Operational experience with the Ketale Web application

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ABSTRACT

Ketale is a collaborative data management system to share, manage and view the results of dispersion and dose calculations and other information related to nuclear or radiation accidents. Ketale was used the first time in an exercise in December 2008. User feedback led to a redesign of the system during 2009. The redesigned version improved the overall performance of the system and introduced some new features like a planning tool for countermeasure recommendations. The present report outlines operational aspects and user experiences of the Ketale system.

Keywords

Emergency exercise, radiological and nuclear disaster, data management

INTRODUCTION

The Radiation and Nuclear Safety Authority (STUK) of Finland and the Finnish Meteorological Institute (FMI) have developed and implemented a centralized data management system (called Ketale) that allows them to manage, view and share the results of dispersion and dose calculations and other information related to nuclear or radiation accidents (Ammann et al., 2010). The system helps them to produce reports of the radiological situation or countermeasure recommendations. These reports typically contain maps of the predicted dispersion area, or maps showing the spatial distribution of the activity concentration on various surfaces, doses and dose-rates. Ketale keeps record of all relevant user activities and of all data received. The newest Ketale version also helps in planning of countermeasure recommendations.

Emergency preparedness is maintained by regular exercises. National exercises for example are organized in Finland at least once a year. These exercises offer good opportunities to critically review existing emergency procedures and evaluate new ones. Information exchange between STUK and FMI relied in the past on telephone calls and data exchange by FTP or e-mail. These procedures proved to be unreliable, cumbersome to use and error prone in their results. An additional complication was the fact that available support tools (e.g. dispersion and dose models) needed considerable user training, which sometimes involved even acquaintance with an unfamiliar operation system. One consequence of this was that it was notoriously difficult to find suitable users and to maintain their proficiency. Another consequence was that it took far too long to produce situation or summary reports.

The Ketale system was conceived as a response to this unsatisfactory state of affairs. A pilot study was undertaken in 2004, and the first project with the goal of establishing a centralized data management system was launched in 2006. In 2008, Ketale had evolved enough to be evaluated the first time in a national emergency exercise. The system drastically improved the way STUK and FMI dealt with the situation, and situation reports could be produced much faster. All users were quite pleased with the capabilities of this new tool. But Ketale

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raised also expectations that it could not fulfill at this early stage in the development. It needed another year of development to implement all new ideas and to arrive at a more mature system. Ketale version 2 was intended to be critically evaluated in the national emergency exercise of 2009. However, this exercise was postponed to March 2010. It is expected that Ketale will be promoted to a fully operational system thereafter.

This report provides an evaluation of the Ketale system from a user's perspective. The national exercises from 2008 and 2009 (postponed to 2010) will serve as cases. As a baseline we will shortly present the emergency process before the introduction of the Ketale system. The reader might observe that the developers of the Ketale system as presented in Ammann et al. (2010) are partly the same as the authors of this contribution. The explanation is simply that, being staff members of the authority in charge of nuclear emergency preparedness, most of us have two roles: we are both users and developers. In fact, we think that being users ourselves was actually an advantage in designing the system.

USAGE EXPERIENCE DURING PAST EXERCISES

Exercises before the introduction of Ketale

In several exercises before the introduction of Ketale it was recognized that the handling of dose and dispersion calculations was quite unsatisfactory and that it took far too long to produce reports that were needed to brief decision makers or their senior advisors.

First of all, most of the modeling programs were not very user-friendly. Models were difficult to use and they often required special operation systems (e.g. UNIX). Their graphical results were mostly static maps with poor geographic details and lacking annotation. The maps also varied with color, projection, grid size, etc., which made it difficult to compare results from different programs.

Secondly, programs did not interoperate well or not at all and it was difficult and time consuming to produce reports of the radiological situation. Whereas it would be important to produce at least the first report quickly after the beginning of the exercise, it took over an hour to produce a first report with a map of the area of risk and relevant weather descriptions.

Information exchange between FMI and STUK happened mainly by telephone request and FTP transfer of the results. Telephone requests, however, had major drawbacks as lists of phone numbers had to be maintained, messages could be easily misunderstood, and the process worked only if there was a counterpart present on the other side. Luckily FMI operated a 24/7 person-on-duty service, though. And then there was the problem of how to convey the content of the telephone conversation to other participants.

There were no technical arrangements in place to communicate source terms – that is, data on the amount and nuclide composition of the release – to different dispersion models. Each model had its own ways (and limitations) of dealing with source terms so that the procedures of providing source terms to these models were rather cumbersome to follow.

Another issue that was not sufficiently supported was the planning of countermeasures. It relied on generic GIS software, which was not linked well with other software. For example, though desirable, it was not possible to display model results as a backdrop map when planning intervention areas. Furthermore, manual cut & paste procedures had to be followed in order to get the resulting images into a report.

Eventually, modeling data and reports were not stored in one place but instead were distributed in several places. After the exercise it was difficult to analyze the case.

