Elaborating Requirements for a Digital Crisis Training Tool: Findings from a Pilot Study

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Abstract

Crisis preparedness is of great importance to many actors in society. Maintaining crisis preparedness is an arduous task that requires frequent exercises. However, many actors have trouble accomplishing this because planning and conducting exercises are time consuming and involve high costs. Digitalization of crisis training has been suggested as a way to partly overcome these obstacles. In this paper, we present the results of a pilot study on an exercise in a digital crisis training tool. Trainees were interviewed and a content analysis was performed on the data. The analytical categories consisted of requirements for a crisis training tool, developed in our previous work. The results of the analysis show that the pace of an exercise, the number of trainees and the number of asynchronous and synchronous modules are all related to boundaries of digital crisis training. These boundaries need to be further explored.

Keywords: Digital Crisis Training, Boundaries, Requirements, Qualitative Content Analysis

1. Introduction

Perry and Lindell [23] describe emergency preparedness as "the readiness of a political jurisdiction to react constructively to threats from the environment in a way that minimises the negative consequences of impact for the health and safety of individuals and the integrity and functioning of physical structures and systems" (p. 338). However, in a municipality and/or organization, preparation for emergencies is always ongoing. For instance, the responsible staff, such as safety coordinators, need to plan both individual training and collaborative exercises. According to Steigenberger [27], a collaborative exercise "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" (p. 70). Yet, collaborative exercises take a long time to plan (e.g. [7]) and according to Sniezek et al. [26] it is not only hard to find time for training, but it is also expensive. There are different types of collaborative exercises, such as tabletop, functional, and full-scale exercises [24]. To bridge and/or complement traditional exercises, *digital crisis training tools* have been suggested. These tools have the potential to facilitate more flexible and frequent training, which could contribute to more resource-efficient exercises (cf. [13]). Examples of crisis training tools that have been developed and tested are reported in Ahmad et al. [2], Cesta et al. [4] and Lukosch et al. [13]. However, [17] point out that even though several digital crisis training tools have been developed and tested, the lack of studies on more than anecdotal usage indicates that their distribution is limited.

Additionally, Cesta et al. [4] point out that current systems train the operational or tactical level, thus leaving out the strategic level (cf. [26]).

Crisis training can be viewed as an umbrella concept for both individual crisis training and collaborative crisis training [14]. In this paper, however, we focus on collaborative crisis training and also on so-called "discussion-based" and "tabletop-like" exercises, since this study builds upon an implementation of a digital crisis training tool in which the trainees conduct exercises similar to tabletop exercises. Some studies have been done on identifying requirements for digital crisis training tools (e.g. [15]). In order to be optimized, requirements for digital crisis training tools must fulfil specific needs and prerequisites for trainers as well as trainees. It is reasonable to assume that there are boundaries of digital crisis training that these requirements need to fit within. With preliminary pilot tests and later with more extensive tests, these boundaries can be identified and explored. With the previously identified requirements [15] in mind, *the aim of this pilot study is to take a first step towards exploring the boundaries of digital crisis training by elaborating and further developing requirements for digital crisis training tools*.

2. Related Work

According to Rafi et al. [21], there has been a notable increase in research on disaster management information systems in the last decade, although overall there are still few such studies. The increased interest might be explained by the growing importance of crisis or disaster preparedness in society as well as the ongoing digitalization in organizations. It is reasonable to believe that this increased attention will also include information systems for crisis or disaster management training. Conventional training has been argued to be costly and difficult to schedule due to time- and space-dependent methods (cf. [26]). At least in theory, digital solutions could offer resource-efficient complements [13].

In [15] the authors identified a need for more (empirical) studies that make explicit the need elicitation and requirement specification processes for such systems to guide forthcoming systems development in the field. The authors described 20 requirements for a crisis management training tool in municipalities. The requirements were divided into seven *overall requirements* (e.g. timeline of exercise/events), eight *requirements connected to the trainers' role* (e.g. enable reuse, and collaboration in planning of exercise) and five *requirements connected to the trainees' role* (e.g. ease-of-use), based on identified problems and opportunities. The authors used a design science research approach (e.g. [6], [8, 9]) where the artifact is made up of the presented list of requirements. Different requirement elicitation methods were used during the data collection phase such as interviews, workshops, screen sharing prototyping activities etc.

