Evaluation of Tabletop Exercises in Emergency Response Research and Application in the Research Project SORTIE

Pauline Tobergte
TH Köln
pauline.tobergte@th-koeln.de

Alena Knispel
TH Köln
alena_charlotte.knispel@th-koeln.de

Lennart Landsberg
TH Köln
lennart_walter.landsberg@th-koeln.de

Ompe Aimé Mudimu
TH Köln
ompe_aime.mudimu@th-koeln.de

ABSTRACT

This paper presents the fields of application of the tabletop exercise in emergency response by explaining the method in emergency response research. The authors illustrate the tabletop exercise of the Institute for Rescue Engineering and Civil Protection (IRG) of the TH Köln in a research project on Sensor Systems for Localization of Trapped Victims in Collapsed Infrastructure (acronym: SORTIE) as an application example. Subsequently, the quantitative and qualitative evaluation methods used generally and specifically for the tabletop exercise of the research project SORTIE are considered, and the technical implementation is explained. The evaluation method used in the tabletop exercise consists of three sub-areas (participant survey; exercise observation; photo, video and audio recordings). Further, the analysis of the evaluation using statistical tools is explained. Finally, this paper refers to possible sources of error in the evaluation of tabletop exercises, such as exercise artificiality and subjectivity of the exercise observers.

KEYWORDS

tabletop exercise, training, observation, evaluation, emergency services

INTRODUCTION

Tabletop exercises can help to study complex structures and processes (Kriz and Lisch, 1988, p. 200) and bridge the transition from "knowing" to "doing". The interactive learning environment promotes new ways of thinking and acting, systematic understanding of processes, and trains the interaction of several actors through the representation possibility of realistic, complex situations. Tabletop exercises help to broaden the spectrum of observation, recognise feedback from one's actions, promote readiness to cooperate, and translate strategies and concepts into decisions. (Rathert, 2003, p. 2)

Within the German fire brigades, this method has been used since the end of the 19th century to train incident commanders and prepare and follow-up operations (Rempe et al., 2014, pp. 11-19). The primary aim is to train the analysis of problems, consider alternatives, develop strategies and tactics, and make decisions in the group or individually (Massing, 2004, p. 165). In research, the tabletop exercise can develop and justify hypotheses/theories and obtain data for empirical testing (Kriz, 2009, p. 568). It can thus be applied in emergency response research to test insights gained in a closed setting.

This paper presents the possible applications of tabletop exercises in emergency response research. It will also show how data can be collected during a tabletop exercise and lead to new findings. As an example of the practical

implementation of the evaluation, the tabletop exercise in the research project SORTIE will be presented.

METHOD OF TABLETOP EXERCISES

The difference between a tabletop exercise and a case study is that scenarios can also be simulated, which have not yet occurred, i.e., which are merely possible. In a tabletop exercise, unlike in a case study, the participants do not take on the role of an outside consultant but are part of the organisation that has to deal with the task. In contrast to role play, no concrete behavioural strategies are trained, but the handling of complex systems in a dynamic situation. There are more rules and framework conditions in tabletop exercises than in role play. (Ameln and Kramer, 2016, p. 153) However, role plays and case studies or case situations can always be part of a planning exercise (Blötz, 2015, pp. 30-32) so that the most beneficial elements can be incorporated.

In emergency response, tabletop exercises can be an extension of a (police) plan meeting and can serve as a preliminary stage for tactically larger exercises, such as staff frame exercises and full-scale exercises. This is particularly useful as preparation for inexperienced leaders. Tabletop exercises are associated with less planning, implementation, financial, organisational, and personnel effort than full-scale exercises. (Siemon, 2013, pp. 6-7; Bittner et al.,2018, p. 410; Rempe et al., 2014, pp. 11-12; Hofinger and Heimann, 2016, p. 239-240) Tabletop exercises are thus a cost-effective, efficient method of testing plans and procedures with an increased degree of realism (Chen et. al., 2003, p. 81). This is also easier in tabletop exercises in many cases, as all practitioners are usually on site (Hofinger and Heimann, 2016, p. 259) and can thus formulate and provide feedback directly to the participants and the exercise manager during the discussion phases.

