scientists and professionals, the ISCRAM community deploys several methods and tools.

The yearly International ISCRAM Conference is probably the most noticeable tool at the moment. It started in 2003 with a 2-day workshop in Brussels, but already the following year obtained its status as an international scientific conference. The predicate 'scientific' is important, especially since the domain of disaster and crisis management is not a field of science. Care is taken that the yearly conference, traveling between Europe and the United States, is a recognized platform for young and experienced scientists to present their best work and get it published in the proceedings. However, the conference also wants to provide a platform for professionals and their contributions via papers and presentations in which their experiences and needs are presented to the academic researchers.

Other tools are the workshops and special Emergency Management sessions at other conferences. They address the need for in-depth study of specific topics or special parts of the user community.

Also a yearly event is the ISCRAM-TIEMS Summer School that targets young researchers, PhD students in particular from various disciplines. The Summer School offers them the chance to learn about the field of disaster and crisis management from experienced researchers and professionals and learn how their own research can contribute to solving problems in this domain.

Finally, the web-based environment www.iscram.org offers community members access to its members list, proceedings and papers, book reviews and a mailing list. It helps to establish contacts, by acting as 'who-is-who' and collaboration.

2 The ISCRAM Community

Membership is open to all that have an interest in studying disaster and crisis management from different angles. From 2003 to 2006, membership has grown to more than 800 people, from graduate and PhD students, to senior researchers but also including professionals such as fire fighters, police, medical emergency staff and government officials. Therefore, the community is not only a scientific community but also a community of practice. As indicated in figure 1, members are spread across the globe and their number is still growing.

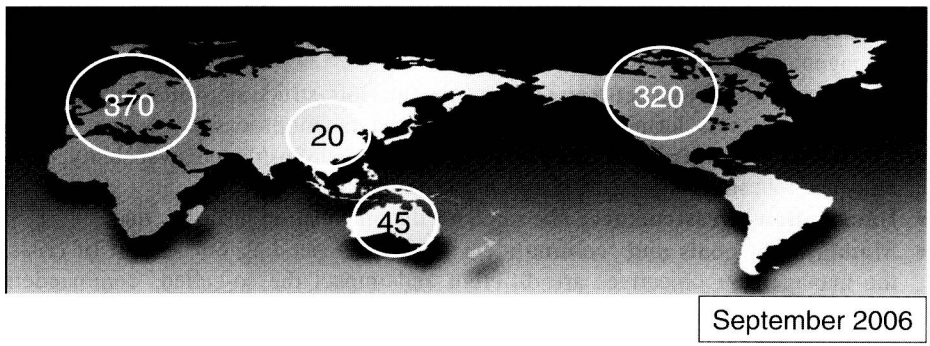

Fig. 1. Distribution of ISCRAM community members over the globe

Apart from disseminating the results of scientific research and experiences with the application of these results, an important goal is to help define further programs and projects and action plans on a national and international scale, for scientific and technology research, and stimulate collaboration between researchers of different disciplines. The aim is to get a better grip on both the impacts of disasters and crises on society and the specific context or circumstances in which they need to be managed. And because of the many different disciplines involved, we need to develop a 'common understanding' that helps us to communicate across disciplines and specializations.

2.1 A Simple Crises Taxonomy

For many experts from many different fields and expertise areas to communicate effectively and exchange information and views, some form of common understanding is necessary, at least within the ISCRAM community. One way of starting a discussion on the subject of a common understanding, is to define and share a simple and fairly abstract crisis taxonomy.

The three main structural elements proposed here are to differentiate between man-made disasters, natural disasters and pandemic disasters. The reason for putting pandemic disasters in a class of their own is because in contrast to the other two, they will not allow us to restore the before-disaster situation. And thus, while the response is in progress, we need to plan ahead for a new society.

Describing their differences in terms of a number of features will help us to understand them as context for our problem definitions and problem solving. The purpose of this classification is therefore not an analytical one, but to define the scope of the problems that we need to focus on, the information system requirements that we need to address and the context in which solutions for (perceived) problems can be validated. As indicated in figure 2, the use of such a taxonomy should allow for specific incidents to fall in two or even all categories, i.e. develop different characteristics while they evolve.

A first set of differentiators could be the following:

- **Predictability and risk assessment:** The models and the reasoning techniques that are available and their reflection on the information systems for the phases of the management process
- **Organization infrastructure:** The organization infrastructure availability, reliability and robustness during the phases of the management process
- **Communication infrastructure:** The communication infrastructure availability, reliability and robustness during the phases of the management process
- **Information infrastructure:** The same for the information infrastructure.
- **Management goals and 'commanders intent':** Depending on the sort of crisis, the management objectives are different and impact the so-called 'commanders intent' which in turn impacts the requirements for the information systems and the context in which they have to operate.

