

CENTERIS 2013 - Conference on ENTERprise Information Systems / HCIST 2013 -
International Conference on Health and Social Care Information Systems and Technologies

Enterprise Information Systems for Crisis Management

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Abstract

Under parallel initiatives across Europe, emergency services are being conjoined or proactively seeking enhanced collaboration for efficiency and improved capacity, while emergency management systems (EMS) are being deployed, in the main, at Regional (Government administrative) level. Interoperability of EMS will contribute greatly to the integration objectives and increasing levels of public safety in a crisis, and this requires an enterprise approach for success. Progress in realising such an objective is reported, along with initial results from field exercises, and future perspectives are offered.

Keywords: Crisis Management; Interoperability; Semantic Translation; Data Mediation.

1. Emergency Management as Extended Enterprise

In the wake of investigations into recent man-made and natural disasters there has been a realization that in order to respond effectively to incidents the emergency services need to overcome existing barriers to collaboration and extend their systems. Many of these services are addressing this by focusing on interoperability and collaboration based on coexistence model where the autonomy of the differing organization is maintained. On the other hand there is also a trend towards integration of emergency services, either by integrating within a single service to cover a larger geographical area (cf., the recent merging of Scottish police forces)[1], or integrating different services to improve joint operational capacity [2]. In either approach first responders (fire, police, and ambulance) face some significant challenges. These include arranging legacy systems, interoperability, and information sharing [3,4,5,6,7,8]. These are underpinned by deeper organizational differences from radically differing organizational norms and values through to deeply embedded routines and ways of working [9].

A noted example of success in overcoming these barriers to create an integrated approach is Veiligheidsregio Kennemerland (VRK, safety region Kennemerland) which follows the Netherlands national approach to service integration, widely recognised as a very progressive European model [10]. VRK have integrated first responders (Fire, Police, Ambulance) and linked them via a National Emergency Management System (LCMS). Figure 1 shows a scheduler using LCMS (data and maps) to guide first responders in action.



Figure 1 - Control Room at VRK, Haarlem, NL

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The LCMS approach provides a “common operational picture” (COP) as annotated maps, showing incident, vehicle and personnel locations, plus data relevant to the incident being addressed. These presentation elements can be interrogated, and the underlying data and information made available to commanders and decision makers. The Netherlands approach exhibits all of the key features of advanced EIS: enterprise class architectures; integrated and coordinated business processes; information sharing across all functional levels and management hierarchies; use of standard data structures to eliminate information fragmentation; assurance of single source data held by owner-experts; integration of legacy infrastructure; enterprise-wide planning and coordination. These relatively recent changes in approach to security, safety, and emergency management appear worthy of closer consideration by, and also support from, the EIS community.

In contrast in England and Wales the co-existence model has been maintained. Here the primary approach has been to follow a model of co-existence where the focus has been on creating a framework within which the autonomous services can share information and collaborate effectively. This has been pursued through the National Policing Improvement Agency Multi-Agency Inter-operability Programme (MAIP) and latterly through the Joint Emergency Service Interoperability Programme (JESIP). JESIP is in the first stages of planning to deliver its own Enterprise approach whereby all emergency services command will be trained to work together in response to major or complex incidents [11]. In the same context, initiatives such as ATHENA [12] are being deployed to deliver interoperable and enterprise class IT support to police forces in seven UK regions. There are a very significant number of challenges within this model. For example, the sharing of certain classes of data and reuse of data is seen as problematic and needing mediation and control as legal and ethical issues remain unresolved around the sharing of sensitive data held by both the health and police services.

In both the co-existence and integration model described above semantic inter-operability remains a significant challenge. In England and Wales the challenge is to provide a system which allows semantic inter-operability between services within the country. In the Netherlands where this has already been addressed the challenge is to provide a solution which addresses semantic interoperability between Dutch responders and services from outside the Netherlands who may collaborate within the service when dealing with cross-border incidents.

