ERMA: Electronic Risk Management Architecture for Small and Medium-Sized Communities

Gertraud Peinel, Fraunhofer FIT, Schloss Birlinghoven, 53757 Sankt Augustin, Germany; E-mail: gertraud.peinel@fit.fraunhofer.de
Elmar Berger, Fraunhofer FIT, Schloss Birlinghoven, 53757 Sankt Augustin, Germany; E-mail: elmar.berger@fit.fraunhofer.de
Thomas Rose, Fraunhofer FIT, Schloss Birlinghoven, 53757 Sankt Augustin, Germany; E-mail: thomas.rose@fit.fraunhofer.de

ABSTRACT
Project ERMA (Electronic Risk Management Architecture) aims to build a reference platform for risk management in the domains of natural as well as man-made disasters with a specific focus on needs of small and medium-sized communities. Communities might be public institutions as well as private sector organisations which share obligations and duties for risk prevention and response. Hence, specific attention will be devoted to a customisable platform, which can be tailored to the needs of the individual risk at hand as well as local equipment and requirements.

1. INTRODUCTION

Project ERMA strives to develop a reference platform for risk management. The engineering paradigm is based on a service-oriented architecture (SOA) in order to integrate components of existing and related systems. ERMA will study the requirements for risk management support in the domains of natural as well as man-made hazards, risks, and disasters. A specific focus will be placed on the needs of small and medium-sized communities. Communities include local authorities and other public institutions as well as private sector organisations with obligations for risk prevention and response. Due to the diversity of requirements, specific attention will be devoted to the customisation features of the platform in order to tailor it to the individual requirements of the individual risk situation.

The vast amount of information during risk incidents compounds any decision process for the responsible rescue organisations. Specific decision scenarios, such as management of rescue resources, are already supported by IT applications for command centres. Yet, workflow management services and key indicator systems are rarely found although their added value for crisis assessment has been proven.

Thus, the ERMA platform comprises:

- a key indicator-based decision support system combined with a workflow management system,
- an early warning system to alarm emergency staff and the concerned citizen,
- a citizen relationship management system to support the communication with the citizen as well as team collaboration software for rescue organisations and other authorities.

This paper will present research in progress of project ERMA by providing its main scientific and technological aims and objectives.

2. IT SERVICES FOR RISK MANAGEMENT

Risk management surfaces as emerging topic for the software industry. Yet, no reference platforms and standard components have been established so far.

The unique features of the ERMA system with such a combination of modules and functionality can not be found in the current market. In science, individual modules have been tested in the domain of emergency management. Examples include the simulation of events with training purposes (Pollak, Falash, Ingraham, & Gottesman, 2004), the support of information dispatching (Van Someren et al., 2005), or collaboration processes (Georgakopoulos, 1999). Unfortunately, no commercial system has emerged from these prototypes, and no prototype is available for testing for ERMA.

However, information technology support is still scarce and mainly focused on

- *Communication infra-structure* — Novel communication infra-structures enable the convergence of various and heterogeneous communication technologies in order to allow different organisations to communicate using their heterogeneous technologies.
- *Geographical information systems (GIS) for information warehousing* — GIS are employed to integrate various data sources about risk-related information. Once doing so, one has a uniform source of all information that are required to assess a crisis and also take measures for prevention. Besides prevention scenarios, such warehouses are also deployed during response and recovery scenarios such as the planning of counter actions.
- *Task monitoring* — Recent systems allow the monitoring of tasks decided in order to document the process and exchange information about resources required for their execution.
- *Resource management* — Since specific incidents might require dedicated equipment not available to everyone in sufficient numbers, repositories about resources and their location are taking-off. They allow for the identification of appropriate resources.
- *Command centre support* — Each command centre uses its own information resources mainly about locations and geographical information. They are management by GIS.
- *Simulation tools for impact analysis* — Simulation tools allow the prediction of impacts such as the dispersion of toxic materials or the spreading of forest fires.

All these types of support for risk management forces are unquestionable. There are also more tools for rescue-related services as well as relevant data sources which have given birth to major European research projects for designing a generic infra-structure platform. For example, Orchestra, OASIS and others are establishing information technology platforms for the integration of data sources and the orchestration of rescue-related services. The SOA approach is the key for a flexible design and adaptation from an information technology point of view. They basically provide the middleware services for the implementation of service portfolios for rescue operations. However, until now these platforms do not consider

- Process support to capture the know-how about rescue operations and support rescue forces during incidents,
- Public alerting, i.e. advising the public about risk incidents in a customised fashion.

