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DESIGNING FOR A REPOSITORY OF VIRTUAL CRISIS MANAGEMENT TABLETOP EXERCISES – LESSONS LEARNED FROM A SCANDINAVIAN R&D PROJECT

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Abstract

Crisis training exercises play a vital role in preparing local and regional governments for the management of crises and disasters. Unfortunately, conducting sufficient training is demanding, especially in small municipalities, due to constrained time and personnel resources, but also complex planning and scheduling of the dominant on-site training methods. Virtual training has been suggested as a resource-efficient and flexible complement. However, despite numerous specifications of digital technology for training, research on organisational implementation and usage is lacking, indicating a low uptake. This article presents a cross-border R&D effort to facilitate the digitalisation of crisis management training by developing generic virtual tabletop exercises (VTTXs) to be shared via a repository, and (re-)used in, and adapted for, diverse contexts. The purpose of this article is to identify essential aspects in designing and conducting virtual tabletop exercises (VTTXs) for collaborative crisis management training.

Keywords: Digitalisation, Collaborative learning, Computer-Supported Collaborative Work, Collaborative Crisis Management Training, Virtual Tabletop Exercise (VTTX), Exercise Design.

1   Introduction

Crisis management training is a vital part of crisis preparedness, aimed at strengthening capabilities that are essential in the various stages of crisis management as well as testing and/or rehearsing contingency plans (cf. Steinberger 2016). Steinberger (2016, p.70) claims that "Training provides skills, informs those involved about every actor's roles and responsibilities, builds informal networks and serves as a stress test for disaster response plans." For the purposes of the present study, we use 'crisis management training' as an umbrella concept covering adjacent activities, such as education and exercises, serving to prepare the strategic management level in organisations for the handling of "unplanned natural or man-made events with a sudden and severe negative impact on human live [*sic*], the functioning of society and/or the physical environment" (Steinberger 2016, p. 61). Our primary context is local and regional governments, as these often have the main responsibility for handling societal crises.

Although most industrialised countries regulate crisis training in legislation (Perry 2004, referring to Selvarajah 1993[1]) previous research (Magnusson et al. 2018; van Laere and Lindblom 2018), and evaluations of disasters (e.g., NOU 2012 p.14) have indicated the importance of further training. However, while the commitment to crisis training is strong in many organisations, they also face barriers that hinder them from expanding their training activities. Among those barriers are time-consuming scheduling and design of exercises (Magnusson et al. 2018).

Virtual or computer-based training has been suggested as a flexible and cost-efficient complement to conventional (in-person and on-site) exercises that could facilitate expanded participation by decreasing costs and/or schedule conflicts of travel (FEMA 2021b; Lukosch et al. 2012). Despite these advantages, and numerous descriptions of training applications (e.g., MacKinnon and Bacon 2012; Reuter et al. 2009), there are few examples of ongoing usage of such applications in extant research, which indicates a low uptake (Magnusson and Öberg 2015). Moreover, many of the existing studies of virtual training

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[1] Selvarajah, C.T. (1993) "Training System Effectiveness in Australia." *Human Systems Management*, 13 (3), 295–302.

focus on computer-based simulations (ibid.), while studies of digital tools for discussion-based exercises such as tabletops are scarce (Araz et al. 2012), although this is a common training format in practice (cf. van Laere and Lindholm 2018).

1.1 Purpose

In this study, we present lessons learned from the process of digitising tabletop exercises for crisis managers digital, in the search for a collaborative repository of exercise outlines. The purpose is to identify important aspects in designing and conducting reusable virtual tabletop exercises (VTTXs) for collaborative crisis management training for diverse types of (societal) crises or disasters.

This is part of a longitudinal research and development (R&D) effort where the overall research problem can be defined as: *How to design for a collaborative virtual training environment that facilitates and increases crisis management training activities.* Here, a virtual training environment is considered to include not only digital technology but also training methods and processes, digital material, etc. The low uptake of digital technology for crisis training motivates a broad approach.

1.2 Background

The study draws experiences from two cross-border R&D projects: CriseIT (1) and CriseIT 2. The Swedish-Norwegian project consortiums had a triple helix composition with (trans-discipline) researchers, companies, and government agencies at local, regional, and national levels. During CriseIT 1, the intended user context was investigated, and high-level methods and software prototypes for virtual crisis training were developed in collaboration with stakeholders; for example, safety coordinators in municipalities. Of importance for the present study is the stakeholders' idea of a collaborative 'bank' or repository of generic and reusable tabletop exercises (TTX). Such a bank would enable more frequent and quality-assured exercises, in that it would aid the planning and execution of exercises. In addition, readymade exercises were considered to help pave the way for the organisational adoption of virtual crisis management training. Another vital component is suitable digital tools. Thus, three crisis training software were developed in CriseIT 1: a web-based prototype for VTTX built in WordPress, a commercial software for (long- and short-term) planning and evaluation of exercises, and an augmented reality (AR) prototype for the training of situational awareness, communication, and decision-making.