2. Cooperation Drives Enterprise Culture

Various studies have set out to show how an enterprise approach could improve emergency management. Kuehn et.al. [13] present a general architecture for emergency communications that incorporates information brokerage, events and event-driven processes, plus a strategy for interoperability, derived in part from consideration of eCommerce practice, and including coverage of semantic interoperability to include agencies with differently coded data. Addressing the problem of including multiple agencies with different cultures, data, and even languages, Schafer et.al [13] emphasize the community ownership of emergency management, and the need to include “Geo-collaboration” as an activity using maps as the reference for a COP derived from multiple sources of information, to be used in exercises (preparation) and in response to emergency. While Franke, Charpoy and Khoury [15] argue for the use of structured approaches and structured tools. Challenges highlighted by preceding research include interoperability of legacy systems for emergency management, and shared usage of content that may use different data encoding or language at source. These issues are partly addressed by the INSPIRE [16] initiative addressing interoperability of Geographical Information Systems (GIS) at Government level, but this is not yet fully sensitized to First Responder needs [17].

While some Member States have well developed Emergency Management Systems (EMS), these are typically deployed at regional level, and there is increasing need for cooperation between regions, or even between Member States. In the case addressed by Weber et.al [18], a Moor Fire penetrating deep turf in the Dutch-German cross-border region of “Amtsvenn” near the cities Enschede (NL) and Gronau (DE) created risk to people and infrastructure. The sub-surface fires could not be easily detected, moving above them could lead to fatality, and their spread towards habitations and roads could not be easily tracked. Helicopters using thermal imaging were deployed by German authorities, but exchange of data with Dutch EMS was difficult because of the lack of interoperability and exchange standards. Furthermore, German and Dutch responders use different map symbols, so even when exchange is possible, there is a need for semantic interoperability (translation of images).

These observations are typical of widespread European experience and highlight the need for adoption of EIS approaches, a view also supported by the European Commission [19] whose Security programme proposes interoperability of EMS to support European cohesion in Emergency Management. This is a key concern for

public authorities, and in response to the German-Dutch experiences, the EU imperative, and research interests addressing interoperability, the DISASTER [20] programme has been initiated.

3. DISASTER : Interoperability for EMS

The DISASTER project programme of work recognises regional and national autonomy in emergency management, and aims to develop a middleware solution, supported by ontology and semantic translation of EMS terms, icon/data formats and communication standards, to allow interoperability of information and communication systems. Data mediation is a primary key to interoperability of EMS such as LCMS, deNIS, DISMA, etc. [21]. The DISASTER approach to data mediation is shown in fig 2.

