Disaster in my backyard: a serious game introduction to disaster information management

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ABSTRACT

Disaster exercises are intended to improve disaster responses effectiveness. Exercises exist in a wide variety, ranging from table-top scenarios to full-scale disaster simulations, offering participants different learning experiences. However these exercises can be overwhelming to newcomers, especially when involving large scale simulations, reducing the effectiveness of the learning experience. In order to make the learning experiences more effective to newcomers, researchers or professionals, a new exercise is proposed. This exercise, designed as a serious game, provides a new way to introduce people to the field of disaster management in general and information management in particular. The first version of the game was played during the 2012 ISCRAM summer school where it yielded positive reactions from both novice participants and experienced professionals.

Keywords

Disaster Management Training, Information Management Training, Alternate reality game, Disaster Scenarios

INTRODUCTION

During the 2012 ISCRAM summer school, the organizers wanted the participants to experience what information management during disasters entails. To introduce participants of the ISCRAM summer school to the this experience the development of an exercise, based on a custom alternate reality game was proposed. When designing an exercise, trainers have to consider a wide range of options to select the most appropriate model (Crichton, 2001; Rosenthal and Pijnenburg, 1991; Rutherford, 1990). Exercises can, for example, focus on a specific subject or have a broad focus. Furthermore the scale of exercises vary, ranging from all-day events involving multiple agents to table-top simulations using models and prepared scenarios.

The value of disaster exercises and simulations and their various benefits have been widely discussed in literature. Usually the benefit of conducting exercises is the promotion of effective emergency management (Drabek, 1985; Lagadec, 2002; Pidgeon and O'Leary, 2000). Exercises rely on learning through experience to aid participants - individuals or organizations - to achieve an improvement in their abilities. Exercise objectives can be specific, shifting the nature towards a training exercise, such as rescue operations. Objectives may also be broad and have an explorative nature, such as uncovering areas for improvement. In any case there is a strong focus on the learning objective in the exercise design (Borodzicz and Van Haperen, 2002; Lagadec, 2002).

The objective intended by the ISCRAM summers school organization and the game presented in this research paper differs from the learning objectives mentioned earlier. Although it could be argued that the exercise will be a learning experience for those who participated, the focus of this exercise is on becoming acquainted with disaster management in practice. 'Playing' this game helps participants gain a better understanding of the operational circumstances, problems and situations faced during disasters. The planned exercise during the ISCRAM summer school provided a first case study for such an introduction game in information management.

THEORETICAL BACKGROUND

When developing an exercise, generally two elements are important: *planning* and *delivery* (Gagné and Driscoll, 1975). Planning involves the preparation of activities and objectives while delivery is the actual presentation or execution of these activities and aims to convey the learning objectives. In exercise design, trainers first consider the particular (learning) objective of the exercise (*planning*). The exercise can then be designed around this focus, incorporating the most efficient ways to deliver the learning experience (*delivery*), aiming to enact in a change in behavior. However, a single experience is generally not enough to enable a permanent change. Learning is an incremental experience, building on previous experiences (Turoff et al., 2006; Turoff et al., 2005)

The delivery of the learning objectives in exercises often revolves around large-scale, multi-organizational disaster drills. Such exercises can be an overwhelming experience for those involved, reducing their learning capacity (Peterson and Perry, 1999; Walz, 1992). This does not merely apply to the persons participating (in-game) in the exercise. Others, such as observers, researchers or game managers, involved may also be overwhelmed and be distracted by the events unfolding (Division, 1998; Klein et al., 2005). The principles of an incremental learning experience also apply to these roles. A prepared researcher with previous experience will be able to anticipate the circumstances, avoid potential pitfalls and work more efficient.

GAME DESIGN

To provide researchers and professionals with an opportunity to become familiar with information management during crisis, an exercise with the objective to provide an 'introductory' experience to newcomers is proposed. Rather than focusing on specific learning experiences (planning), the exercise intends to provide a broad experience, knowing this could overwhelm them. In other words, the exercise was developed to have a stronger focus on delivery and presentation making participation in future exercises more efficient.