In CriseIT 2, the idea of an exercise repository was explored through the design and evaluation of seven exercises. The exercises were (primarily) designed by the researchers in the CriseIT 2 project, evaluated with stakeholders and students, and re-designed according to the observations during the demonstration exercises and feedback received from the participants. The design of several exercises led us to develop an exercise template that could be used to design new exercises as well as the development of immersive resources (such as videos) that could enhance the experience of the virtual exercises. Furthermore, the previous crisis training software prototypes were further developed in CriseIT 2.

2 Related research

2.1 Crisis management training

Regarding how to design crisis management training in an organisation, van Laere and Lindblom (2018) suggest to "first educate then train". They also stress the value of multiple exercises in series, rather than single exercises. Crisis training exercise formats can be divided into discussion-based (seminar, workshop, tabletop) and operation-based (drills, function exercises, full-scale, etc.) (Skryabina et al. 2017). The focus of this study is tabletop exercises (TTXs), a common discussion-based training format. In TTXs, the participants usually meet in a conference room to discuss suitable actions for a simulated event (Peterson and Perry 1999). TTXs can be used to familiarise participants with crisis plans, policies and procedures (Skryabina et al. 2017). They are the least formal and least complex of all exercises (Peterson and Perry 1999), and as such they provide a "stress-free environment: equipment is not used, resources are not deployed, and time pressures are not introduced" (Tena-Chollet et al. 2017, p.145). Roud et al.'s (2021, p. 180) survey study found that learning was slightly stronger correlated to

usefulness for tabletop exercises than for full-scale exercise and they reflected on whether "less pressure and fear of failure may also result in a more creative discussion that enables more learning". Either way, because no actions are simulated, only discussed, in collaboration with other actors, the requirements on resources and equipment are low, which makes TTXs comparably low-cost and easy to arrange.

Although TTXs are the least complex exercise format, they still require a well-thought-out design. A safety or emergency coordinator often handles the coordination of an organisation's safety and security work, crisis training included. Meum and Munkvold (2013) found that while the scope and scale for this role vary, in small municipalities it may only account for a 20 per cent position. Considering such limited resources, the design, planning and conduct of exercises could be challenging. Safety coordinators in local and regional governments express that they lacked the time to plan and conduct sufficient training, and also sometimes lacked the creativity and knowledge for designing them (Magnusson et al. 2018). Accordingly, Field et al. (2012) note that planning can take several months. Naturally, this affects the frequency of exercises. To simplify and reduce planning efforts, Field et al. (2012) suggest a virtual training environment with basic scenarios that can be reused. Moreover, Stern (2014) claims that strategic leaders are an especially challenging target group for crisis training. He suggests that "if it is difficult to gather leaders in one place or in one time, introduction of technology for at-a-distance participation and/or asynchronous game design […] may be indicated". Unfortunately, Tena-Chollet et al. (2017, p. 854) conclude that: "most of the training environments for crisis management are intended for tactical or operational levels (emergency services, firemen, etc.), and not for strategic ones (e.g. stakeholders)". Thus, enabling more training for the strategic level is crucial.

Several authors present frameworks and design guidelines regarding *what* to train in exercises. For instance, Greenberg et al. (2016) propose a "capabilities-based framework for disaster response exercise design and evaluation". In a similar vein, Olsén et al. (2020) identified four core, six supportive, and four enabling capabilities for inter-organisational crisis management. The Norwegian Directorate for Civil Protection (DSB) (2016 p. 20) defines generic competence areas as capabilities that all actors with a (formal) role in the handling of a crisis should have and that these can be trained in exercises regardless of the scenario type. According to DSB (2016), examples of such competencies areas are prioritising resources, creating and sharing (joint) operational pictures, communication, and information sharing.

2.2   Computer-based training

Computer-based training, like conventional crisis training, can be either individual or collaborative (e.g. Arafa et al. 2011). In the present article, collaborative training is referred to as crisis exercises. The training environment can be co-located or distributed or a mixture (Pettersson 2022). While 'co-located' denotes a training session where the trainees are gathered in the same physical location, 'distributed' training means that the trainees are geographically separated from each other, thus offering remote access (e.g., MacKinnon and Bacon 2012).

Studies of technology use in TTX are rare, although Araz et al. (2012) suggest that multi-media are useful tools for increasing the realism in TTXs. However, the Emergency Management Institute (EMI) at FEMA (FEMA 2021a) has offered monthly virtual TTXs (VTTXs) to key personnel from the emergency management community of practice in the United States since 2012. The exercises are conducted via a standard video teleconference (VTC) platform and "allows the connected sites to assess current plans, policies and procedures while learning from other connected sites as they provide their perspective and practices facing a similar situation" (Boin et al. 2014, p. 47).

Regarding how to plan and conduct virtual exercises, we have only been able to identify a few previous research publications. One example is Tena-Chollet et al. (2017), who discuss the design of a semi-virtual training environment. However, their focus is more on *what* to include than *how*. Grunnan and Fridheim (2017) present success criteria for planning and conducting crisis management exercises for decision-making. These include defining the exercise goals as early as possible in the planning process and making sure that the scenario that is later selected is relevant and specific enough to engage the participants. Grunnan and Fridheim also highlight the importance of preparing the participants; for example, with read-ahead material. Overall, research that provide support for designing and executing VTTXs and other virtual training formats is scarce. Also, Alexander (2003) calls for more standards in emergency planning and training.

