Outlines of a content management system for nuclear emergency preparedness and response

AMMANN M., PELTONEN T. & LAHTINEN J.
STUK - Radiation and Nuclear Safety Authority, P.O.Box 14, FI-00881 Helsinki, Finland

Abstract. Computer support is needed to facilitate the emergency management process during nuclear or radiation accidents, and, since these events happen luckily rather rarely, computer support is needed for simulation, training and exercise purposes. Within Europe there are prominent decision support systems available today that tightly integrate measurements and models into a coherent package and provide comprehensive support during all phases of an accident. However, the systems we are aware of mostly lack the notion of collaboration, which is central to the emergency management process. Meanwhile, some European countries have adapted generic content management systems for information sharing purposes. Content management systems (CMS) were chosen because they excel at collaborative content management throughout the life cycle of documents. They provide out of the box functionalities for content classification, content syndication, user management, language translation, access control, workflow management, versioning, multi-channel publishing, etc. Some of these have scalable feature sets and can, within limits, be adapted to the needs of the application domain at hand. However, there is another approach available to accommodate the peculiarities of the emergency management process: a generic web framework can be taken as a starting point for the development of a custom tailored application and readily available CMS functionalities can be added to it as needed. This is the approach we have taken at STUK, the Finnish Radiation and Nuclear Safety Authority, and FMI, the Finnish Meteorological Institute. This paper outlines the content management functionality that is currently being added to STUK's and FMI's emergency management platform. Our goal is to merge the functional areas of more traditional decision support systems with the collaborative feature set of content management systems into a usable, reliable, secure and extensible platform that fits into our actual emergency management process as neatly as possible.

KEYWORDS: Emergency preparedness and response, content management system

INTRODUCTION

Emergency management is a collective effort and relies, amongst other things, on effective information flows and communication. It is a field that is constantly reformed by societal changes and by advances in information and communication technologies. While there is certainly a big market both in terms of demand and supply for supportive technology for the various aspects of everyday emergency management (e.g. communication technology, command and control software) and for generic software (e.g. content management systems), readily available software is either too specific to support the business of nuclear emergency preparedness and response we are in, or too generic to allow addressing the peculiarities of our particular emergency management process.

To find support for this claim we have to look at the peculiarities of our business. What is so special about nuclear emergency preparedness and response? And what requirements for a computer support solution can we derive from these observations? Notwithstanding the fact that a major nuclear disaster just happened recently in Japan, it is still true that nuclear emergencies are low-probability events. This means that most of the time we need software support for preparing, simulating and conducting exercises, and for testing and training purposes. In short, we need multi-purpose software. On the other hand, if accidents happen, they develop easily into large-scale, high-cost events and the repercussions are felt in large sectors of the society. This means that emergency management process will involve all political levels, and that there is a pronounced need for information exchange and cooperation. Nuclear

emergency management is thus collaborative at heart, multi-disciplinary and multi-institutional. Today the need for stakeholder involvement, for example, is well recognized as well as the need to pool the expertise of different groups.

But not only people have to work together; software has to work together as well and has to cope with data in various formats. Models for example are needed to forecast the likely course of events and to assess potential consequences. Model predictions will have to be merged with measurements in order to take advantage of all available information and to best fill in the gaps.

In summary, software support for emergency management can be characterised by the following demands:

- support team work
- allow different groups to work together to achieve a common goal
- preserve audit trail
- allow to make assignments and be aware of who is doing what and when
- allow to share information and documents
- support different workflows for the different tasks
- integrate various data (measurement data, background data, model predictions, etc)
- give access to remote models

Soon after the Chernobyl accident the European Commission tried to address the need for a coherent and comprehensive decision support system by developing the RODOS system (Ehrhard & Weis 2000). Basically it is a system that features various databases and integrates models for the tasks of analysing the prevailing situation, for predicting consequences, and for evaluating protective strategies. There are other prominent decision support systems available within Europe (for example, the Danish ARGOS[1] and the French ASTRAL) and elsewhere (e.g., the Japanese SPEEDI, the American NARAC, the Russian PRANA). Having been developed decades ago (the RODOS system for example in the 90s with roots in the 80s), many of these systems were not particularly designed with collaboration in mind nor with the flexibility to adjust to the ever growing information needs of an ever more complex world.

Meanwhile, some European countries have adapted generic content management systems for information sharing purposes. Content management systems (CMS) were chosen because they excel at collaborative content management throughout the life cycle of documents. They provide out of the box functionalities for content classification, content syndication, user management, language translation, access control, workflow management, versioning, multi-channel publishing, etc. Some of these have scalable feature sets and can, within limits, be adapted to the needs of the application domain at hand. However, there is another approach available to accommodate the peculiarities of the emergency management process: a generic web framework can be taken as a starting point for the development of a custom tailored application and readily available CMS functionalities can be added to it as needed. This is the approach we have taken at STUK, the Finnish Radiation and Nuclear Safety Authority, and FMI, the Finnish Meteorological Institute. This paper outlines the content management functionality that is currently being added to STUK's and FMI's emergency management platform (Ammann et al. 2010, Ammann et al. 2011). Our goal is to merge the functional areas of more traditional decision support

[1] See Reference section for ARGOS and all other mentioned systems.

systems with the collaborative feature set of content management systems into a usable, reliable, secure and extensible platform that fits into our actual emergency management process as neatly as possible.