This lack of services motivates the birth of ERMA. In addition, risk monitoring and assessment on the basis of indicator systems that take into account specific industrial and natural risks is included for automatic monitoring purposes.

Since ERMA uses a SOA approach, it is able to orchestrate services from existing systems. Compliance with specification patterns of major infrastructure projects is sought but not considered essential in detail, since all SOA-oriented approaches are based on similar principles: specify core business services provided by existing systems and configure them to customer-oriented services based on SOA or in the terminology of rescue forces: use IT services for the preparation and orchestration of rescue operations.

3. MOTIVATION FOR PROCESS MANAGEMENT

ERMA is going to employ a process engine, which supports emergency staff with predefined and ad-hoc process description. Know-how about processes furnishes an invaluable source of knowledge about tasks to be conducted in order to respond to specific events. This know-how is only available in terms of manuals for the most part, i.e. major fire brigades have specified their response patterns by so-called standard tactics. Each tactic describes certain patterns of actions to be taken depending on the event at hand. As such, predefined workflows collect experience, organisational and administrative knowledge about how specific actions are to be undertaken, like e.g. evacuations, securing of installations, mounting of flooding dams. Ad-hoc workflows allow one to plan end execute not yet modelled series of actions in specific occasions in order to customize pre-defined patterns to event-specific requirements. Once defined and completed, they can be adapted, stored, and reused later for similar situations. Until today, action plans of emergency situations like flooding are collected in large manuals with small or no IT support at all. Such manuals do not support tracing of actions, graphical overviews, showing of interdependencies, logging, or ad-hoc changes by nature.

A formal representation of such processes is required in order to embark for process guidance and analysis. Moreover, the use of workflow engines will ease the definition of complex scenarios, so that each step and respective information exchange can be modelled. In the case of an emergency, involved staff can concentrate on extreme and unusual events while routine jobs are guided by quality-assured workflow procedures.

By the same time, authorities have started an exchange of best practices with regard to risk assessment, monitoring, prevention, awareness, response, recovery and management. Although project SETRIC (SEcurity and TRust In Cities — www.setric.org) has established a platform for the publication, exchange and dissemination of best practices, information exchange is mainly based on text documents. Here it is where process modelling approaches will foster the reuse of process know-how.

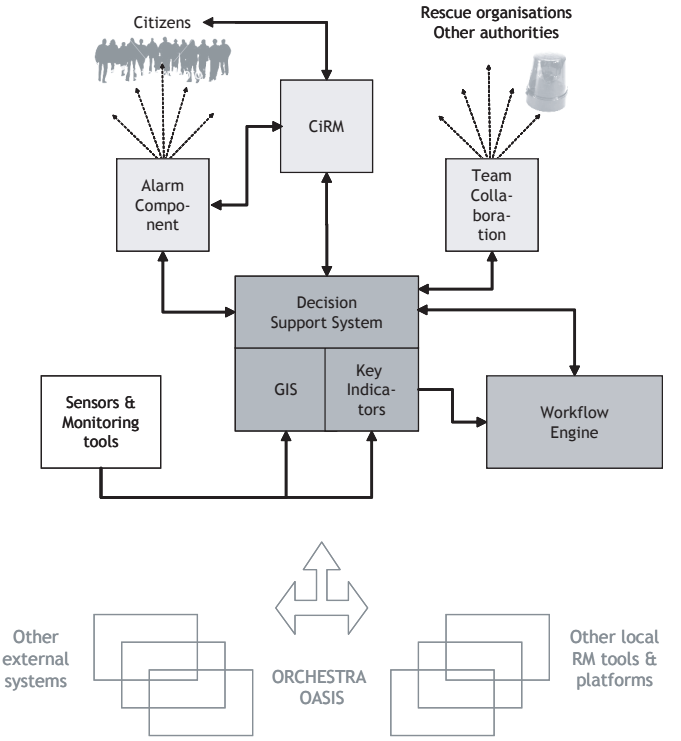
4. IMPLEMENTATION

ERMA will build an innovative prototype that targets the requirements of small and medium-sized communities. ERMA will establish links to existing risk management initiatives and pursue information exchange, discussion, and reuse of research results and components with a particular focus in mind: migrate these results to small and medium-sized communities. Of specific importance is the fact that the consortium includes several small to medium-sized companies with innovative product portfolios.