2.3   Designing virtual exercises

One of the few detailed pieces of advice on planning and conducting VTTXs is given by FEMA (2021b). They present pre-conduct considerations for VTTXs concerning, for example, virtual platform features, participants' registration and preparation, exercise documentation, and exercise staffing and roles. Also, post-conduct as evaluation and briefing are included. The suggestions include limiting the number of participants, providing technical support and to conduct a welcome session or video. Also, Boin et al. (2014) suggest some best practices from the experiences of VTTXs offered by EMI/FEMA. One recommendation is to use file formats that are compatible with many different software (such as PDF) to avoid restricting participants to using expensive, proprietary software.

Overall, virtual training has similarities with e-learning and e-collaboration. A common division of technology used in computer-supported collaborative work (CSCW) is the CSCW matrix by Johansen (1988), where the work and the technology used are divided by location (vertical axis) – that is, if the collaborators are in the same place or different places – and also by the time of work (horizontal axis) – that is, if the collaboration/cooperation is conducted in synchrony or asynchrony. However, as noted by McDermott et al. (2015), the CSCW matrix is "hampered by a reliance on just two components based on physical constraints" (p.4) and, as argued by Jørnø et al. (2013), the division of technology according to the matrix does not say much about the properties of the tools or technologies for collaboration. Furthermore, the virtual tabletop exercises for crisis management training are not only a collaborative professional practice, but it is also a collaborative *learning* process, and other dimensions than time and location may have an impact on how such exercises should be designed. Building on experiences from the CriseIT projects, Pettersson (2022) notes that, for crisis training exercises in the digital format, the continuity of the exercise is important. This means, for example, that "a synchronous exercise can alternatively be divided into shorter steps that are not carried out in an unbroken sequence, but instead at times when people can afford to leave their ordinary tasks" (p.868). McDermott et al. (2015) apply the model of coordinated action by Lee and Paine (2015) to their analysis of two computer-supported collaborative learning projects. In Lee and Paine's model, dimensions such as "number of communities of practice", "nascence" (from routine to developing) or "planned permanence" (short-term or long-term) and "turnover" (of participating people) constitute elements of the model.

Finally, virtual crisis training is an innovation in many organisations. Previous practices, needs and problems in the adopter context and norms in the social systems have proved to affect the adoption of innovations (Rogers 1995). Thus, it is important to understand the intended application context with its current crisis training practices, social and technical systems, problems and opportunities for change (cf. Hevner 2007) in order to develop solutions that will be adopted, used and create value for both individuals and organisations.

3   Research approach

The CriseIT projects have been conducted with a user-centred design (UCD) focus. This means that the context of the stakeholders such as crisis managers and safety coordinators in municipalities have been thoroughly investigated and that the needs of the stakeholders have been the centre of attention during the whole project. A crucial part of UCD, applied also in this project, is to evaluate designs together with stakeholders iteratively, and update designs as well as requirements accordingly (Gulliksen et al. 2003). This approach has been applied throughout the entire project.

The idea to move from centring the stakeholders to involving them as co-designers (confer, for example, Bødker and Grønbaek 1991) – that is, to let stakeholders be in charge of the exercise planning and design – was discussed during the project. However, as noted earlier, the safety coordinators are under immense time pressure, so it was not possible to put them in charge of planning this new type of exercise. Furthermore, it was argued that an exercise outline to build upon would be beneficial, rather than asking them to design an exercise from a clean slate, which is rarely the practice anyway. These considerations resulted in an iterative and collaborative effort between the researchers involved in the R&D project and the stakeholders in designing and evaluating exercises.

The study follows an action case approach (Vidgen and Braa 1997) in that it seeks to gather practical knowledge of how virtual tabletop exercises should be designed and conducted, and how the move from co-located exercises to the new virtual or semi-virtual format may change the context of the exercises.

Overall, the research has followed a design science research (DSR) approach (cf. Hevner et al. 2004; Peffers et al. 2007). The result from DSR is always an artefact, that in the information systems (IS) area can be a construct, a model, a method or an instantiation (such as software) (Hevner et al. 2004). In the CriseIT projects we have developed several artefacts, at different levels: instantiations in the form of software for crisis training, as well as emerging design theory in the form of a method for designing and executing training, design principles, etc. Some of these contributions are complete and some are under development. However, in this paper we wanted to be able to describe our research insights in a holistic way, rather than focusing on the individual contributions.

3.1   Empirical data collection and analysis

Regarding the empirical data collection in the projects, we had two important aims. First, we wanted to investigate the needs for and attitudes towards this type of training method, and in particular, the asynchronous and distributed elements of VTTXs as these differ most from conventional training. This was first studied in an in-depth interview study of 19 respondents from 16 crisis-handling organisations in Sweden and Norway. The semi-structured interviews, which were 45–120 minutes in duration, were summarised and analysed in an iterative coding process as explained by Miles and Huberman (1994).