An alternative approach to focusing on requirement specifications is presented in Tena-Chollet et al. [28] who discussed the design and improvements of virtual training environments. They studied simulation-based tools and found a need for improvement in three domains: the teaching strategy, the simulation system, and the (virtual) training environment. Tena-Chollet et al. [28] thus highlighted that constructing good training systems is not 'just' about systems design; the pedagogical strategies applied in exercise design and execution, and the overall training environment must also be considered. Adler et al. [1] discussed a concept for an Internet-based learning platform for strategic crisis managers. They concluded from their interviews with 34 disaster managers in six countries that a common theme is a desire to learn from peers. They suggested an Internet-based platform to allow for optimal accessibility that enables collaboration also across borders. Flexibility is also stressed in terms of the compatibility of a learning environment approach with the users' daily work and responsibilities, e.g. by low dependence on time constraints for trainer and trainees.

Furthermore, crisis management training systems need to be able to include actors that crisis managers have to interact with in actual crises. Some of these will be companies or volunteers that lack access to the organization's information systems. To include them, and to fit the stressful situation of a crisis (exercise), IT system interfaces have to be easy to interact with. Díaz et al. [5] presented design requirements for a 'digital knowledge

ecosystem on emergency early warning'. As this system is to be used in crises by professionals, volunteers and citizens, mobile access is provided and the importance of intuitive interfaces is stressed.

High-level requirements for management training can be found in van Laere and Lindblom [30]. The authors presented a number of propositions for organizational development of a crisis management organization. Building on rich empirical experiences, van Laere and Lindblom [30] argued that crisis management training should be organized as a continuous training program with regular exercises in varied forms. They suggested first educating the trainees in crisis management basics to gain role understanding and then training them in exercises with others to develop skills and practices. Discussion in tabletop exercises is for example suggested to make subsequent role-playing exercises more effective.

Reuter et al. [22], who built a prototype for a computer-supported collaborative training system of crisis communication in an infrastructure providing company, presented required functionality that to a large extent seems usable for crisis training systems in general. This functionality includes modules, for example for user, role, scenario, event, and time management. The system provided support for preparation, simulation/exercise and evaluation. The evaluation showed that the participants appreciated being able to prepare, perform and evaluate the entire training process within one system. However, the prototype was only tested with a handful of users. An integrated Skype interface was used to enable verbal communications. Earlier research stressed the importance of interacting with others also in IT-supported training [29], particularly with team members to create realistic training [13]. Another feature of Reuter et al.'s [22] prototype was that all communication activities were automatically logged and displayed as a time bar. Reuter et al. [22] argued that this helped the trainer to review the actions and evaluate the exercise.

In [17] the authors claimed that earlier research on information systems for crisis training has mainly focused on simulations. There are exceptions such as Araz et al. [3] who exemplified how a tabletop exercise can be supported with digital tools. Furthermore, a study by Toups et al. [29] showed that software tools need not be high-fidelity to promote learning. Their 'zero-fidelity' solution was considered to work well for training team coordination in a simulation exercise.

Finally, requirements engineering, including requirements elicitation, in general is briefly addressed. Nuseibeh & Esterbrook [19] addressed the importance of requirements elicitation, stating that "One of the most important goals of elicitation is to find out what problems needs to be solved, and hence identify system *boundaries*" (p. 39). Méndez Fernández et al. [18] studied problems, causes and effects in requirements engineering. As one of the results of their study, the authors concluded that the three most contemporary problems are incomplete and/or hidden requirements, communication flaws between project team and customer, and moving targets.

3. Method

3.1. Research Setting

One of the tasks conducted in the Preparing for Future Crisis Management (CriseIT) project was to develop a digital crisis training tool (see [16]), based on a number of requirements (see [15]). While conducting the requirement elicitation and developing the tool a design science research (DSR) approach was applied (e.g. [6], [8, 9]). The result of a DSR approach is always an artifact, defined by Hevner et al. [9] as "[…] *constructs* (vocabulary and symbols), *models* (abstractions and representations), *methods* (algorithms and practices), and *instantiations* (implemented and prototype systems)" (p. 77). In Magnusson et al. [15] the artifact was a compiled list of requirements, a *model*, while the artifact in Magnusson et al. [16] was the digital crisis training tool, an *instantiation*. The research presented in this paper was performed in a follow-up project called Implementing Future Crisis Management Training (CriseIT2) where one of the tasks is to conduct and evaluate exercises performed in the digital crisis training tool. Results of an exercise cycle are presented focusing on elaborating and further developing requirements for digital crisis

training tools. In other words, boundaries of the requirements presented in Magnusson et al. [15] are here analyzed, highlighted and discussed.