Requirements

Prior to the development of this exercise several requirements were defined, based on the field experiences of the organizers. First the specific domain for the exercise is information management, coordination and communication. Second, the exercise should be playable without prior knowledge. Participants for example do not need to have first-aid knowledge to 'rescue' victims. Third, the delivery is a crucial aspect of the exercise: the exercise should be based on real cases but should also include actors and attributes for a realistic effect. Finally, the proposed exercise is intended to be 'merely' an introduction, thus the efficiency of setting up and executing the exercise is important. For these reasons the exercise is designed as a serious game, with a modular setup. This allows trainers to adapt the game to their own needs and resources. Since the game does not have a specific learning objective but has an explorative nature, alternative ways of capturing results are needed.

Game structure

Scenario: The game is set during a rainy period; heavy rains of the past days have caused the rivers burst from their banks. Due to the rising water, residents of the affected area need to be evacuated, some needing assistance. Authorities are taken by surprise and the participants are called upon to assist in combating the unfolding disaster. They need to manage the information flow, organize the response and assist the affected population.

Teams: Participants are divided in different teams, representing for example different organizations. Each team will appoint a team leader. The rest of the team sets out to aid and rescue the victims, based on the instructions provided by the team leader.

Control & evacuation center: Two centers are used in the game. The team leaders are based in the control center, where they collect and process information, coordinate with others and communicate with their team. In the initial game the center relies on Ushahidi with Twitter input. Additionally a map is projected, showing the rising water or locations of resources. The *evacuation center* is a separate location where the recued are brought.

Game elements: Participants can interact with certain elements in-game. *Victims* are either actors or dummies with a unique profile, detailing their background, their current situation and game-information (i.e. time and location) (figure 1). Actors take on multiple roles as not all victims are in play at the same time. *Key figures* are people with skills providing assistance to teams, such as construction workers or the police. The final elements are *resources* teams need, e.g. medical supplies.

Location, attributes and effects: The game can be played at any location with multiple rooms or buildings. A smaller location will increase the intensity of the game but also makes it more demanding for the game managers. Depending on factors such as the available facilities, budget and volunteers and effects can be added to the game to add more realism. These however have no effect on the mechanics of the game itself.

Game-play

The game is played by teams of between 4 and 6 persons, headed by a team leader based in the control center. Each team gathers points by rescuing victims i.e. safely bring them to the evacuation center. Certain victims, for example requiring medical attention, are worth additional points but require more effort. The teams are free to decide their own response strategy, for example exchange information with others teams or apply triage. The game provides teams with real-time information on the status of the scores and the game progress.

Technology

At the heart of the game is the *mobile application* provided to the participants. This application represents some of the field operations such as providing medical care. The application is connected to a central database from which the game can be controlled and updated. The teams use the app to scan QR codes placed throughout the game. Scanning of QR codes allows teams to interact with the game elements, for instance to examine the status of a victim, apply first aid and register victims in the evacuation center. The devices can also send images to the control center or track the team's location. The workflow of the app usage is shown in figure 2.