Second, we gathered feedback for formative evaluations of the exercises' outline, content, planning and execution, including the IT system used. This was done in several ways; for example, by 17 screen-sharing prototype sessions and systems walkthrough(s) with stakeholders. Also, observation notes were taken during stakeholder workshops inspired by future technology workshop (FTW), "a method whereby people with everyday knowledge or experience in a specific area of technology use […] envision and design the interactions between current and future technology and activity" (Vavoula and Sharples, 2007, p. 393) However, the formative evaluations mainly took the form of test exercises performed by stakeholders in their organisations. A total of nine VTTXs took place during the projects, involving between two and 15 participants. In addition, three (3–4-hour) 'demo exercises' were held in which stakeholders were introduced to VTTXs and had the opportunity to try them in smaller groups. Data were gathered in connection to each event but in different forms: online surveys, video conference interviews, observation notes, system data, and notes from focus group-like interviews/hot-wash-up evaluations after exercises. The questions varied from broad questions – for example, what are the strengths, weaknesses and needs/ideas for improvements – to semi-structured interview guides building on, for example, theory on information system success (DeLone and McLean, 2003). The empirical data were used to iteratively update requirements and design choices (cf. Gulliksen et al., 2003).

The purpose of the (formative) evaluations was to assess and improve the utility, quality, and efficacy in terms of functionality, completeness, usability, fit with organisational needs, etc. (cf. Hevner et al. 2004). A limiting factor during the tests was that none of the groups were authentic crisis management teams, as our partner organisations were occupied with the COVID-19 pandemic. Overall, more trainers than trainees have participated in the projects.

4   Results from the design process

In this section, we present a summary of our iterative design process of collaborative crisis management exercises. As mentioned in the introduction, an early request from the projects' stakeholders was to develop a 'bank' of exercises to share and reuse between organisations. Different municipalities often have similar needs for training and scarce resources for planning exercises, which means that developing fact-checked and varied exercises is a demanding task. Therefore, the ability to re-use and adapt other organisations' exercise planning is one aspect that the stakeholders believe could increase the number of exercises performed in their organisations. Thus, an overall objective for CriseIT 2 was to develop a repository of exercises for the crisis management level in municipalities. From workshops and semi-structured interviews with stakeholders in the CriseIT 1 project, it was found that exercises should be easy to access, use and reuse; and that achieving this requires the exercises to be generic and

adaptable rather than specific and context-dependent. Furthermore, the exercises should contribute to filling the current lack of (minor) exercises that are easy to arrange for a wide training audience.

It was realised during the CriseIT 2 project that the vision for a joint cross-border bank of exercises where different organisations could share their exercises required a standard format for the exercises. The idea was to eventually implement the exercise bank as a database with a graphical user interface that allowed the user to upload and search for exercises. The primary target group was safety coordinators (the exercise planners/trainers) in local government, and a secondary target group was the strategic crisis management organisation (the trainees).

The primary exercise format was set to VTTX since an important objective was to enable less complicated exercises. Another objective was to develop exercises suitable both for physical (co-located) and digital (distributed) environments, and both synchronous and asynchronous communication as these features facilitate participation regardless of time and space. Next, the utilised digital exercise system(s) is described, followed by a presentation of the different elements in the design and evaluation of the exercises.

4.1 The exercise system(s)

During the CriseIT 1 project, a VTTX system was tailor-made in WordPress. This solution proved to be difficult to maintain and lacked vital functions such as user management. Therefore, in CriseIT 2 it was decided to migrate to a standard learning management system (LMS); Canvas LMS. There were three main reasons for this decision. First, LMSs contain a lot of the required functionality, such as the management of users, roles/rights, documents and media, communication tools, etc. (cf. Reuter et al., 2009). Second, all of the researchers were already familiar with Canvas LMS, which facilitated the design of the repository and the exercises. Third, the fact that the universities used Canvas LMS in their education, simplified GDPR compliance during exercises and tests. Also, previous empirical studies have found LMS to be a valuable part of emergency management systems (e.g., Neville et al., 2018). In one of the exercises, another LMS – Moodle – was utilised by the request of the participating organisation. In addition, an AR tool (prototype) for the training of situational awareness, communication, and decision-making that was developed in the CriseIT projects, was tested for exercises with students, as was a VTC platform.

4.2 Designing collaborative virtual tabletop exercises

Some of the participating organisations prepare the trainees before the exercise by using short educational sessions; for example, for repeating what to document in a common operational picture. An even more common practice, in line with the recommendations in Grunnan and Fridheim (2017), was to send out read-ahead material, often including exercise goals, background information on the scenario, and practical information about the exercise. Such content was also considered an interesting component in VTTXs by the safety coordinators and was therefore included in the exercise outlines.

As mentioned, it was identified that, in order for exercises to be usable in many organisations, they need to be generic; that is, easy to apply in municipalities in general. This means aiming for exercises that meet *common training needs* and could potentially be used for *different exercise formats* and in *different software systems* (cf. Boin et al. 2014). For the exercises to meet common training needs, generic capabilities were used as a starting point for defining exercise goals. Weighing together different sources, the following five generic competencies or capabilities were defined to guide the exercise design: (1) situational awareness and mental models, (2) leadership and organising, (3) collaboration and teamwork, (4) decision-making and processes, and (5) internal/external communication.

