Disaster management training environment

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ABSTRACT: This paper argues the preparedness level for dealing with crises (including flooding) can be significantly improved with the use of Serious Gaming techniques. This paper discusses reasons why the preparation (at least from a Dutch perspective) is relatively low and how the research that is conducted could improve this. The research conducted in the Flood Control 2015 program is aimed at the development of a Crisis Management Training environment. Prototypes of such an environment were tested with the target users and shows great potential to raise preparedness among crisis responders to mitigate negative effects of crises.

1 INTRODUCTION

Crisis management deals with unplanned and unwanted events or threats in which organizations and people have to respond. A crisis occurs suddenly, is potential harmful and requires fast decision making for those involved. Although crises rarely occur (in The Netherlands), we nevertheless expect crisis professionals to perform efficient and effectively in case of a crisis.

Over the last years an increasing amount of effort has been made to prepare for all kinds of disasters, including flooding. An example is the development of disaster management plans to help gain an understanding of possible scenarios that might unfold. Preparations are based on exercising credible scenario’s which characterize the nature and scale of the incident to test these disaster management plans with a focus on crisis processes like ‘communication’, ‘cooperation’ and ‘decision making’.

This paper discusses a training environment especially developed to train crisis teams at a tactical and strategic level with gaining hands-on experience with the developed disaster management plans. The training environment offers scenarios with realistic feedback to information requests and decisions made by the trainees to help overcome the lack of experience in dealing with real crises. With this training the preparedness levels of crisis managers should increase. This in turn has to lower the impact of a real crisis on society.

2 CRISIS PREPAREDNESS

2.1 Introduction

The crisis management complexity lies in the fact that there is not a single recipe to fight a crisis because of all the variables. For example it is unknown where and when a disaster will occur and how it will unfold, it is uncertain how people will react and not fully known which resources will be available to mitigate unwanted effects.

In order to be effective in crisis management, the crisis managers need to have a good understanding of different scenarios, the roles and responsibilities of all parties involved and the processes and procedures agreed upon between the different crisis response teams. In other words: the crisis manager needs to be prepared. In this paper we define prepared as the ability to take the appropriate measures during a crisis situation in order to minimize the unwanted effects.

This paper argues that the level of preparedness with which the crisis responders handle crisis is relatively low. This level can significantly improve with the use of Serious Gaming as the authors are currently researching in the Flood Control 2015 program.

2.2 Preparedness level

To prepare for crises implies training of both the crisis management professionals individually and also the crisis response teams. On average the preparedness level of teams is less than desired. There are a
number of factors contributing to the low level of preparedness such as a low frequency of training, not enough realism in the training and no clarity in the level of different participants. The figure below shows a simplified graph of the preparedness level of a crisis professional as function of time. Initially the preparedness level will increase at a certain rate due to training of the crisis professional.

Currently, one of the major problems in training crisis teams is to obtain sufficient realism in training scenarios. Money, time, availability of trainees and complexity of IT infrastructure, all contribute to a training setup that is too simplified. Simplifying the training setup implies that only a few aspects of crisis response are trained. Unsatisfactory to the crisis professionals who know the real thing will be very different. As a result the level of preparedness will never reach a very high plateau (depicted in the simplified model as the level ‘X’).

This plateau of the maximum preparedness is probably never reached, as crisis responders change positions in the organization every so often. When a crisis responder changes position, the level of preparedness in his/her new role will drop again close to zero. If this pattern repeats, the average preparedness of a team of crisis responders will have a very low average (depicted in the simplified model as the level ‘Av’).

Training is a burden on the organization. Crisis professionals must to be trained next to their ‘normal’ role. Training events and exercises must be planned well ahead to prevent interfering with schedules and plans. In practice it proves difficult to plan several meetings for training purposes because of workload, noncrisis related events and existing schedules.

Besides the scheduling difficulties, there is also a cost component. Training for a crisis implies less productive hours. The few opportunities available to improve crisis management skills is one of the reasons that the learning curve of professionals is rather flat. Typically the training of crisis teams follows a four-year cycle, starting with elementary crisis skill in the first year, up to multidisciplinary exercise in the last year.