3.2. The Empirical Case Study

The digital crisis training tool was developed to support tabletop exercises, but also synchronous and asynchronous elements in distributed exercises, and the ability to use any device that has a web browser. Based on the identified requirements presented in [15], the tool is a responsive web application based on WordPress, presented as an "[…] open source software you can use to create a beautiful website, blog, or app" [31]. In the tool, several plugins were also used, where the most important one was LearnPress [12], a Learning Management System (LMS) plugin.

In the tool, it is possible to plan, design, conduct and evaluate exercises. The trainees are presented with a webpage that contains five tabs starting with *exercise content* followed by *terms of the exercise*, *participants*, *aims and goals*, ending with *all comments* (Fig. 1). In the rest of this presentation of the tool, we focus on the tab exercise content which is where the exercise takes place. An exercise is divided into a number of modules, which in the tool are implemented as accordions that can expand and collapse when clicked. Each module can contain information that drives the exercise forward and instructions for the trainees. Following instructions, the trainees respond by writing their answers/decisions as comments in the tool. A module is given a date and time stamp for when it will be visible and can require either synchronous or asynchronous response by the trainees. An asynchronous module can be responded to within a defined time slot, giving the trainees the opportunity to answer when they have time.

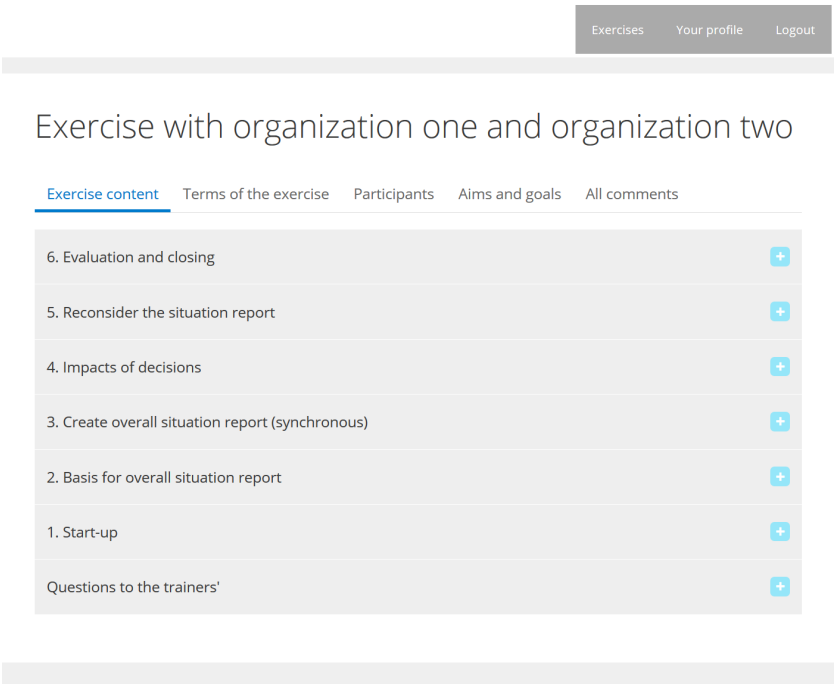

Fig. 1. The Exercise when all modules are visible.

The exercise used in this study, and designed by the authors with some input from the trainees, contained six modules with at least one instruction each, which were all to be solved during a three-day period. Two modules were presented each day; one in the morning at 09:00 and one after lunch at 13:00. The trainees knew when each module was going to be released, meaning that they could plan in advance when to enter the tool and respond to the given instructions. On the first day of the exercise, the trainees were presented with two asynchronous modules where a scenario was presented, and they were instructed to gather information and conduct a situation report. On the second day the trainees made a joint decision based on the situation reports in a synchronous module, and described the impacts of the decision in the respective organization in an asynchronous

module. On the third and final day about a week was supposed to have elapsed in the scenario. The third day of exercise consisted of two asynchronous modules where the trainees analyzed the situation for the coming week, and where the exercise was evaluated.