A prioritised list of event types for the scenarios was defined in a workshop with stakeholders early in CriseIT 2. The scenarios were designed to avoid references to specific places, points in time, etc. Two virtual workshops, one of which involved stakeholders, were used for the collaborative design of one of the exercises.

In striving to develop a joint repository of exercises, an awareness emerged of the need to standardise the exercise planning documents (cf. Alexander 2003). These were often written in regular office ware, with varying information content, and order of the content. Also, several stakeholders stressed the need

to establish the exercise purpose and goals before starting to outline the scenario. Thus, a quality-assured process ensuring that vital content was not left out, or defined in the wrong order was called for. Governmental handbooks for exercise design in general, and discussion-based or tabletop exercises in particular, were used as a starting point (e.g., DSB 2016).

4.2.1   Virtual tabletop exercise outlines for the repository

Seven virtual tabletop exercise outlines for the collaborative repository were developed and completed during CriseIT 2 (see Table 1). "Completed" means that the exercise was designed, conducted, demonstrated and/or evaluated, and improved from the feedback in demonstrations/evaluations. Assessing how well a designed element supports a solution to the identified problem is a crucial aspect of the design process, as emphasised by Peffers et al. (2007).

The exercises were demonstrated and evaluated with various groups, including partner organisations (Exercises 1 and 4), both master's (Exercise 7) and bachelor's (Exercise 2) students specialising in emergency preparedness and crisis management, as well as master's students in public administration (Exercises 5 and 6). Creative input for the exercises was solicited and received during each demonstration and evaluation session.

While all seven exercises incorporated synchronous elements, they were configured differently. In the case of Exercises 4 and 7, we experimented with both asynchronous and synchronous elements within the same exercise, combining individual tasks with group discussions. Additionally, Exercises 3 and 5 featured asynchronous elements. Exercise 7 was designed in collaboration with master's students. It was then showcased to partner organisations, at site and via VTC, at the concluding conference of CriseIT 2. The entire repository, comprising the exercise outlines, was conceptually demonstrated and evaluated in brief demonstrations/workshops with project stakeholders.

Nr	Scenario (event) type(s)	Exercise format	Training tool(s)	Demonstrations and evaluations
1	Terror: School shooting	Tabletop	Canvas LMS + TV-screen	Demonstrated and evaluated in a 4 h co-located 'demonstration exercise' with 11 Swedish and Norwegian stakeholders.
2	Terror: DDoS-attack	Tabletop	Canvas LMS	A previous version was tested with BA students in the AR tool
3	Extreme weather: Forrest fire	Tabletop with asynchronous elements	Moodle LMS +VTC	Demonstrated and evaluated in a distributed 3 h workshop incl. a 'demonstration exercise' with 20 teachers/thematic experts at a national authority.
4	Extreme weather: Power outage	Tabletop	Canvas LMS+ VCT	Demonstrated and evaluated in a distributed 4 h 'demonstration exercise' with 9 Norwegian and Swedish stakeholders.
5	Terror: Power outage	Tabletop with asynchronous elements	Canvas LMS + VTC	Tested with > 20 master's students in a distributed setting.
6	Accident/ civilian-military collaboration: Train accident during a pandemic	Tabletop	Canvas LMS + VTC	Demonstrated for > 20 master's students in a distributed setting.
7	Extreme weather: Flood	Tabletop with asynchronous elements	AR tool + VTC	Tested with > 20 master's students, demonstrated for appr. 20 stakeholders in a co-located and distributed setting.

Table 1.   The seven exercises designed during the CriseIT 2 project (modification of Bakken et al., 2022, p. 6)

Evaluation data were collected in different formats: notes from observations of exercises and de-briefings, surveys following exercises, semi-structured follow-up interviews, and analysis of systems usage and content. As already stated, the purpose of this formative evaluations was to assess and improve the utility, quality, and efficacy in terms of functionality, usability, fit with organisational

needs, etc. (cf. Hevner et al. 2004). In general, the attitudes toward the virtual tabletop exercises among the participants were positive. One respondent wrote: "I'm not used to this way of training but [I] like it. I think it will become common in some areas in the future as I can see the benefits of it." Several respondents believed that VVTXs can facilitate broadened and more frequent training/exercises, as well as the introduction of new employees. The possibility of using asynchronous elements was seen as advantageous for flexibility and learning.

The negative feedback was connected to the scope and detail of the exercises, and the lack of roles. One comment voiced was "The content of the exercise would have needed further development if we had been an actual municipality, with roles, more injects, etc."

Several of the challenges identified is connected to technology: start-up problems, poor internet connection, technology resistance, etc. As one respondent put it, "The technology is a limitation […] technology habituation takes time from an already frugal time." Some participants also pointed out that this format has its obvious limitations in what can be trained.