### 2.3 Need to improve

Since the average preparedness level is dominated by training we need to increase training efficiency. Training efficiency implies the training possibilities and training effectiveness. The latter involves the quality of the training program. Given the quality of the training program we can increase training effectiveness, and thereby the preparedness level of crisis professionals by creating an training environment which offers realistic training on demand and at a lower cost.

### 3 DISASTER MANAGEMENT TRAINING ENVIRONMENT

Basically there are three reasons to improve the status quo. The first reason being: it helps. High level of preparedness improves efficiency and effectiveness in minimizing societal disruption; effectively lowering impact and with that costs and casualties involved (Alexander, 2012). A second reason is the crisis managers are expected to improve their performance. Civilians are getting increasingly critical towards the government, having less tolerance for inefficiencies and mall performance of government agencies (Boin et al., 2005). A third reason would be that we can improve. New technologies allow for further improvement in the level of preparedness.

#### 3.1 Levers to improve

In order to increase the average level of preparedness of crisis management teams, three parameters can be influenced (see figure below):
1. Increase steepness of learning curve (a)
2. Increase the maximum level (X→X’)
3. Decrease the drop (S→S’)

![Figure 1](image1.png)  
*Figure 1. Preparedness level as function of time.*

![Figure 2](image2.png)  
*Figure 2. Parameters which influence average level of preparedness.*
The learning curve is steeper when professionals can train more often (availability of training material is higher) and the training itself is more effective in adding to the skill-set.

When training more closely resembles the real life situations of a crisis, the professional is more able to recognize the crisis situation and apply the skills gained in training to the real world. Besides, realism in training motivates the crisis professional to perform at a high level, which has a motivational effect on other teams and players as well. Higher fidelity in training thus leads to more efficiency and effectiveness in a real crisis.

When professionals are adequately prepared, they can broaden their skills and practice other roles to gain a deeper understanding of crisis management and the impact of their role. When switching roles, the professional will not start from scratch, but will already have a firm base to build on.

In theory, the combination of increasing the learning curve, increasing the maximum level of preparedness and decreasing the drop in case of switching roles, means an increase of the average preparedness of teams (AV→AV').

3.2 Determinants of high preparation level

In order to improve the training situation we need training tools with a low threshold to use, offer a realistic crisis scenario to exercise with and facilitate the trainer by observing individual and team performances and feedback to the trainees in real time.

Feasibility of training tactical and strategic crisis teams using Serious Gaming techniques is researched in the Dutch Flood Control 2015 research program (Nagel et al., 2010). The research is conducted from the premise that techniques used in Serious Gaming can be applied with these professionals to train different aspects of crisis management with the goal of raising the preparedness levels. The research resulted in a training environment for crisis teams.

The training environment was developed in close cooperation with the anticipated end-users for flood management. The interaction with the end users provided inside information as to how the Flood Control professionals wanted to be trained and what they expected from a ‘Serious Gaming’ training environment. In the military, where education, training and exercising is a great part of the career of a soldier, they have the doctrine ‘Train as you fight’. For them this means there should be as little difference between a training and actual combat as possible (with acceptable risks). This doctrine is also appreciated by the crisis managers that we involved in the development and testing of the training environment.

There are a number of functional requirements which can be derived from the doctrine ‘train as you fight’. The following requirements have guided the development of the solution that was built:

- Training for teams
- Use of real (IT) tooling
- Focus on real procedures

These requirements are further elaborated on in the next sections.

Training for teams
Crises are complex events involving multiple organizations to minimize the negative impact of unplanned and unwanted effects. Training of these complex ‘ecosystems’ of crisis management organizations is currently not possible with enough fidelity (realism). Crisis professionals indicate that the new training environment should accommodate the ability to train the communications between the crisis organizations.

Use of real (IT) tooling
Crisis managers indicated that they are unwilling to spend much time learning how to participate in the training. The training environment should mimic the real situation as much as possible, in order to minimize the familiarization with the training environment. Skills trained in the training environment can also de directly transferred to the real-life work environment. In other words: in training the crisis professional uses tools (almost) identical to those used in an actual crisis situation.