During an exercise, trainers have the ability to make necessary adjustments based on observations and/or input from trainees. The expected activity from the trainers during an exercise might vary, and during the exercise in this study, the trainers did not see any reasons to make adjustments.

3.3. Data Collection and Coding

In the early spring of 2018, two representatives from two large public sector organizations that did not participate in the project conducted an exercise using the digital crisis training tool. The aim of the exercise was to practice crisis communication and crisis management routines, and to test and evaluate the digital crisis training tool. Here we focus on the last of these three aims. Both trainees held management positions at their respective organizations. While the organizations are separate they still in large parts share a crisis management plan that one of the organizations is responsible for – the other organization is in many ways dependent on functions provided by the responsible organization. After having completed the exercise, both trainees were asked to participate in an explorative follow-up interview study, to which they agreed. Before each interview, an information letter, including written consent to participate in the study, was sent out to the trainees. Both interviews were completed between four to eight weeks after conducting the exercise. Respondent 1 was interviewed for approximately 55 minutes and Respondent 2 for approximately 60 minutes. The interviews were conducted by two of the authors and took place at the university; they were recorded and later transcribed by one author. The interviews were semi-structured and followed an interview guide that covered a variety of questions, such as tool improvement suggestions, encountered problems, and exercise design as well as questions related to synchronous and asynchronous usage. Two of the authors read the transcripts several times and after some discussions it was decided that a directed content analysis (Hsieh and Shannon [10]) would be performed using the requirements presented by [15] as analytical categories. Hsieh and Shannon [10] pointed out that "Sometimes, existing theory or prior research exists about a phenomenon that is incomplete or would benefit from further description" (p. 1281). In this study, existing requirements [15] are elaborated and further developed following the analysis of interviews with trainees. Using NVivo [20], the authors iteratively categorized the content in the interviews. Two of the authors took part in this process and worked closely together.

This study focuses on the trainees and the overall requirements as presented in [15], leaving out the requirements for the trainers, since no external trainers were involved in the exercise. Four overall requirements and four requirements connected to the trainees' role that were addressed in the interviews are briefly described below.

Support of the entire process from planning, invitation, execution, and evaluation to bringing back identified needs for improvement to the organization. Our previous research showed that planning for exercises is time consuming and complex, often lacking a structured approach. In addition, maintaining the organizational knowledge in-between exercises is seen as problematic. *Mobile access.* Both the time it takes to conduct exercises and traveling time to the exercise location present problems. Digitalization, allowing for high flexibility and distributed exercises, is seen as an opportunity by stakeholders [15]. *Timeline of exercise.* In summary, a digitalized timeline is believed to enable better overview and more structured planning. *Support short, module-based exercises.* Exercises are too few and far in-between, due to planning and implementation being very time consuming. Digitalization is thought to enable more frequent, shorter exercises. *Accessible independent of platform.* This category is similar to what above is referred to as mobile access. However, from a trainee's perspective the need for platform independency was emphasized. *Ease-of-use.* While exercises is seen as an integral part of building and maintaining skills and functions related to crisis management, a recurring point of view was that there are several barriers, for example staff turnover, keeping organizations from exercising as much as needed. Digitalization can possibly make it easier to exercise more

often and with more actors/trainees. *Supporting multimedia content.* The need for a realistic and varied exercise that provides learning for all trainees was expressed and this could be realized by different multimedia elements which could also contribute to making exercises more fun. *Flexibility in time and place.* This category pinpoints the need for flexible distributed exercises that could include for instance asynchronous as well as synchronous modules.

4. Results and Analysis

In this section, we present the results of our study and briefly describe each category. In most cases, we also provide examples of how the category appears in the interviews. Some of the categories occur more often than others; however, in the presentation below we disregard this and instead present the categories given in the order in [15]. The categories are also divided into and presented as *overall requirements* and *requirements connected to the trainees' role*. In this section, trainees are referred to as respondents.