CONTENT

A content management system for nuclear emergency preparedness and response has to deal with a variety of documents: events are declared, the site is characterised, weather predictions are made, the reactor and accident sequence described, the inventory communicated, the release assessed, dispersion and dose assessments requested, recommendations made, tasks assigned, samples collected, measurements made, etc. Characteristic is that these documents partly contain structured data, and it is beneficial to mark it up appropriately to allow processing the documents with computerized systems. For example, almost all documents have titles, and it is useful to mark it as such. Or within a 'site document' it might be expected to find longitude, latitude coordinates. Again it is useful to mark these up as such. The documents are thus best viewed as being semi-structured with parts of the document being marked up for easier digestion by electronic data processing and other parts having no restraints regarding their formatting. Unrestrained parts are important as they can be used for the often unpredictable needs of future emergencies.

In addition to the aforementioned event dependent dynamic content, there will be a need for static background information. Static data is best kept in libraries from where it can be queried and reused in different events. It is beneficial for example to keep libraries for sites, reactors, nuclides, inventories, representative releases, recommendation templates, administrative units, action descriptions and instructions, reference levels. Other obvious examples of static data are geographic and demographic data from GIS.

Document-oriented databases, as opposed to more traditional relational databases, might provide a more natural way of implementing the database backbone of the application. At least they provide a measure of structural flexibility and extensibility (i.e. the ability to add new content types or to adapt existing ones without major changes to the system) that will accommodate the unpredictable needs of future emergences.

Content need to be accompanied with metadata. Obvious such metadata is who created/modified the content, when it was created/modified, a descriptive title, the content type, and content status. This metadata fulfils not only various bookkeeping purposes, but it can also be used to filter and sort the content according to some criteria. For example the user might want to list all approved (*status*) recommendations (*type*) in chronological order (*timestamp*).

In addition to the aforementioned fixed set of metadata, there is a need to allow freely tagging of content. Sometimes this is called *folksonomy* as opposed to *taxonomy*, which is the classification of content according to fixed categories. Both folksonomy and taxonomy provide keywords to search, filter and arrange content in many (and again unforeseeable) ways.

VIEWS, USERS AND PERMISSIONS

A content management system for emergency preparedness and response has many different users (mostly simultaneously), who are assigned to different tasks. There are for example those who assess the plant status and provide others with release assessments; there are those who predict the atmospheric dispersion; there are those who recommend protective actions; there are those who make task assignments and those who accept these assignment and report back whatever they need to report;

there might be even other systems providing data (e.g. on-line measurement data). All these users have different needs and need different views of the system. A role based authentication scheme is used therefore, and allows tailoring views according to the role the user occupies within the emergency management process. By introducing authentication we risk demanding from our users to remember yet another user account and password. A solution is to reuse existing credentials and implement a single sign-on policy.

Related to authentication is authorization: users need the right permissions to access resources. For maximal flexibility we envisage an access control list (ACL) based security model, which gives fine-grained access on a document-by-document basis. In this model a list of permissions it attached to each document, and access is only granted if the user (or better his role) has suitable permission settings. Users are not assigned permissions directly, but acquire them through their role. The management of individual user rights becomes a matter of assigning appropriate roles to the user. This simplifies common operations, such as adding a user, or changing a user's role.

Permissions are also at the heart of the workflow implementation. Content can be in one of several states (e.g. documents can be *private*, *draft*, *approved*, *public*) and states, transition between these states and associated permissions define a particular workflow. Different content types can belong to different workflows. For example, the workflow of drafting, approving, and implementing recommendations is quite different from the workflow of making, accepting, and closing task assignments.

There are various other views that deserve mentioning:

- Users benefit of knowing who there counterparts are. Modern information technology makes it easy to provide a *who-is-online* page. The page could contain up-to-date contact information.
- Revision history view, which for hindsight analysis provides an audit-trail of who was doing what and when.
- Table views and blog views with AJAX based *behind-the-scene* updating.
- Tree view (directed acyclic graph) to show dependencies and child/parent relationships.
- Business mashups, i.e. the stacking of data, measurement, or recommendation layers on top of background maps. This is described in more detail in Peltonen and Ammann (2011).
- Multi-channel publishing of content on video projectors and handheld devices, as PDF prints and RSS feeds, and in various export formats.

RECOMMENDATIONS AND REPORTING

Recommendations on protective actions are in a way the outcome of the whole process at the Radiation and Nuclear Safety Authority. A recommendation is basically a prescription of who (*actor*) is recommended to do what (*action*), when (*timing*), where (*location*), why (*rational*), and how (*instruction*). Recommendations are normally based on reference levels, and computer support is provided in form of choropleth maps of the reference values and how they compare to relevant reference levels. Administrative units can then be superimposed and flagged by the user with suggestions for appropriate interventions. Rational and instructions can be retrieved from a static library and the resulting report can be forwarded according to workflow settings.

Reporting remains one of the major steps within the emergency management process. It is reports that are the end products of processing pipelines within which raw data is more and more refined towards the end products of recommendations or press releases. Typically a report is a distillate of the input from

many experts, advisors, or users in general. In order to facilitate this processing pipeline, content has to be collected, portrayed, annotated, filtered, and arranged. Embedded WYSIWYG editing allows for location independent and user friendly editing and provide flexibility regarding the way content can be reported (e.g. as text, images, tables). On the other hand it is important to keep the formatting as unified as possible.

CONCLUSIONS

This paper outlined the content management functionality that is currently being added to STUK's and FMI's emergency management platform. Our goal is to merge the functional areas of more traditional decision support systems with the collaborative feature set of content management systems into a usable, reliable, secure and extensible platform that fits into our actual emergency management process as neatly as possible.

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