Focus on real procedures in real situations
Crisis professionals want to build routine in the approach towards handling of different crises. While the environmental circumstances might be different in each crisis, the specifics of their area stay mostly constant. It helps a crisis manager more to train in a virtual environment that acts in the same manner as real life. This means that each organization want to have its own specific situation reflected in the development of the scenario.

3.3 Business process management

With the experience from the interaction with the users, the researchers have found a software platform, which they were able to build on. After a review of alternatives, the project team settled on Business Process Management (BPM) software as the core of the training environment.

BPM offers the necessary functionality to provide training for a large of trainees. Since BPM software is aimed at interfacing with corporate back-end IT systems (ERP, CRM, etc.) the requirement to interface with the IT tools of the crisis
management professionals was also supported. Furthermore BPM is built around making complex processes easy to implement and transparent to track and trace during training.

During the development and testing of the system, the research team explored how to further take advantage of the BPM software to strengthen the goal of raising the preparedness level of crisis management professionals. The following capabilities have been demonstrated using BPM software:

1. Use of a facilitation layer
2. Re-use of prepared scenarios
3. Offer full training program
4. Integration of IT tools
5. Ability to train large groups
6. Role based offering of training
7. Scoring mechanism integration

These capabilities are further elaborated on in the next sections in light of the development of the system BPM software.

Use of a facilitation layer
The facilitation layer contains all the features and capabilities that are generic to training of crisis management situations. Examples of features are the support of sending e-mails and logging phone calls. These capabilities are needed in every crisis training and should therefore be in a generic gaming layer and not the specific content layer with the scenario and script. This separation of facilitation layer and content allows trainers to quickly define new scenarios and not spend their time on the generic capabilities.

Re-use of prepared scenarios
Scenarios can be re-used for other training modules as a whole or parts thereof. This makes it faster and cheaper to prepare new training scenarios when a sufficient library of scenarios have been developed. Training experiences and results can be incorporated in the existing scenario's adding more realistic detail into these scenarios.

Offer full training program
To train a professional from zero to fully operational, a range of different types of training is necessary. This begins with education and skill building to the role specific situation and builds toward the functioning of the role in a broader network of crisis organizations. The highest level is an exercise in which the total ecosystems of organizations are assessed in handling crises on high level KPI's.

Integration of IT tools
To offer an immersive learning experience, the IT tools of crisis professionals (forecast models, warning system, decision support systems, communication devices) need to be fully integrated in the simulation/game play. In the case of the 2011 test of the training environment, it meant that Delft FEWS was part of the environment and the FEWS fully interacted with the scenario and script.

Ability to train large groups
The pilot of the training environment comprised a scenario involving 8 crisis teams and a trainer. The same software is in use in financial institutions with thousands of users in as many different instances of processes (in this case simulations).

Role based offering of training
Assignment of individual roles to tasks is the core of BPM. This makes this type of software very suitable to offer any role in a crisis management organization those types of training that suit that role in the context of the experience of the professional. It allows the coordinator of the training curriculum to discriminate the offering of training modules to the professional best suited to execute it.

Scoring mechanism integration
A framework is used to integrate a scoring mechanism in the simulation, using Boyds' OODA loop of Observe, Orient, Decide and Act to follow all actions of players and rate those against expected of wanted behavior. The level to which the professional follows of exceeds the expected behavior is a measure for the score of the performance in the simulation.

4 TRAINING PILOTS

The training environment is build around a scenario engine that distributes events at the appropriate time to the trainees. It distributes the data needed to describe the crisis situation (e.g. weather forecasts) and sends messages from all parties involved in crisis response (e.g. situation reports and news bulletins). The training environment provides an autonomous e-mail service, shielded from the real world to prohibit interaction between training scenario and the real world.

The trainer controls time like a video player, including fast forward and pause. A trainer dashboard displays information on the trainees' activities and progress. Extra inserts are possible if needed.

Additional features to the training environment:
1. Integration of FEWS tools;
2. Graphical interface for scenario definition;
3. Trainer dashboards displaying activities and interaction of trainees, including the trainer;
4. Clock, displaying (remaining) training time;
5. Support of GIS-tools;
6. News bulletin (avatar with text-to-speech capabilities);
7. Presentation of data on maps, charts and websites.