4.1. Overall Requirements

Support of the entire process from planning, invitation, execution, and evaluation to bringing back identified needs for improvement to the organization. Evaluation was discussed in the interviews. The respondents had differing views on when and where the evaluation should take place. Respondent 2 (R2) argued for keeping the entire process within the exercise tool:

> No, I think it is best to have it in the tool. Each new thing you have to learn is an obstacle. (R2)

Respondent 1 (R1) instead argued for evaluation in an IRL setting:

> […] but I think after the exercise […] you could have a physical meeting where you have an evaluation seminar […] (R1)

After the exercise, it became clear that the trainees' input into the tool was limited to the results of their process and did not include the process as such. Questions regarding the process (and product) were therefore asked during the interviews. The respondents' discussions could be summarized into two overall strands, one dealing with the problem of not being able to observe the process and one dealing with possible solutions. An example of the first strand from Respondent 1 points to one of the reasons why the process is lost:

> […] that which appears in the text is very constructed you know, and it is the result of what you decide through a process. And then you need to keep it as short as possible too. (R1)

An example of the second strand from Respondent 2 points to a solution where a chat function could be used to capture the discussion and parts of the process:

> Yes, you could add another text in the current exercise saying that you can chat to each other without submitting and saving, so that you kind of can save several times and continue. Having an explanatory text could've solved a lot very easily. And I think that if you had, when you are in different places, then […] those who are not actively participating in the conversation […] would've been able to see how the discussion panned out, what the first ideas were, and how it developed. (R2)

Mobile access. Only Respondent 1 referred to something that could be related to the category mobile access, saying that the tool is a good complement to traditional tabletop exercises due to its mobility:

> Yes, as I said, having this type of tool as a complement to traditional crisis training exercises and tabletop exercises and double-sided exercises, sort of. […] And as I said, it is a good way to train effectively without needing too much surrounding organization and needing to bring people together and so […] (R1)

Timeline of exercises. In this category, the respondents talked about the pace of the exercise. Respondent 1 mentioned that it would be interesting to stretch the boundaries of the exercise, including more people and/or playing it out over a longer period. Both respondents also touched on the (general) upper and lower limits to the pace of an exercise. For instance, Respondent 1 suggested:

> […] Later, of course, you can increase the difficulty depending on who is training. If it is a well-trained group, you can dial it up and then they get a very short time to complete a module, maybe […] (R1)

Respondent 2 mentioned:

> But I think it will be hard to take breaks, longer breaks, in this type of exercise, because it is, doing an exercise on this [type of small scenario] is just a tiny little thing […] (R2)

Besides that, both respondents mentioned that the pace of the conducted exercise was appropriate:

> No, I thought it was very comfortable, sort of, and you had enough time […] (R1)

> No problems at all. It becomes very clear when doing it like this that there is a rather natural number of modules too […] (R2)

Support short, module-based exercises. According to the respondents, each module took an average of roughly 30 minutes to complete. The synchronous module was considerably more time consuming than the asynchronous modules.

4.2. Requirements Connected to the Trainees' Role

Accessible independent of platform. The respondents mostly used their PCs for working on their assigned tasks. Respondent 1 thought this was comfortable:

> No, I mostly saw advantages to that. You are kind of at home […] So that felt good. And then it felt good [that] you also had access when you were where you were, so I could look in […] my files, contingency plans and so on. No, it felt comfortable with the computer, I think. (R1)

Both respondents felt that a mobile screen would be a bit too small, even though the tool from a design perspective was thought to be well adapted to mobile use. Respondent 2 said:

> Yes, you are considerably more limited if you're sitting with a mobile and can only write with two fingers instead of ten, and the size too, you don't get the same amount of text on the screen. So it would've, eh, the homepage was very well adapted to mobile use and it worked really well, almost better. Eh, if you look at the possibilities it was better adapted to mobiles than PCs. (R2)

Ease-of-use. The respondents' discussions could be summarized into two overall strands, one comprising examples where the tool was easy to use and one dealing with problems and sometimes solutions to problems. Examples of the first strand from each

respondent deal with ease-of-use in relation to the start of the exercise, as well as working asynchronously in the tool:

> […] No, as I said I think the level was really good, so that it was this basic when you kind of start with such an exercise. […] (R1)

> No, I thought that bit was very clear. I had no problems at all with how it was, with the design. It was very pedagogical and clear. […] (R2)

> It worked without any problems, it was simple and clear – 'write here, answer here' […] (R2)

In the second strand, the respondents discussed problems surrounding the use of terminology, the login process as well as the platform of the tool being designed for asynchronous usage, thus making synchronous usage difficult in some respects. For instance, Respondent 2 said that what the other trainee had written was invisible, until Respondent 2 had published a text of his/her own or had reloaded the webpage:

> […] but when we worked synchronously, the others' texts didn't appear if you didn't save [submit] your own text […] (R2)

As a solution, Respondent 2 elaborated on the use of a chat function:

> […] If we hadn't been sitting together it would've been good to have some kind of chat function perhaps, or if you include it more in that text box […] (R2)

Support multimedia content. Both respondents suggested that sound could be a possible multimedia feature that could improve the tool. Respondent 2 also suggested video as a possibility and elaborated on when to use such features and when one should stick to the written word:

> […] But then I think that the final decisions themselves, or the end of each module, should be in writing. It is easier to summarize, easier to go back to if you are somewhere where it is inappropriate to play sounds, or maybe impossible, and then it also […] becomes clearer what it is about. You can get away from tone and those things too, but then it is 'this is how it is'. (R2)

Flexibility in time and place. Respondent 1 identified an upper and a lower limit to the number of synchronous modules that is appropriate for this type of exercise. With no synchronous modules, there are certain issues/challenges that will be difficult to handle. With too many synchronous modules, the benefits of this type of exercise, e.g. its flexibility, will be lost. Respondent 1 said:

> […] While at the same time not tying oneself too much to time and place, but retaining the good parts of this too. (R1)

Both respondents also elaborated on the circumstances under which it is appropriate to have synchronous modules, concluding that it could be appropriate when making decisions together, having discussions or creating a common understanding:

> […] when you need to arrive at something together then synchronous is so much better […] But if you need to discuss something or get a joint picture, absolutely. (R2)

The respondents elaborated on flexibility with regards to place. Respondent 1 argued that one of the benefits of this type of exercise tool was the ability to conduct distributed

exercises, regardless of place,

> […] but I think much of the advantage of this is that you should be able to sit in, in another location or so. (R1)

For the synchronous section, the trainees chose to sit together and do the assignment. Respondent 1 realized that it was possible to be in separate places:

> […] But later, yes then it will be different, we are so close to each other here – obviously if [Respondent 2] had been in [place] and I had been here like… So it was no problem […] (R1)

Yet, as Respondent 2 agreed, it is always better to sit together if possible:

> Clear advantages, if you can, to meeting in person, so you should do that. It is easier to talk, it just is. You are more limited in writing, both in speed and in tone, expression, and… So I thought it was very good […] (R2)

Respondent 2 also pointed out that the tool as currently constructed is not perfectly suited for working synchronously while trainees are in different locations:

> […] If we hadn't sat together it would've been good to have some kind of chat function maybe, or if you include it more in that textbox, but as it is now, the format does not give you much room for having, well you don't get the idea that that you can have like questions for the others, like a conversation […] (R2)

5. Discussion

In this section, we discuss the aim of this pilot study, which was *to take a first step towards exploring the boundaries of digital crisis training by elaborating and further developing requirements for digital crisis training tools*. There were four requirements that stood out where the respondents elaborated and gave further nuances of the requirements.

First, related to the requirement *support of the entire process from planning, invitation, execution, and evaluation to bringing back identified needs for improvement to the organization*, the respondents discussed at length the importance of being able to capture the process behind their decisions. As constructed, the input into the tool, based on the trainees' decisions, is limited to the result of their process alone. For evaluation purposes, this is problematic as it is impossible to see the reasoning behind the trainees' decisions and makes it difficult to identify needs for improvement to the organization as well as the individual. As a solution to this problem, both respondents suggested implementing a chat function in which the trainees could discuss more freely before making a decision and typing it into the tool. This requirement is in line with Reuter et al. [22], while arguing that the entire process should be kept within one system (tool). The respondents' diverging views on this issue, where Respondent 2 argued in line with the requirement and Respondent 1 argued to keep part of the evaluation separated in seminar form, shows that it might be good to be flexible and allow parts of the process to be lifted out of the system (tool) if it is convenient and desired.

Second, related to the requirement *timeline of exercises*, the respondents discussed the pace of the exercise and identified both an upper and a lower limit. The respondents were satisfied with the pace of this particular exercise. For example, Respondent 2 thought that two modules per day felt natural as a regular workday can also be divided into two parts, before and after lunch. Respondent 1 argued that the pace of the exercise could be adapted to how experienced the trainees are – a higher pace, meaning for example more stress, could be applied for groups that with much prior experience of crisis training. Respondent 2 had thoughts on the lower limits of pace. If the exercise had spanned more than three days, for instance, it could be good to lower the pace to one module per day, so that the

trainees are not exhausted. The respondent also mentioned that it would probably not be a good idea to have rest days in-between exercise days, as this would make it difficult for trainees to maintain their attention on the exercise.