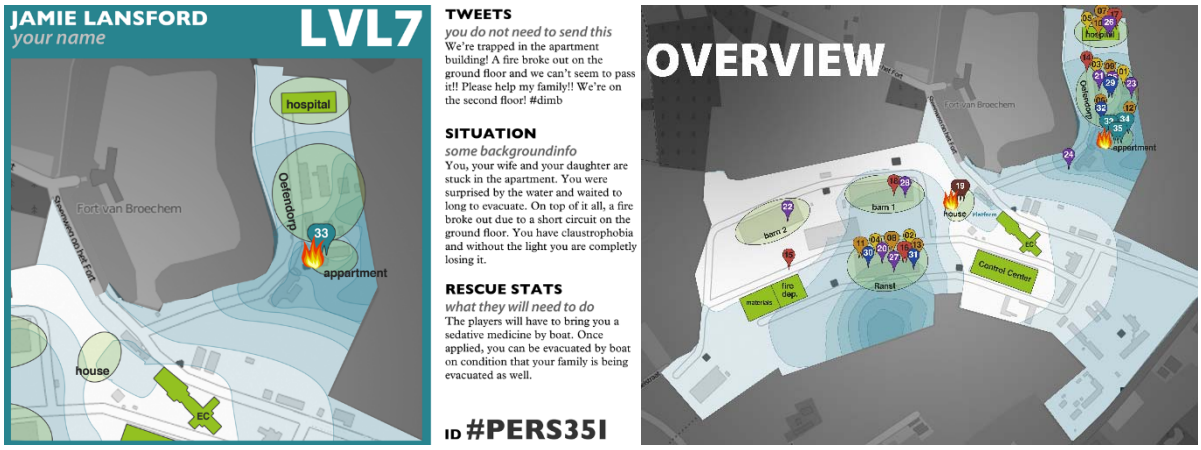

Figure 1 Victim profile

The game control consists of two separate parts, stored in a central database, which can be manipulated in real-time by the game managers; the *information flow* and *in-game resources*. Information flows are sources provided to team-leaders. The resources are used by the teams in the field and have distinct properties, for example the health of a victim (i.e. time to life) or the contents of a med-kit. The use of different levels allow game managers to trigger an information flow and set the game field accordingly. Levels also allow game-managers to plan ahead: a large part of each level, such as the information flow or victim profiles, can be prepared in advance.

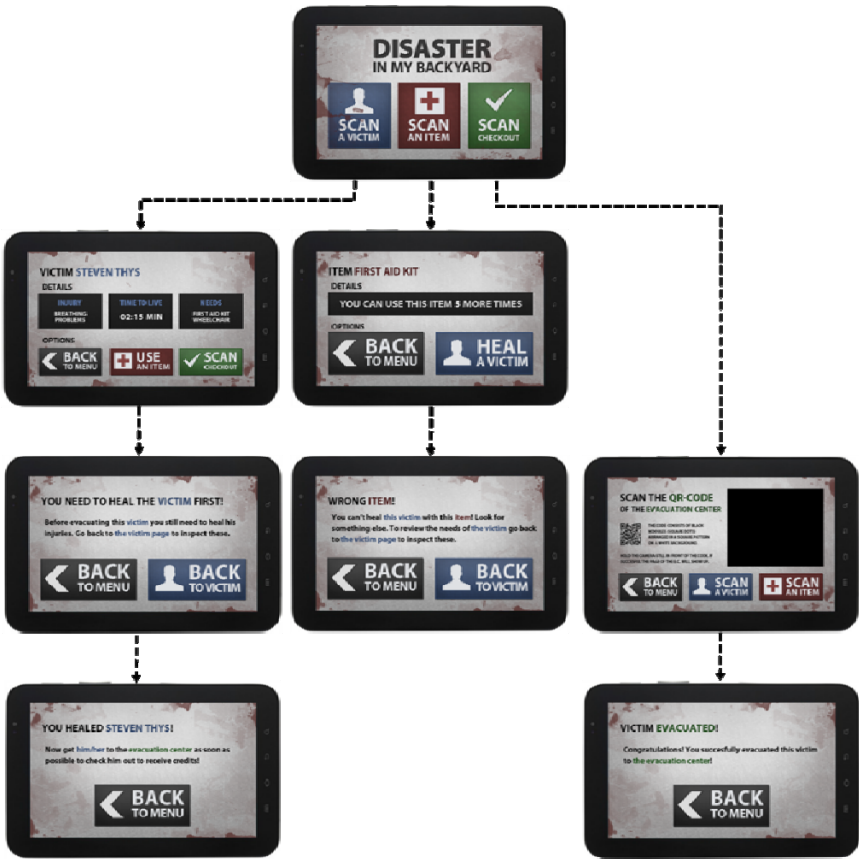

Figure 2. Application data flow diagram with screenshots

ISCRAM SUMMER SCHOOL EXERCISE

The full-scale version of the game was 'played' at the 2012 ISCRAM summer school. 24 PhD students from 11 different countries participated in a simulation of a regional emergency, lasting through the night. The participants were not instructed prior to game, receiving only a brief instruction upon arrival at the site.

The scenario is divided in 7 levels, excluding the debriefing, representing different stages of an unfolding disaster. The information sources used, in particular the social media (tweets), are based on the Pukkelpop 2011 disaster; where 4 people died and 140 got injured due to severe weather (Terpstra et al., 2012).