The training environment is successfully demonstrated in two pilots. The first pilot facilitated a multidisciplinary exercise for tactical teams. The second pilot constituted an exercise with multiple teams in coordinated flood forecasting. Both situations dealt with a realistic flood scenario (based on historic events). The teams used their 'standard' tools (like e-mail and forecast models).

4.1 Pilot “Multidisciplinary exercise”
In 2010 the training concept was tested in an exercise involving three different professional teams in a flood situation. The Water board responsible for the dikes and protection against flood, the Safety region (emergency services) dealing with related incidents (traffic, civil unrest) and the National flood team responsible for the coordination of the flood on a national level.

The teams played the same flood scenario in three stages, representing three consecutive days. Each team was provided with their own information using e-mail and GIS-tools. News bulletins were available to all the teams.

4.2 Pilot “Flood forecast training”
In 2011 the training environment was used for an exercise in coordinated flood forecasting. Seven teams, ranging from the regional flood forecast up to national flood coordination trained simultaneously. These teams work together using the flood forecasting tools (FEWS). The scenario provided the weather and water data (based on historic events) to the FEWS and forecasts were made in real-time. As time progressed, new data became available (like during actual floods) and new forecast had to be made.

Oral or telephone communication was allowed, with the restrictions to log each conversation (which is standard procedure in a crisis situation). The information and forecasts was presented on (a mock-up of) the Rijkswaterstaat website.

The task for the teams was to produce (regional) flood forecasts, share their data, forecast and insights with other teams and contribute to the (national) flood forecast reports. The training combined flood forecasting skills with cooperation between teams under a strict time schedule.

4.3 Findings and results
The pilots proved successful in their objective to demonstrate the training environment. Participants (players) and public considered the system set-up a mayor step in developing a realistic training environment”. The presented flood situation was realistic and successful. All three teams were enthusiastic about the presented scenario, which was conceived very realistic. The scenario itself should be increased with more player interaction.

In the first pilot the flood scenario was played in three parts, all comprising a full working day. This made it difficult for a conference setting to practice because the trainees were constantly engaged with new information. The lesson learned was either to make adjustments to the scenario of play in (near) real time. In the first pilot communication by telephone was prohibited because the training environment could not monitor the communication. Since the trainees considered this a problem because they view telephones a crucial tool in crisis management, the environment was augmented with a log function for communication.

Directly after the exercise an evaluation report with team performances was printed. The direct and objective written report was assessed very positive and is seen as an important complement to (traditional) exercises.

5 CONCLUSIONS
The training environment provides a means for training of crisis teams using realistic training scenarios. The training environment provides the actual crisis management tools with identical look-and-feel making the environment easy to use. Training are available on demand providing plenty training opportunities with a very low threshold. More training opportunities, realistic training scenario’s and low training thresholds will inevitably lead to higher crisis preparedness of crisis professionals.

Business process management software supports the integration of crisis tooling into the environment as was proven by integrating the FEWS. Furthermore training environment supports the current movement of the crisis organizations in the Netherlands to work more through Net Centric Operations.

Using BPM opens extra functions to the training environment. BPM supports from itself the facilitation and administration of multiple training simultaneously, herewith supporting complete training programs for crisis managers. The system could be configured to monitor performances of each trainee, schedule training exercises and
maintaining on-line a ‘crisis training CV’, which is an important step in quality assurance for crisis management.

Based on the feedback by crisis professionals who participated in the pilots, the training environment is considered well suited for tactical training exercises of crisis teams. The use of the training environment for tactical teams was tested and found to increase the level of preparedness. Testing the training environment for a policy level teams and for teams active in the field during crisis situations remains unproven. The next level of the system should involve the means to include other accountability levels (strategic and operational) in the training.

Future applications of the training environment are for training crisis communication during floods and training of the Water Board liaison officer with the Safety Region.

Next step for the training environment is build databases with the responses of crisis teams involved in training. In time this database may be used to simulate responses from these particular crisis teams in case they are absent in the training. In the extreme a crisis professional can train multidisciplinary crisis by himself at a convenient moment while the crisis partners are all simulated.

REFERENCES