Process-oriented Risk Management for Smaller Municipalities

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ABSTRACT

Project ERMA (Electronic Risk Management Architecture) develops a platform for risk managers that can be customised to individual risk management scenarios in order to meet the needs of small and medium-sized municipalities. Due to their limited resources, smaller boroughs call for flexible and intelligent platforms that can be tailored to a set of risk management scenarios that might range from natural disasters to man-made hazards. This paper will promote a process-oriented stance for supporting emergency management operations. The scope of services ranges from decision support via key-indicators with attached process management system up-to alarming services that incorporate citizen relationship management services to keep the citizen well informed and use him for the capture of additional information.

Keywords

Crisis management, process management, key indicator system, SOA.

INTRODUCTION

The unfolding amount of information during risk events compounds decision processes for responsible rescue organisations. Although rescue forces adhere to specific response patterns and the flow of information is overwhelming, information technology (IT) support is still scarce. The penetration of IT tools into the risk management domain is often limited to geographical information systems and various simulation approaches for impact analysis. More recently, some projects have been funded by the European Union for the design and implementation of service-oriented platforms for the integration of risk management services. For emergency operations, IT support is in place for the use of converging communication technologies. However, there are no specific services for process management support although major organisations are standardising their processes.

The ERMA project (Project ERMA, 2007) focuses on assisting local authorities or municipality services in creating and efficiently managing risk management processes. ERMA has studied the requirements for risk management support in the domains of natural as well as man-made hazards, risks, and disasters. A specific focus is placed on the needs of small and medium-sized communities, including local authorities and other public institutions as well as private sector organisations with obligations for risk prevention and response. The diversity of requirements has posed specific requirements on the customization abilities for any IT platform to be developed. Hence, specific attention is devoted to the customisation features of the platform in order to tailor it to the individual needs of the local risk situation and available resources.

The engineering paradigm of ERMA is based on a service-oriented architecture (SOA) in order to integrate existing and related components. Following a careful requirements elicitation process, the platform will finally comprise:

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

This paper presents the background of ERMA and its major objectives for the support of small and medium-sized communities. It further presents the architecture and the implementation approach chosen. Specific attention will be devoted to the design of the process management component, which is founded in systems that have originally been designed and evaluated for the automotive (Rupprecht et al., 2000) and the health care domain (Sedlmayr et al., 2007).

BACKGROUND

Know-how about processes furnishes an invaluable source of knowledge about tasks to be conducted in order to respond to specific events (Mak et al., 1999). 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. Until today, action plans for 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 (Curtis et al., 1992).

ERMA is going to employ a process workbench, which supports emergency staff with predefined and ad-hoc process descriptions. As such, predefined process models 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 processes allow one to plan end execute not yet modelled series of actions in specific occasions in order to customise pre-defined patterns to event-specific requirements. Due to the modelling of processes best practices between communities (larger and smaller) can be exchanged and adapted to local requirements. Once defined and completed, they can be adapted, stored, and reused later for similar situations.

This process feature of the ERMA system is currently not available on the market. In acedemia, some modules have been tested in the domain of emergency management. Examples include the simulation of events for training purposes (Pollak et al., 2004), the support of information dispatching (Van Someren et al., 2005), or collaboration processes (Georgakopoulos, 1999).

Small and medium-sized communities pose specific requirements compared to large cities:

- towns or villages with less than 50.000 inhabitants. Main characteristics of small and medium sized municipalities in risk management are (in comparison to large municipalities):

Small and medium-sized municipalities	**Larger cities**
Less number of risks and accordingly less experience with rare events.	Attracts more risks (be it due to more installations, more density of population and related effects like traffic, being a more attractive target for terrorists or trouble makers).
Less number of risks and accordingly less experience with rare events; only specific knowledge about local risks.	More risk targets, more risk types.
Fire brigades are mostly voluntary forces that are responsible for emergency management).	Dedicated staff and departments responsible for general crises management.
Less budget, staff bound in daily work, no time and budget for rare risk types.	Large budget, better equipment, time and budget for specific emergency training.
Fewer facilities and less people in danger in case of emergencies.	Large amount of people and high number of facilities in danger; due to high density chains of episodes possible; strong side effects due to blocking of access streets in high-density areas.
Mostly no software available for crises management support.	At least simulation tools and software for resource management available.

- organisations with security tasks and departments like ports, airports, large shopping sites, leisure parks, or commercial organisations with clear risk responsibilities like chemical sites, firework manufacturers, and the like.

The ERMA project is part of a series of risk management-related projects (including (Project ORCHESTRA, 2006) or (Project OASIS, 2006)). ERMA will build upon the experiences gained in projects APNEE and APNEE-TU for the dissemination of information towards the citizen in case of health threatening episodes, since sophisticated know how is required for the selection of communication channels in case of a crisis as well as the customisation of mes-

sages. Moreover, the city network of SETRIC (Security and Trust in Cities), which so far produced a significant number of best practice reports, will be used for elaborating the requirements, transfer best practices in process models, and disseminating the results.