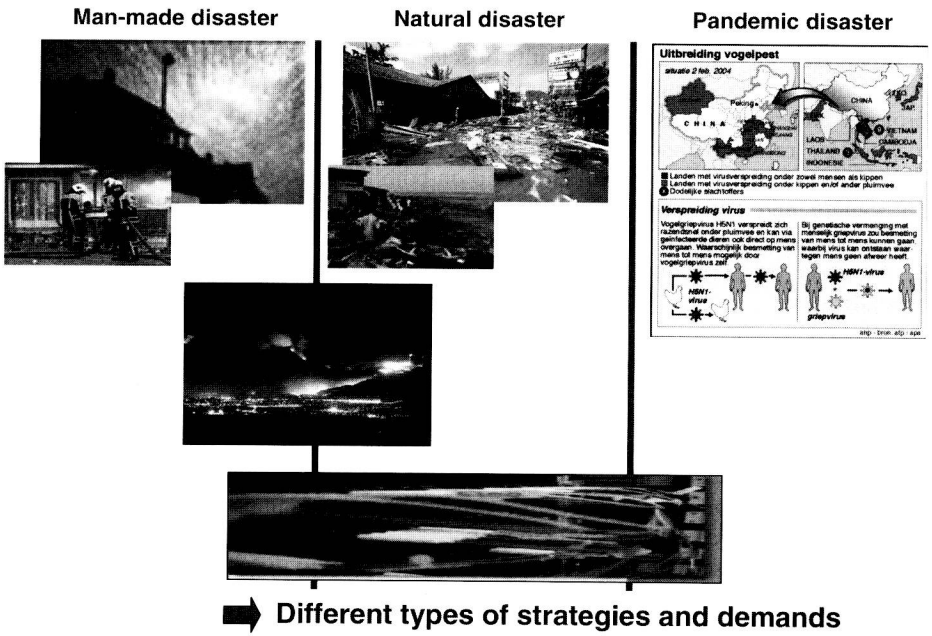

Fig. 2. A simple crisis taxonomy to structure discussions

As stated in the beginning, the views presented here are aimed at starting a discussion within the community and can thus be defined as 'work in progress' on the foundations of ISCRAM. They have nothing to do with scientific research on disasters themselves.

2.2 Common Concerns

From an operational view, the disaster and crisis management process is often described in a sequential way by a number of steps that impose their own specific requirements on the information systems for their support. This process description is common to all three elements of the taxonomy introduced.

A step-wise process description that is often used in the ISCRAM community is the following:

- **Detection:** the process concerned with searching the environment for key features of an incident of a particular nature
- **Assessment:** the process of building situation awareness and trying to classify and quantify an observed incident
- **Alerting:** planning for a step-wise increase in detection and assessment with the aim to respond
- **Mitigation:** planning the first response and the necessary scaling up
- **Response:** scheduling (and re-planning) to actually engage resources to contain the incident under severe time-constraints and uncertainty
- **Recovery:** planning and scheduling for rehabilitation

One process step that does not fit well with the step-wise approach explained before, but which is vital for the quality of all these process steps, is

- Training.

Training at the operational, tactical and strategic level focuses on the preparedness of the humans involved in the overall process. It has two important links with the information systems that are the main concern of the ISCRAM community: first, for training we need specialized information systems and, secondly, training involves the use of the information systems that we need for the different steps described above. Therefore, training also needs to be addressed as a common concern.

2.3 Disciplines Involved

As for the scientific and technology disciplines involved in further investigating and elaborating on ISCRAM, a projection of the background of present ISCRAM community members already includes: computer science and technology (from computational techniques to AI), communication science and technology (from telecommunication to information distribution and security), information science and technology (from information modeling to knowledge extraction), the human sciences (from psychology, sociology, anthropology to cognition), operational research and business science etcetera.

The list can be made longer, but already indicates that advances in the domain of disaster and crisis management are, by necessity, based on a cross-disciplinary approach rather than a mono-disciplinary one. Still, the well known methods of research: fundamental research, applied research and empirical research, apply. In fundamental research we can distinguish two basic approaches: a theoretical or model based approach and an experimental one. In the first we calculate and analyse and in the second we capture and analyze. In Applied research we can distinguish between the use of controlled experiments and prototyping or simulating (and capture and analyze the data). The use of these two methods is well embedded in the ISCRAM community. The third method, empirical research, is also well known in this domain. Here we can distinguish between controlled reality experiments and dedicated exercises. Not withstanding the excellent research projects in which this method is used, I would argue that it is under-valued especially by the professionals in the field. There are many good reasons for not using this method, especially political and practical ones, but there are also excellent reasons for its use and work to overcome the difficulties associated with it. And to name the one that is most important in the authors view: research in now-time can be used for demand articulation.

3 Some Thoughts on a System Architecture

Looking at the disaster management and crisis management process in the real world, it is clear that it involves two sorts of information processing entities: the humans and the computer based systems. This is also clearly reflected in the research that is presented by members of the ISCRAM community. However, in most discussions, we are still stuck with the traditional view on information systems as the 'silicon based' and engineered partition that is 'used by' humans.

It is time to shift gears and to redefine the notion of an information system so that it can include also humans and thus forces us to investigate the use of for example human cognitive capabilities with as much vigor as the use of AI-techniques, in the context of crisis management. This implies that we define a new paradigm from which to derive requirements for new architectures for information systems for crisis response and management. The paradigm proposed is that of Actor-Agent Communities. The actors refer to the human (or carbon-based) information processing entities or systems. And the agents refer to the software (or silicon-based) entities. The use of the word 'communities' reflects the notion that an information system for crisis response and management is, at any given moment in time, a dynamic configuration of collaborating and therefore interacting entities of the two sorts, but with emergent properties that are not all defined at design-time.

A number of issues emerge from this paradigm that must be addressed at the architecture level, such as communication, shared awareness, collaborative decision making, the construction of systems-of-systems, the construction of organizations-of-organisations and coordination and autonomy. This list is not complete, future research will set the scope by adding more issues that need to be addressed in a multi-disciplinary way.