In detail, ERMA is going to assist small and medium-sized communities to:

- Access monitored sensor data related to various natural and industrial risks existing within their district, i.e. enable proper risk assessment.
- Define and employ process guidelines for risk management procedures, i.e. support proper workflow for risk analysis and response.
- Deploy and manage enhanced emergency telecommunications systems and implement a public communication system devoted to the communication with the citizen, i.e. support appropriate dissemination and warning procedures.
- Integrate and connect partners from various sectors, e.g. public, private and associated sectors, i.e. provide a collaboration platform for the exchange of information among different stakeholders.
- Prepare the elements (organizational/technical) for the implementation of a risk management network at a local scale, i.e. install and customize the platform to local requirements.

ERMA will develop a comprehensive risk management platform which is based on the orchestration of relevant systems thanks to the application of service-oriented architectures, and interfaces to other systems will augment the ERMA service portfolio where needed.



The planned architecture shows the different modules to be integrated. Some of them are provided by project partners, i.e. the alarm component, a customer relationship management tool, and the team collaboration system, which are already commercially available. They have to be adapted to the risk management domain taking especially into account the need of smaller communities and their respective citizen requirements. For example, the CRM (Customer relationship management) component has to be adapted to a citizen-oriented system supporting the specific work of rescue organisations and authorities in crisis situations.

The process/workflow engine as well as the decision system based on key indicators and visualised by maps of a GIS or mapping tool will be designed and developed during the course of ERMA.

ERMA's innovation lies in the combination of a key indicator system (KIS) and a workflow engine. While the KIS will collect sensor data, derive the current state of the event and give recommendations for further actions, the triggered workflow engines show the work schedule on how to perform the different steps of these actions. These are pre-modelled based on typical crises management procedures. But ERMA also wants to allow ad-hoc workflow in order to change, adapt and store for reuse.

External links to other projects and systems, especially the EC funded projects Orchestra and OASIS, will complement the service offer and provide additional means for information exchange.

The information flow between modules is presented in the following figure. Optional components (presented in light grey) will be linked by SOA to establish loosely coupled and interoperable services, which can be integrated or deselected for individual requirements. The decision system serves as core component integrating the application logic and scheduling other functions when demanded.

5. RESULTS

Scientific and technical results of the project will be:

- Research on a generic SOA for risk management systems with a holistic approach to flexibly integrate standards and components.
- Research on risk management for small and medium-sized authorities: decision making patterns, information needs, assets, and vulnerabilities.

- Application of process models and workflow and decision support systems to risk management tasks for small and medium-sized communities' requirements.
- Design of an information infrastructure dedicated to manage most aspects related to the management of risk to improve the confidence of citizens to their local governmental institutions.
- Design of an innovative method to "map" the risk environment.
- Design of an innovative method to optimize individual information flows between risk management actors.
- Design and implementation of a risk monitoring system configurable to a multitude of contexts, and centralization of risk measure data in the local authorities' system.
- Decision system based on key indicators with map-based visualisation tools.
- Mapping of basic best practices of risk management to process and workflow engines with online support in risks at present.
- Customised and instantaneous warning of citizens in affected regions via multi-channel means.
- Citizen relationship management – applying commercial oriented CRM systems to communication with citizens in the risk management context.

6. OUTLOOK

The ERMA project started in September 2006 with a two year perspective. It will provide a first prototype to be tested at two user sites in 2007. Final findings about the performance of the platform and its customisation prospects are expected by the end of 2008.

Due to the employment of service-oriented architectures, ERMA is going to adapt and build upon existing components for alarming, geographical visualisation, collaboration, and citizen relationship management. Specific components will be developed for indicator-based risk assessment as well as dedicated process support for risk management. Hence, ERMA will combine best-of-class components and best practices on risk management. Its innovative power is due to the combination of services and their customisation features.

7. ACKNOWLEDGEMENT

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