METHODOLOGY

The ERMA project develops a comprehensive risk management platform, which is based on a SOA-enabled orchestration of relevant systems. Interfaces to other systems are going to augment the ERMA service portfolio where needed.

Figure 1 shows the architecture and information flow of the ERMA components. Some of the modules are provided as commercial products by partners, e.g., the alarm component, a customer relationship management tool, and the team collaboration system. But they have to be adapted to the risk management domain. The decision support system with key indicator and process management support is an additional component that will be tailored to risks of the end-user partners. External links to other projects and systems will allow the integration of additional services.

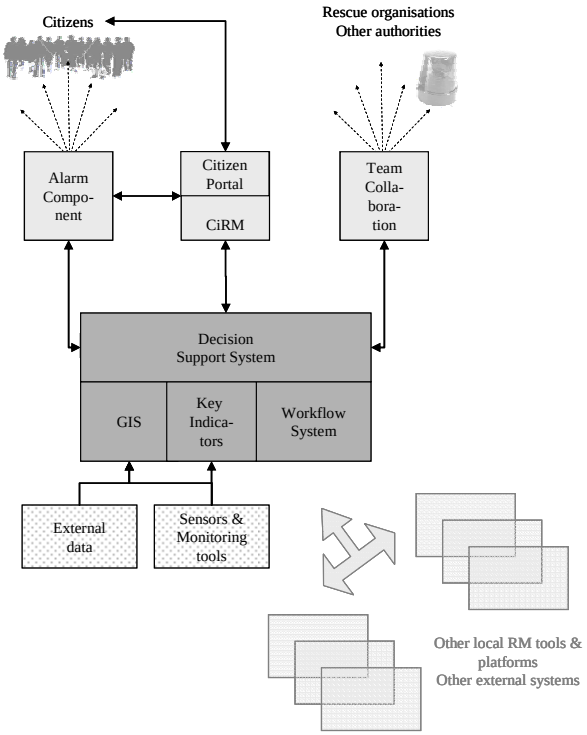

Figure 1. ERMA SOA Architecture

All 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 support system** (DSS) serves as core component integrating the application logic and scheduling other functions. The DSS of ERMA will perform the following tasks:

- collection of sensor data,
- assessment by key indicator system,
- derivation of states and actions,
- visualisation of measurement data in specific region, deduced state and actions, and finally
- display of processes for corresponding tasks of action.

Cartographic visualisation is very common for risk management systems. ERMA also employs map visualisation of the risk situation by incorporation of a GIS and **key indicators**, their source and the region affected. This visualisation assists in the assessment of the current state of risk and decision on further steps. The **process management system** details counter measures and guides users in executing the necessary steps. These steps in turn have been specified beforehand. However, customisation of processes is supported in order to adapt process models to current the crisis situation (ad hoc processes). The exchange and adaptation of process models and instances will be possible, which allows the re-use of process models across different organisations.

The user interface follows a cockpit paradigm. The DSS will give indication on what happened and how to react. Additional components foster communication:

The **alarm component** allows one to warn and inform the public by transmitting vocal or textual messages to a specific region. Feedback tracing collects the response of the public and gives an indication on further measures.

Additionally, a **citizen information portal** will be established. It is connected to a **citizen relationship management module** (CiRM), which fosters communication and also channels citizen feedback.

Team collaboration software allows the sharing of short textual information, forms, movies and images, documents and the like between rescue organisations and/or authorities. Additional features like chat functions, notifications on changes and upload, calendars, address and contact lists supports information exchange.

The system can be extended to incorporate other systems and services due to the SOA architecture, but also scaled down, if individual components are not required from the target community. For example, the collaboration software might not be desired for smaller teams. On the other hand, the ERMA systems might be scaled up with additional tools useful for larger emergency conglomerates, e.g. add dispersion tools for impact analysis.

PROCESS ENGINEERING WITH ERMA

The ERMA architecture will be applied to small and medium-sized municipalities and operated in command centres of disaster management authorities or organisations like fire brigades. Best practices will be represented in terms of processes. The question arises of how to engineer these processes due to their complexity and organizational dependencies that have to be considered. Here it is where a process engineering workbench (Scheer and Nuettgens, 2000) is beneficiary for the design of processes due to the variety of tools and libraries provided, e.g. reference libraries or performance measurement tools. The spectrum of optimisation approaches that have been developed for the business domain will be investigated in order to design appropriate performance measures and key indicators for risk management scenarios.