- Prequel: The first level is 'played' prior to the arrival on-site and sets the stage for the game. During the summer school messages are sublimely presented to the students, reporting the bad weather in a region of Belgium. News reports are released and staff members discuss the situation just within hearing distance.
- Briefing: During a field excursion news bulletins are played, detailing the critical situation on site. Staff members receive phone calls from the local authorities and are asked to provide assistance as they are the closest responders available. Upon arrival the participants are briefed, shown the control center and divided in teams. Out-of-game, they receive instructions on the application and in-case-of-emergency' procedures.
- Evacuation starts: Action is undertaken by teams in the third level. In this initial search & rescue level, the goal is familiarizing the teams with the game, each other and the game-play. Participants have to figure out how to organize their team and rescue operations. In the control center the first tweets are received and processed by the team leaders. In the field the teams leave the base and set out to evacuate the first victims.
- The flood: Once the teams have successfully completed their first evacuations and are 'familiar' with the game, the next level is initiated. The situation takes a turn for the worst, as a dam breaks and a larger area is flooded. More people become trapped and/or injured and require medical attention. During this stage teams will have to work more efficiently to cope with the increasing number of requests.
- Power outage: The flashflood has damaged the infrastructure resulting in power failures. Communications are down and fires erupt due to short circuits. Teams have to find alternative ways of obtaining information and managing their efforts. They need to enlist firemen to assist in combating the fires to reach the victims.
- Vultures: Water levels have stabilized but the population is panicking. Riots erupt and mobs raid the medical logistics depot. Areas become 'dangerous' and can only be safely accessed under police escort. Entering these areas without escorts can result in hostage situations and the loss of valuable supplies.
- Bring them home: At the climax of the exercise, the water reach its highest point. People flee to the top of high-rise buildings and a large coordinated evacuation effort is needed. Inside fires have erupted, impeding the rescue efforts. Teams need to coordinate, collaborate and share resources to rescue the victims.
- Debriefing: At the debriefing, the number of casualties, rescued victims and other scores are presented. Teams have an opportunity to evaluate their performance, receive and provide feedback and review lessons learned. Given the fact that the game is intended as introduction to crisis management, the main focus is to recount and share the personal experiences and observations. Finally the game itself is evaluated.

The game was played according to the setup described earlier using social media as an information source and mobile devices to track the progress of teams. In addition to this setup, the provided location along with roughly 20 volunteers provided unique opportunities to add realism to the game. As a practice ground for local emergency and law enforcement services, the location offered facilities such as a fire training tower and a small village, and a hospital. Supplies such as dummies, wheelchairs and smoke machines added to the realistic experience. The volunteers played roles as victims or supporting characters as rebels, police officers or construction workers. Finally, experienced first-responders accompanied teams during the game and provided real-time feedback. Together with the central database, these mentors enabled extensive control over the game.