4.2.2 The exercise template

As mentioned in the background section, a design template was initiated by the researchers in a search for standardisation and quality assurance. The design of the exercise template began with a list of concepts based on definitions collected from handbooks and guidelines on exercise planning by the national authorities for civil contingencies. In addition, exercise materials from conducted exercises in the partner organisations served as inspiration.

The design was complicated by the lack of a common terminology/standard for the naming of concepts, between the countries but also within countries and even within organisations. Although there was a general awareness of this, and a will among practitioners to cohere to the terminology promoted by the national authorities, it was expressed that both synonyms (for example, 'trainer' and 'game master') and homonyms (such as 'exercise participant') existed.

The template aimed to guide the design of exercises shared in the repository, to ensure that they are complete and follow an easily recognisable standard format. The design of the exercise template was conducted iteratively and began with a template in Microsoft Word. The Word template was sent to five stakeholders for expert reviews and the template was then updated accordingly.

One stakeholder stated that "Through systematisation and digitalisation, training becomes easier, more efficient and less costly. Fewer resources are needed for planning exercises, etc. You ensure a quality level and open up for more but shorter [training] opportunities to increase the competence level in your organisation." The same respondent considered the exercise template to be a great tool that helps the exercise planner avoid forgetting or opting out of important parts of exercise planning, such as identifying indicators for the goals. Another advantage mentioned was that a common template can facilitate inter-organisational collaboration, for example in a region, by contributing to coherency in planning and evaluation. Furthermore, the respondent suggested that the template could be utilised to highlight power structures, such as the gender distribution in planning. The template was also tested and reviewed by a few of the researchers in the project, each of whom planned one exercise using the template.

4.2.3 Immersive resources

The immersion resources can be included in an exercise to amplify the written scenario and enhance the trainees' feeling of realism; that is, to allow them to immerse into the exercise scenario during virtual tabletop exercises. Several different immersion resource templates were developed that can be used to create fictive newspaper articles and social media posts (Facebook, Instagram, Twitter) (see Figure 1). In addition, a marketing agency was used to develop a few professional movies of news reporting about a forest fire and a school shooting, social media updates from the school shooter, and a telephone call to the police about a bomb threat towards a school.

The supporting resources are generic in the sense that they may be used in several exercises, but only where they are applicable. This means that the news reporting about the forest fire and the movies about

the school shooting, for example, is not tied to a specific location, certain people, or connected to a specific date. They are, however, tied to specific event types (forest fires and school shootings).

The movies were appreciated by the trainees in the two exercises (1 and 3) that used them. One respondent wrote, "Videos are very good for reinforcing and clarifying a situation and how people in the situation experience it." The templates for the newspaper articles and social media posts have not yet been evaluated with exercise planners in crisis handling organisations.

Figure 1. Media templates to illustrate exercise scenarios.

5 Discussion and conclusions

In this chapter, we discuss our lessons learned and present conclusions on aspects to consider in designing and conducting reusable virtual tabletop exercises (VTTXs) for collaborative crisis management training.

5.1 Lessons learned

This section summarises our insights from designing, planning and conducting the project's exercises.

5.1.1 Insights on designing VTTXs

An important motive for using virtual training formats is to facilitate further training. VTTXs could reduce barriers connected to the target audiences' lack of time by making it possible to participate in exercises from different locations in a *distributed* mode. Distributed exercises are highly appreciated by a majority of the participants, especially when the COVID-19 pandemic made conventional in-person exercises difficult to conduct. This is to be expected since, based on our experience, VTTXs are a combination of e-learning and collaborative computer-supported work, resulting in a collaborative learning process conducted with the support of computers. Somewhat surprisingly, *co-located* VTTXs were perceived to add value, for example in terms of better documentation.

Moreover, the project stakeholders appreciated the possibility of using *asynchronous* communication, allowing them to conduct their training with some flexibility in time. Thus, selecting between distributed or co-located execution, and synchronous or asynchronous communication, and defining continuity are important design choices that separate TTXs from VTTXs (Pettersson 2022). Designers of reusable exercises should strive to plan VTTXs in a way that allows different configurations to be decided when conducting the exercise.

Another way to reduce time barriers is to *make the exercises less comprehensive*. Shorter but more frequent exercises are an often-mentioned aim in the partner organisations. Exercises are often divided into modules. Our preliminary results indicate that a rough benchmark for VTTXs is three to six modules.

When planning VTTXs, we have found, in line with previous calls for standardisations (cf. Alexander 2003), that standardisation can help establish a common language and working practices. Furthermore,

standardisation may be essential in organisations where the turnover of trainees is high, and when the nascence of crisis training is still on the developing level (Lee and Paine 2015). By *following the terminology, exercise structure and proposed planning steps of national bodies*, such as DSB (2016), standardisation can be achieved. Also, in line with Grunnan and Fridheim (2017), several stakeholders have stressed the need to start the design of an exercise by establishing the purpose and goals. These requests raised the idea of *a design template* to ensure that exercises are quality-assured, easy to produce and reusable.