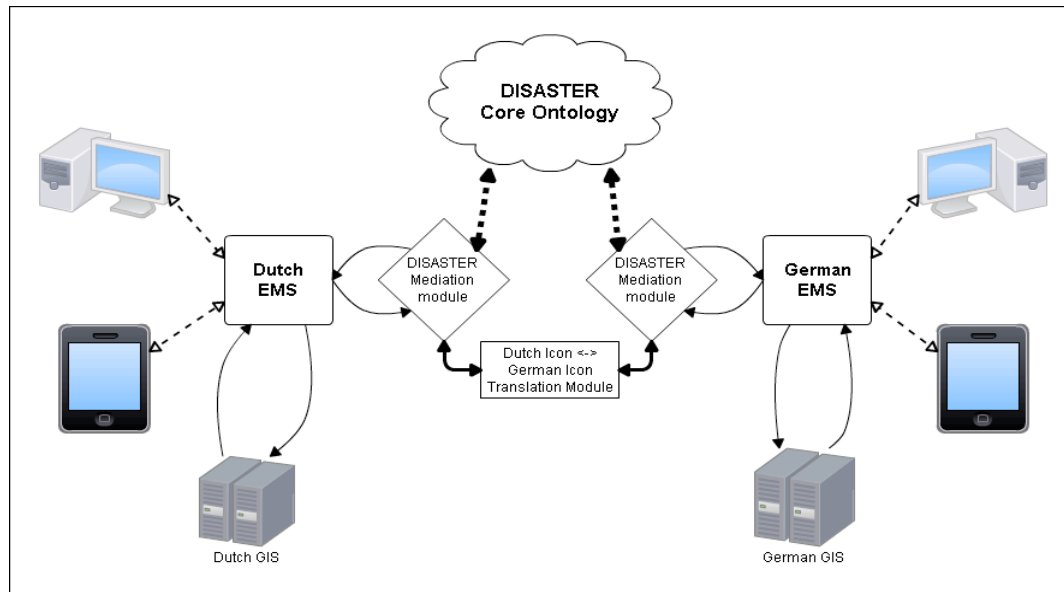
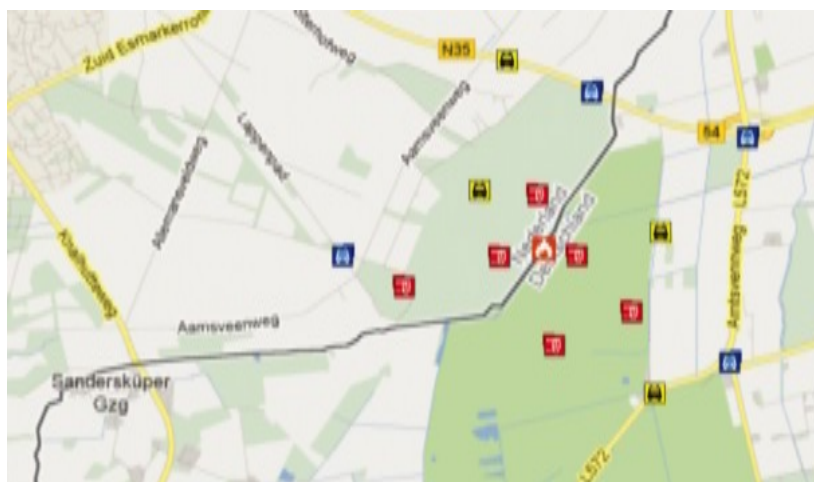


Figure 2 - DISASTER Middleware for Data Mediation between EMS

During a critical incident, Information Officers of First Responder Agencies can arrange geographical coverage to be extended, and the system seamlessly merges GIS content and operational content to deliver an expanded COP. This is made available to EMS workstations at command posts, and also to tablets that can be in vehicles, in mobile command posts, or carried by responders.

The conjoined COP includes semantic translation so that German responders see a cross-border map with German icons and text to support user understanding, while Dutch responders see only Dutch language and symbols. The middleware, created and operated by Treelogic in Spain, includes an Ontology built by CTIC to allow multi-lingual terminology translation, while the Treelogic icon translation module supports semantic interoperability of graphical elements.



The first proof of concept system was deployed during field exercise in December 2012 where a Dutch mobile command unit was linked via the national secure military network, then via Internet, to another field operations command post where screens showed German icons and text on the map portion of the COP. This was mediated via the Treelogic server in Spain, and showed that German and Dutch responder teams can be conjoined by DISASTER in much the same way that two Dutch teams can be conjoined by LCMS.

The staff in the mobile command unit (Fig 4) are able to conduct all normal crisis command activities even though the COP is covering a cross-border scenario. This proof of concept demonstration is the first of its kind in Europe, and shows an extended enterprise in emergency management supported by data mediation between different EMS either within a single country, or cross border. A key success factor in DISASTER this far has been the preservation of the working practice of emergency professionals, and simply using enterprise technology to enrich available content, and enable joint command operations.



Figure 4- Mobile Command Unit

Future Developments and Acknowledgements

The current prototype has been exposed to commanders and responders in two countries who react very positively to the removal of interoperability barriers, and it is now being used as the basis for extensive studies with EMS Providers and EMS Users across Europe to further elaborate functional requirements for the next level of prototype. Results from the work will be published on a public portal [20], and will inform a second stage exercise involving a major European Airport in Autumn 2013. We believe that it has value in both the co-existence and integration models described above. In the context of the EU (2012) security programme [19], and its future extension, several similar and related initiatives are now reaching initial technical maturity, and so the human-centred aspects of the emerging EIS scenarios can be more fully explored.

The research leading to the reported results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement No 285069 (DISASTER Project).

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