On the whole, the reliability of the whole process was unknown. Major exercises are arranged quite rarely (about once a year) and accidents can happen at any moment. That is why it is important to regularly check the availability of all tools. Routine tests of such non-automated procedures are quite time-consuming to perform, however, so that they were not often enough made. This left the users often in the awkward situation that they did not know whether their tools will work or not.

First emergency exercise with Ketale

The first big exercise where Ketale was used was the Olkiluoto NPP preparedness exercise held in December 2008. There were 30 different organizations from Finland involved in the exercise. Six users from STUK and two users from FMI actively produced and shared information using Ketale. In addition, there were observers who followed the Ketale web site during the exercise. Ketale's notification page was also projected on the

screen of STUK's emergency center. The exercise lasted about five hours. During the exercise 9 reports were produced and totally over 80 notifications appeared on Ketale's main page (info messages, requests, source terms and reports). After the exercise feedback was collected.

Many of the just mentioned shortcomings could be remedied. A trajectory model and a long-range dispersion model, both from FMI, were coupled to the Ketale system as was a dose model from STUK. Results from these models could be transparently requested by filling in and submitting Ketale forms, the results could be displayed interactively, and suitable portrayals could be added effortlessly to summary reports. The requests appeared on the notification page and were accessible to all observers.

The major advantage compared with the situation before the introduction of Ketale was the significant improvement in the duration of creating reports. It took less than 10 minutes to create a summary report containing for example a map of the dispersion area and a textual weather description. Also the quality of graphical outputs was improved. These improvements were achieved by automating some steps that previously had to be done by hand with word processors and image manipulation programs. Ketale's translation feature was another major benefit. By changing the language settings of the web page it was very easy to create reports in English in addition to reports in Finnish.

This was the first exercise in which Ketale was used and evaluated. Naturally there was also some criticism and scope for improvement. The load to the server was bigger than expected and during the exercise it needed to be restarted once. Also some minor bugs were encountered. The produced summary reports were not so good that they could be used without postprocessing, but being PDF-documents, editing was cumbersome. Also countermeasure recommendations still had to be made using desktop GIS software, and the sharing of source term information was not implemented. Uploading of custom content to Ketale was not simple enough, although this would have been important given the fact that DSS tools (e.g. RODOS) were not integrated into Ketale and file upload was the only available option.

Some users reported that the application did not work properly in their browsers. This was found to be due to the fact that Ketale uses advanced web technologies and needs a reasonable recent browser, which these users did not have. Especially the Web GIS component was hard to implement in a way that it worked in all web browsers.

The feedback from this exercise – though very positive in its general tenor – led to the redesign of Ketale.

REDESIGN OF KETALE

Learning from user feedback, Ketale was redesigned and the version number incremented to 2. The aim was to improve existing components and add new functionalities. The redesign touched almost all model-controller-view components: the database model was revised, the controller software rewritten and the view templates updated. Most of these improvements were not visible to the end-users. Visible to them, however, were the new features that were added, in particular the countermeasure recommendation page, and the visualization of real-time dose-rate measurement data from the national monitoring network.

As just mentioned, the biggest improvement was a page that helps in planning countermeasure recommendations (Figure 1). As far as Ketale is concerned, a recommendation comprises a list of administrative units, and associated to each unit is one or more protective actions and their implementation statuses (planned, recommended, or lifted). The user first selects a protective action and a reference map showing e.g. that some intervention level is exceeded, and graphically selects administrative units on the interactive Web GIS component. The recommendations can be subsequently tabulated or presented in the form of thematic maps.

Data import and export has been improved. The system checks the content of the uploaded file and handles it in accordance to its content. For example all files of a compressed archive are extracted and registered separately. This feature can be used to upload a complete image series from another model.

The operational system is deployed on three computers (web server, database server and application server), which helps balancing the load. This is becoming more and more important as the number of Ketale users is growing all the time. Each service can run on any of these computers. If one or even two servers drop out, the system can be recovered by starting the service on a remaining computer.

Ketale is a multi-user system but the permission assignments were incomplete in version 1. There were groups in this older version too but these were not fully utilized. All users belong to groups, and groups have permissions associated to them. Some users (called observers) can only follow up the notification page, whereas others can submit long-range dispersion calculations or edit countermeasure recommendations.