Several respondents stressed the need to collaborate and design exercises that are *reusable*. In line with Field et al. (2012), we believe that an important factor for spreading VTTXs as a complement to conventional training is to create a joint repository with exercises that are shared freely or at a low cost. Such a repository could serve as a facilitating condition that lower the barrier to start using virtual exercises and make this type of training more observable and easier to try (cf. Rogers 1995); that is, moving from a short-term planned permanence to a long-term (Lee and Paine 2015). However, it is noteworthy that project stakeholders have emphasised that participation in exercise planning, despite being time-consuming, is a learning process. Thus, a potential disadvantage with overly frequent reuse of exercises is that important learning opportunities disappear. However, the number of people involved in the exercise planning process is limited and may not include people who play an active role in, for example, the crisis management in a municipality. It could perhaps be a learning opportunity for the safety coordinator to fine-tune a generic exercise to the specific exercise needs of an organisation, but that remains to be studied.

In search for reusable exercises, it became vital to *design generic exercises*; that is, to avoid context-specific references to make exercises applicable in different organisations. However, one respondent voiced concern that the content of the (generic) exercise would need to be customised to a particular context. Similarly, Grunnan and Fridheim (2017) warned that overly generic scenarios were found to be less engaging for the participants in their study. A compromise is to add tailored information – for example, context-specific information – to the scenario at the time of exercise (re)use.

Another important feature to enhance learning from exercises is to *use generic capabilities as a starting point* to define exercise goals (e.g., DSB 2016; Greenberg et al. 2016; Tena-Chollet et al. 2017). Also, some stakeholders expressed that exercises should enable progression in training. This could, for example, be implemented as providing the same exercise in three different complexity levels (cf. complexity factors in Greenberg et al. 2016). Furthermore, to support the call for frequent training, programmes or a series of exercises could be used, as suggested by van Laere and Lindblom (2018).

Immersive resources such as short videos, fictive telephone calls, and photos can make the exercise scenario more realistic and engaging. In our application of immersive resources, empirical data from observations, interviews and surveys indicated that it can help engage participants enough to compensate for a generic design of the exercise. It could also increase what one safety coordinator named the fun factor, which is important, as exercises are often voluntary.

Finally, as always when planning for crisis exercises it is essential to assess whether the purpose of the exercise is appropriate for the format. Our tests and evaluations have only considered this to a minor extent but the preliminary results indicate that purposes in line with those mentioned by Skryabina et al. (2017), such as familiarising participants with crisis plans and policies, are suitable. In addition, training on decision-making, preparing for simulation exercises, and 'training on how to train regularly' are among the areas that our stakeholders believe to be suitable for VTTXs, along with educating people before training (cf. van Laere and Lindblom 2018). Several stakeholders noted that the ability to prepare new employees is especially interesting.

5.1.2   Insights on conducting VTTXs

On an overarching level, VTTXs are conducted in the same way as conventional TTXs. There are equivalent roles (trainer/facilitator, trainees, evaluator, etc.). There is a purpose and perhaps some exercise goals defined, and documents presenting goals, scenarios, guiding rules for the exercise, etc. Our experiences are in line with FEMA (2021b), that these could be implemented in the digital training system. However, some issues are different and need tailoring from TTXs. For example, we have some indications that *preparing and introducing the trainees* to the exercise in advance may be especially

important for VTTXs to run smoothly from the start. Just as in conventional training, a time and responsibility plan for the entire exercise process needs to be prepared well in advance, and information should be e-mailed to the target audience as soon as the date(s) are set. A couple of weeks before the exercise, an email with basic information, and read-ahead material about the exercise, together with instructions for how to get access to the exercise system, should be sent out (cf. Grunnan and Fridheim 2017). We found, in line with the advice from FEMA (2021b), that it is vital that *technical support* is offered. Some trainees needed help with accessing the system. Measures should be taken to ensure that the trainees are able to log in and navigate the system in good time before the exercise starts.

Some of the participants saw *starting* the exercises *with an individual and asynchronous task* connected to the scenario as a good way of achieving more variation and creativity and avoiding 'group-thinking'. Also, to spur active participation and get the trainees tuned in on the exercise, quizzes (such as surveying expectations), discussions for raising questions/communicating with the trainer, or assignments were found to be helpful. Before starting the exercise, the exercise planners need to *decide which activities should be asynchronous and which are better performed in a synchronous mode*. Our findings indicate that asynchronous activities work best for the start-up of the exercise. This is in line with FEMAs (2021b) suggestions for a welcome video or similar. Furthermore, stakeholders in our study, familiar with the role of the trainer, have often chosen synchronous communication for conjunctions for decision-making/agreeing on actions to take (the discussion can very well start asynchronous), and (hot wash-up) evaluations with the entire group. This can possibly change if virtual training becomes a habit.

Experiences from the projects' exercises show that the trainer/facilitator have a key role also in VTTXs. It is a fallacy to believe that virtual training could be run without a trainer monitoring and, when necessary, intervene in the exercise. Another task we have observed that the trainer may need to handle is reminding trainees to participate in a certain activity during the defines timeslot. Features that may need re-configuration are the planned *time-span for the asynchronous parts*. The key here is to provide enough flexibility for an exercise to fit in the daily work, while not losing the momentum in the exercise.