Third, related to the *ease-of-use* requirement, the respondents on several occasions expressed that the tool (including the content of the exercise) was in general easy to use. However, on several occasions the respondents pointed out problems accompanied by solutions that could be expressed as nuances of existing requirements or even as new requirements. The problems (including the solutions) could be divided into two: problems of a more technical nature or of a more operational nature.

Three technical issues stood out: the importance of terminology and having clear instructions; having the functionality to save drafts; and adapting the tool to suit both synchronous and asynchronous modules, which would enable the use of a real-time chat function.

Two operational issues stood out. First, the respondents discussed limits to the number of trainees, where Respondent 1 thought that it was easy to only have one counterpart in the exercise while Respondent 2 said that more than five trainees might make an exercise messy and cluttered. Second, the instructions need to be very clear otherwise the trainee will make assumptions on what the challenges were and how to tackle them. Respondent 1 gave an example of this kind of assumption when talking about the length of the text typed into the tool, where the assumption was that the text should be as short as possible. This assumption may lead to less data for evaluation purposes and for other trainees to relate to. It also decreases chances of revealing parts of the process behind the input in the text. Assumptions and interpretations might also affect the direction of the exercise if the trainer does not intervene and explain what the trainees are supposed to do. This is in line with Tena-Chollet et al. [28], who stated that good training systems (tools) depend on pedagogical exercise design and execution.

Fourth, related to the requirement flexibility in time and place, the respondents discussed the upper and lower limits for synchronous modules. Respondent 1 felt that too many synchronous modules would be too similar to a traditional tabletop exercise, which would go against many of the requirements that this tool is based on as well as the findings from Adler et al. [1]. It can be noted that respondent 1 referred to his/her ability to look in "my files, contingency plans and so on" just as reported in [25]. Both respondents said that at least one synchronous module per exercise is necessary, as it is important to have active discussions and reach joint decisions.

The respondents discussed their reason for sitting together during the synchronous module by simply stating that if there is an opportunity to sit together and talk it is the easiest option. Respondent 2 argued that if they had chosen not to sit together it would have been a bit difficult to solve the task at hand without some kind of chat function. A chat function has been proposed as a solution to problems related to several requirements. This is in line with findings in Toups et al. [29] and Lukosch et al. [13].

Overall, our study also confirms that it is not necessary for a crisis training system to be high-fidelity to be considered useful by the trainees (c.f. [29]). Moreover, the respondents' comments about where to perform the evaluation, what a suitable length, pace, and difficulty level for an exercises are, etc. support the need for a well-planned teaching strategy and training environment as suggested by Tena-Chollet et al. [28].

Not all requirements of [15] were addressed in the interviews because these interviews were of an exploratory character. This study is part of a larger project where the requirements have been collected and discussed with stakeholders on repeated occasions and the tool has been built based on these requirements which influenced the data collection process. The fact that not all requirements are discussed by the respondents could be due to the limited number of trainees, the size of the exercise and the overall purpose of the exercise.

Finally, the four requirements that the respondents elaborated on can be related to what was addressed in [18] as incomplete and/or hidden requirements. In other words, the boundaries of the four elaborated requirements could be viewed as incomplete and/or hidden portions of the requirements as presented in [15]. System boundaries were

addressed in [19], which in our study can be related to the boundaries of the addressed requirements.

6. Conclusion and Future Work

The aim of this pilot study was *to take a first step towards exploring the boundaries of digital crisis training by elaborating and further developing requirements for digital crisis training tools*. Four requirements have been elaborated on and within three of these, different aspects of digital crisis training boundaries have been elucidated, namely the pace of the exercise, the number of trainees and the number of asynchronous and synchronous modules. Another key discovery of this study is the challenge of capturing the decision-making process behind the trainees' input into the tool.

This study has confirmed that exploring the boundaries of digital crisis training is an important endeavor. While this pilot study is small in scope the results are still an important contribution and point the way forward for future research. One more exercise was conducted in this project while writing this paper and more exercises are planned in the near future, creating an opportunity for more in-depth research.

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