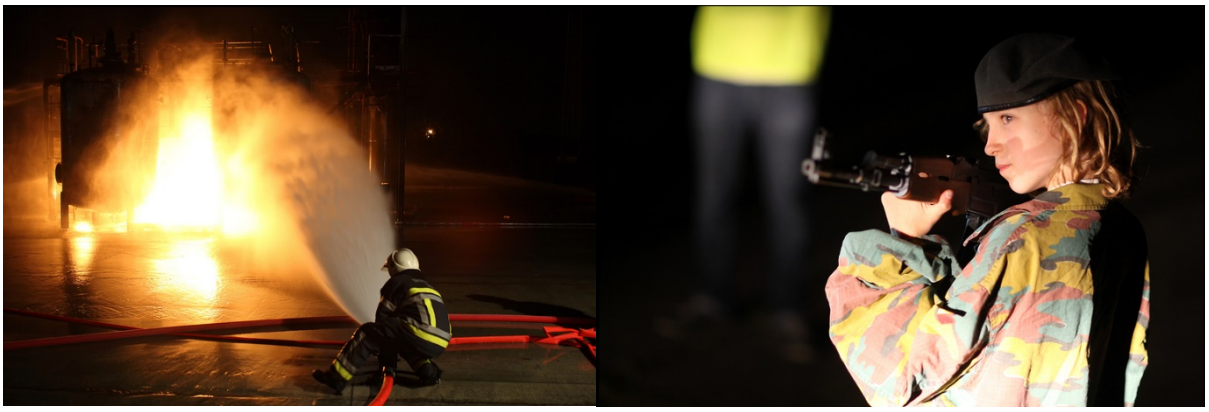

Figure 3. Realism added to the ISCRAM exercise

DISCUSSION

As a first objective, the game presented in this paper is intended as introduction to the field of disaster information management. The initial test yielded positive reactions from the participants as well as the professionals involved. According to these professionals, the decision making process, uncertainty and communication difficulties are similar to real-life experiences. This realistic experience was realized through significant efforts from involved organizations, such as the local fire department and the provided location.

As a second requirement, participants should be able to play the game without *prior knowledge*. The introduced technology allowed participants to experience circumstances faced by emergency responders, without specific knowledge. The game could be extended to include more in field operations, presenting more choices to teams. Finally the framework and technology of the game provided real-time control over the game and its elements.

LIMITATIONS & FUTURE RESEARCH

The concept however needs further improvement regarding the effective use of options to add realism. As an important part of the follow up it needs to be determined what are key-elements in creating the desired circumstances and how these can simulated in an efficient manner.

The framework upon which the game has been build provides interesting opportunities for both future use and research. Different scenarios could be developed and easily deployed using the game framework. Captured crisis information sources and social media can be used as input and certain scenarios can be re-played. By adding more information sources and tools to the game, professionals can train to realistic (information management) scenarios. Researchers can also use the game to create a controllable environment for disaster management training and research. The used technology aids in gathering (research) data from the game, for example mobile devices can track locations, keep track of time and information use. In the follow up of this project we will develop the game further to not only capture this data but also present it (continues) feedback to participants.

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REFERENCES

1. Borodzicz, E., Van Haperen, K. (2002) Individual and group learning in crisis simulations. *Journal of Contingencies and Crisis Management 10*, 139-147.
2. Crichton, M. (2001) Training for decision making during emergencies. *Horizons of Psychology 10*, 7-22.
3. Division, G.B.H.O.E.P. (1998) The Exercise Planners Guide. Home Office.
4. Drabek, T.E. (1985) Managing the emergency response. *Public Administration Review*, 85-92.
5. Gagné, R.M., Driscoll, M.P. (1975) Essentials of learning for instruction. Dryden Press Hinsdale, IL.
6. Klein, K.R., Brandenburg, D.C., Atas, J.G., Maher, A. (2005) The use of trained observers as an evaluation tool for a multi-hospital bioterrorism exercise. *Prehospital and Disaster Medicine 20*, 159-163.

7. Lagadec, P. (2002) Learning processes for crisis management in complex organizations. *Journal of Contingencies and Crisis Management 5*, 24-31.
8. Peterson, D.M., Perry, R.W. (1999) The impacts of disaster exercises on participants. *Disaster prevention and Management 8*, 241-255.
9. Pidgeon, N., O'Leary, M. (2000) Man-made disasters: why technology and organizations fail. *Safety Science*
10. Rosenthal, U., (1991) Crisis management & decision making: simulation oriented scenarios. Springer.
11. Rutherford, W.H. (1990) The place of exercises in disaster management. *Injury 21*, 58-60.
12. Terpstra, T., Stronkman, R., de Vries, A., Paradies, G. (2012). Towards a realtime Twitter analysis during crises for operational crisis management, Proceedings of the 9th ISCRAM Conference. Vancouver, Canada.
13. Turoff, M., Chumer, M., Hiltz, S.R. (2006). Emergency planning as a continuous game, Proceedings of the Information Systems for Crisis Response and Management.
14. Turoff, M., Chumer, M., Yao, X., Konopka, J., Walle, B. (2005). Crisis planning via scenario development gaming, Proceedings of the 2nd International Conference on Information Systems for Crisis Response and Management (ISCRAM 2005). *ISCRAM*, pp. 207-212.
15. Walz, B.J. (1992) Disaster Training Exercises: An Educationally-Based Hierarchy. *Disaster Medicine 7*