5.1.3   Technology-related insights

Conducting tabletop exercises virtually demands the use of technology, and, at least during parts of the exercise, access to the Internet. In five of the exercises, we used an LMS as a VTTX system. We have seen some advantages of using an LMS in this way. For example, the system has means for user management and enables easy file management, something that is important when new trainees should take part in the exercise and many documents should be shared. Another important aspect pertains to the learning. It is possible to design quizzes for pre-tests before exercises, to ensure that trainees are on the same level when entering the exercise, or for evaluations after the exercise, via the LMS. Regarding the asynchronous communication, the discussion forum in the LMS facilitates this. The LMS also allows tracking of which participants have taken part in each exercise event, which is advantageous for follow-up. Furthermore, the documentation of the exercise is simplified, especially in asynchronous exercises, by the fact that the trainees use the system to take pre-tests, communicate in discussion forums when discussing solutions and making decisions, and that all events and contents of the exercise are compiled in one place. Admittedly, the number of participants in a VTTX will probably have an impact on how easily discussions and evolution of the exercise can be followed by trainees and exercise trainer; this should be taken into account when designing or choosing technology for VTTXs. A feature that was in high demand by our stakeholders was the ability to aggregate comments and discussions in an exercise automatically.

We also identified shortcomings with Canvas LMS as an exercise system. These include the lack of a graphical timeline for planning and for visualising the scenario events and the participants' actions chronologically. A timeline-based structuring is a common feature in many dedicated crisis training systems (Bacon et al. 2011). Since the Canvas LMS system is intended for educational use, the terminology in the graphical user interfaces is not adapted to crisis management. One example is the teacher/student user roles, or features coloured by common education activities such as submitting assignments. This mismatch between the stakeholders' terminology and the system may decrease the user experience for the trainees (cf. common usability heuristic such as by Nielsen 1994).

We see many reasons why the *usability of the technology used for the VTTX is of outmost importance*. Even if the number of exercises could increase by the digital format, exercises are not done daily. Furthermore, organisations that may not have trained together before may be introduced to participate in an exercise. Furthermore, turnover in the training organisations can result in new personnel participating in exercises. Therefore, the system(s) used for exercises must be designed with infrequent users in mind (Gulliksen et al. 2003; Nielsen 1994). The users' satisfaction with the VTTX systems is important; the system should not be a barrier to overcome to conducting exercises. Finally, in line with Boin et al.'s (2014) advice to use common file formats, we have so far documented the exercise repository in .docx, .xlsx and .pdf formats to enable reuse in different software applications for training.

5.2   Conclusions

As can be concluded from the discussion on lessons learned, there are several important aspects to consider when designing and conducting reusable virtual tabletop exercises (VTTXs) for collaborative crisis management training. For exercises to be reusable, generic capabilities should be used as a starting point for defining exercise goals. It is also important to avoid context-specific references in the scenario and to follow the terminology and exercise structure proposed by national bodies. To meet the needs of both the strategic crisis management teams, and safety coordinators, it is essential that VTTXs are easy to plan and participate in. In order to allow for flexibility, utilising the distributed and asynchronous possibilities in digital systems is key. Preparing the trainees, providing technical support for login, and easy access to an exercise facilitator/trainer are other important aspects for the conduct of exercises. Some exercise tasks or events are best done in synchronous mode. Since the COVID-19, pandemic most organisations have been familiar with using VCT, and nowadays VCT may be integrated in LMSs.

5.3   Concluding remarks and further research

VTTXs clearly have certain limitations. At the same time, we can see promising results in several aspects, and for particular usage areas. This shows the importance of communicating that virtual training is a complement to, and not a replacement for, conventional training. Also, virtual exercises need both an introduction to and support for this type of training. The idea of a joint repository of exercises (outlines) remains to have strong support among the projects' stakeholders. To our knowledge, several issues remain to be solved before an exercise repository could serve as an easily accessible, collaborative resource that facilitates cross-border, and inter-organisational training. First, for the repository to continue expanding *a standard for content and terminology need to be agreed upon*. A design template for exercise design and planning that we propose in this article, is one step in this direction. However, our model needs further testing with a broader audience and above all, the model (or a similar standard) needs to be adopted by governing bodies at the national, regional, and local levels to form the lowest common denominator for exercise content with a joint terminology.

Second, *barriers connected to technology interoperability need to be solved*. One solution could be for national or regional governments to offer (for free or low-cost) solutions for VTTX in line with FEMA (2021b). Preferably, however, such a solution should not only consist of a VCT system, but at least also include LMS functionality to increase flexibility by enabling asynchronous modules, enhanced documentation, etc. Without joint collaborative platforms, individual organisations are left to export and import exercises into their own LMS or other systems. APIs, which would facilitate import and export between the most common LMSs, seem to be largely lacking at the moment.

Several areas require further research. These include what type of training purposes and goals are suitable for (different types of) virtual training. Moreover, how to configure an exercise in respect of co-located or distributed, synchronous and asynchronous modes, as well as continuity.

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