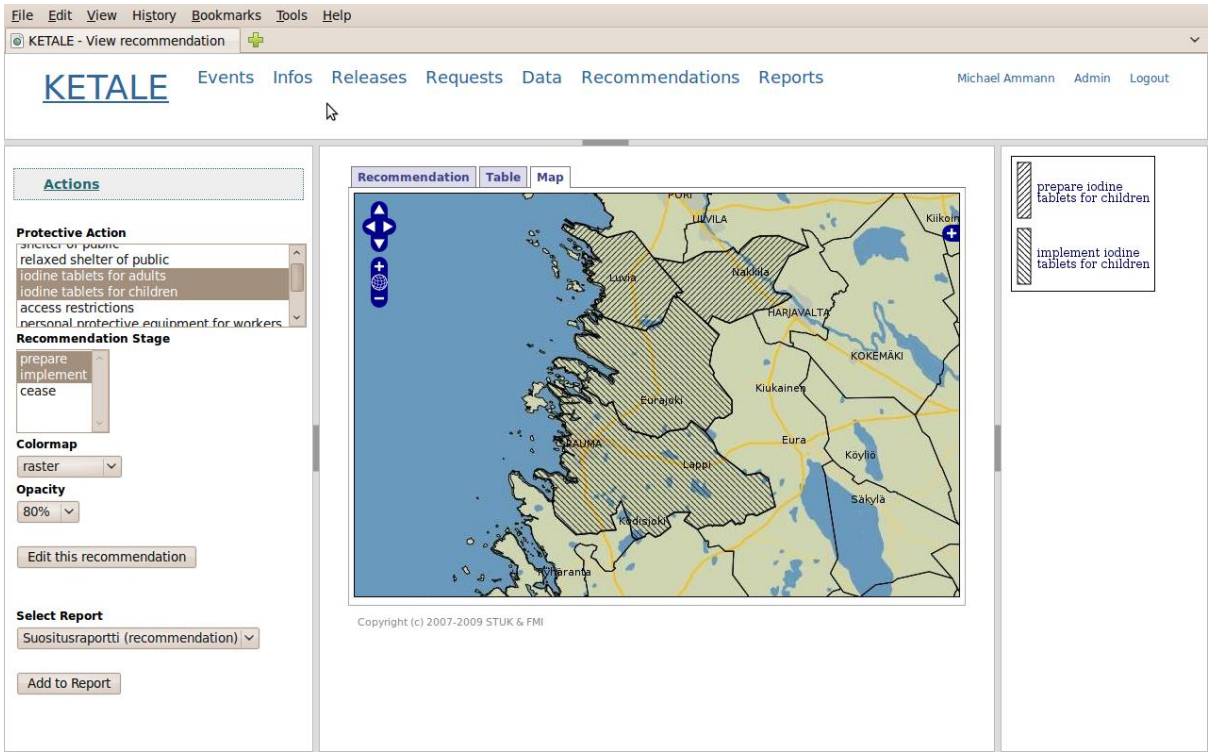

Figure 1. Recommendation page. Recommendations can be filtered, tabulated, graphically modified, and visualized in various ways; recommendations and their rational can be added to reports. (The figure represents a hypothetical situation around the Olkiluoto NPP).

Second emergency exercise with Ketale

The next big exercise where Ketale was intended to be evaluated was the Loviisa NPP preparedness exercise to be held in November 2009. This exercise was postponed, however, to March 2010. A more restricted exercise was held instead with the main focus on training and evaluation of Ketale.

The countermeasure recommendation page was highly appreciated by the recommendation team because previously it was very time consuming to produce recommendation maps and instead of thinking about the content they were concerned with technical annoyances. In addition, Ketale supported the process in a rather elaborate manner. Different stages in the approval process were recognized (draft, approved, withdrawn), notes could be made of the rationales, and the protective actions themselves could be at different stages (preparation advised, implementation advised, cessation advised).

Future Plans

The routine testing procedures are still incomplete. Because Ketale is designed in a way that allows all the actions to be performed without user interaction, it is possible to automatically test the main functions and communication channels. Test scripts will be scheduled on a daily or weekly basis and monthly reports will be generated. Randomized site and source term selections will allow testing the whole application domain.

There are many intranet and internet pages that must be followed during the exercise. It can be time-consuming to follow many sites when you are busy and filter the essential information they offer. One solution for this problem is to syndicate content by means of news feeds. Ketale can easily syndicate the notification page to various subscribers, which then will not have to actively follow the Ketale pages. Instead, they can use any news reader of their liking.

The reporting functionality still needs some improvement, as it is not yet flexible enough. The intention is to integrate a WYSIWYG report editor into Ketale, and to provide an improved set of templates.

CONCLUSION

Ketale was found to be very useful in the exercises held so far. The time needed to produce reports for senior advisors or decision makers has decreased significantly, and their quality and consistency has improved substantially. The countermeasure planning page was highly appreciated by the recommendation group.

But Ketale was not only found to be useful, it had also a considerable effect on the emergency preparedness organization and on how the process could be conducted. Prior to the introduction of Ketale, far too much expertise had to be diverted from producing assessments and recommendations to the technical details of the process (how to get data from here to there, how to produce maps, etc.). Formerly STUK needed to maintain trained personnel for the various modeling applications, now this demand has almost vanished. Ketale provides a consistent user interface to the modeling applications and hides all technical peculiarities. Questions like: Where is program X installed? What is the user account? How do I get the results into the report?, do not have to be asked anymore.

Information exchange between STUK and FMI has mostly been automated. It is now documented and constantly tested. Testing will not only allow increasing the reliability of the preparedness tools and communication channels, but also allow putting a reliability index on the availability of the system, that can be used for quality assurance purposes.

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