Processes are built upon individual activities that are orchestrated to serve a particular task. Each activity is performed by specific organisational units which require certain capabilities and competencies for this specific task. By the same time, certain resources are required or consumed by activities, be it equipment or just physical space.

Recently, German fire brigades have specified a common procedure for the treatment of mass casualties, i.e. providing medical support for about 500 up-to 1000 people injured. Hence, a process description was required that specified the rescue services provided at an abstract level. Each service has been described in terms of activities involved and resources required. Then, a coordination process started to design a process which can be served by all parties involved and which obeys all resource limitations, such as space.

The information displayed in figure 2 is instrumental for the coordination of a process. The overall structure is displayed in the centre part while additional information about organisational properties and resource requirements are displayed in the side bars at the left and right part of the screen. In the course of the project, sophisticated methods and tools will be developed for the analysis of processes. Models are going to be improved with regard to synchronisation patterns or resources consumed.

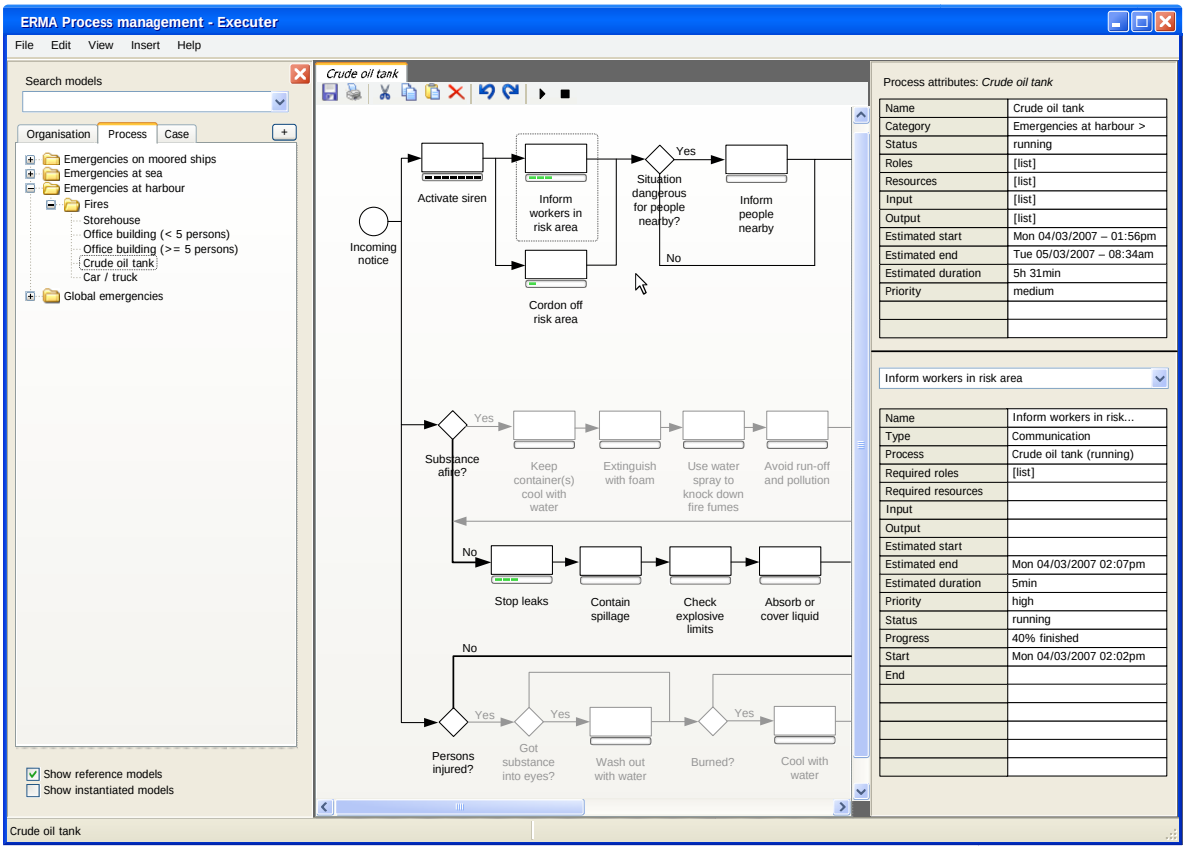

Figure 2. Process Management Environment (Mockup of ERMA)

OUTLOOK

ERMA 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. Currently the user requirement state is finalised with first mock-ups, which have been presented to user sites. Next step is the definition of emergency scenarios and use cases, which will be translated to process models. These mock-ups and use cases will be presented in the ISCRAM 2007 conference in order to trigger a discussion about process support for the risk management domain.

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. It will promote a process-oriented stance for supporting emergency management operations. Specific components will be developed for indicator-based risk assessment as well as dedicated process support for risk management. 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.

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