The initial situation in a tabletop exercise involves a (fictitious) problem to be solved or a decision to be made. The task can be formulated in an open or closed manner, whereby the predominant closed variant is characterised by fixed rules and framework conditions as well as homogeneous cooperation of the functions and a controlling authority (exercise manager) (Blötz, 2015, p. 51). The participants move around in a fictitious environment (e.g., a staff room or a situation model (diorama)) (Geuting, 1992, p. 27; Grob, 1995, 15 ff.). A diorama can be equipped with building models, roads, vehicles, as well as people, animals, and others (Rempe et al., 2014, p. 11). However, being equipped with pen and paper and/or forms, rooms, and maps is sufficient for implementing a tabletop exercise (e.g., in a staff room) (Blötz, 2015, p. 258). PC-supported interactive exercises can also be realised (Blötz, 2015, p. 47). VR implementations were shown to have advantages especially in terms of cost and personnel expenditure as well as in terms of realism (Siemon, 2013, pp. 6-7; Rempe et al., 2014, p. 19) and, for example, provide a better understanding of the scenario through the use of interactive maps (Zhou et al., 2015, p. 222). However, this seems less suitable for local scene, as described in the project. In addition, temporal stretching and tightening, if necessary, cannot be implemented either (Rempe et al., 2014, p. 20).

The minimum personnel required for a tabletop exercise includes at least one exercise manager (Dittmar et al., 2012, p. 320) and one participant. The participants take on roles (competing or also working together) and interact with each other, sometimes separated from each other, in the simulated decision-making world (Geuting, 1992, p. 27; Grob, 1995, 15 ff.), whereby the existing situation and limited resources determine the framework for action (Ameln and Kramer, 2016, p. 150). It is also important to consider the frame of reference (e.g., operations centre or crisis team) (Blötz, 2015, p. 47).

As part of the preparation, a flexible script must be defined, as the course of the tabletop exercise depends mainly on the behaviour of the actors involved. The scenario should be based on real disaster situations. (Hofinger and Heimann, 2016, p. 259) Some information about the situation is already provided to the participants at the beginning or fed in by the exercise manager during the tabletop exercise (e.g., when the situation changes), such as maps, plans (Rempe et al., 2014, p. 11) or information about resources (Dittmar et al., 2012, p. 320). By speeding up events but moving through the decision-making cycle much more slowly (Blötz, 2015, p. 18), complex actions of the command functions can be broken down into small steps (Rempe et al., 2014, p. 19) and decisions can be checked directly by feedback from the exercise manager, whereby the consequences of certain actions cannot be predicted by the participant (Rempe et al., 2014, p. 5).

Procedure of a Tabletop Exercise (on a Diorama)

At the beginning of the tabletop exercise, the participants can be given a deployment dispatch with all relevant initial information. The task forces then arrive at the model of the operation site with corresponding vehicle models (Rempe et al., 2014, p. 21). They set up the vehicles and secure the scene (Rempe et al., 2014, pp. 56-57). This is followed by a reconnaissance of the situation on the model (Rempe et al., 2014, p. 62) and an assessment through hazard analysis, prioritisation, and consideration of tactical options (Rempe et al., 2014, pp. 67). After the selected measures have been communicated to the exercise manager, feedback on the success as well as information about changes in the situation are given. The command cycle is continued until all hazards have been eliminated (Rempe

et al., 2014, p. 143). This procedure is based on the command cycle described in the German fire service regulation 100 (FwDV 100). It is possible to adapt the command and decision-making process to internationally valid guidelines in the tabletop exercise (e.g., the INSARAG-Guidelines for the international scenario in SORTIE).

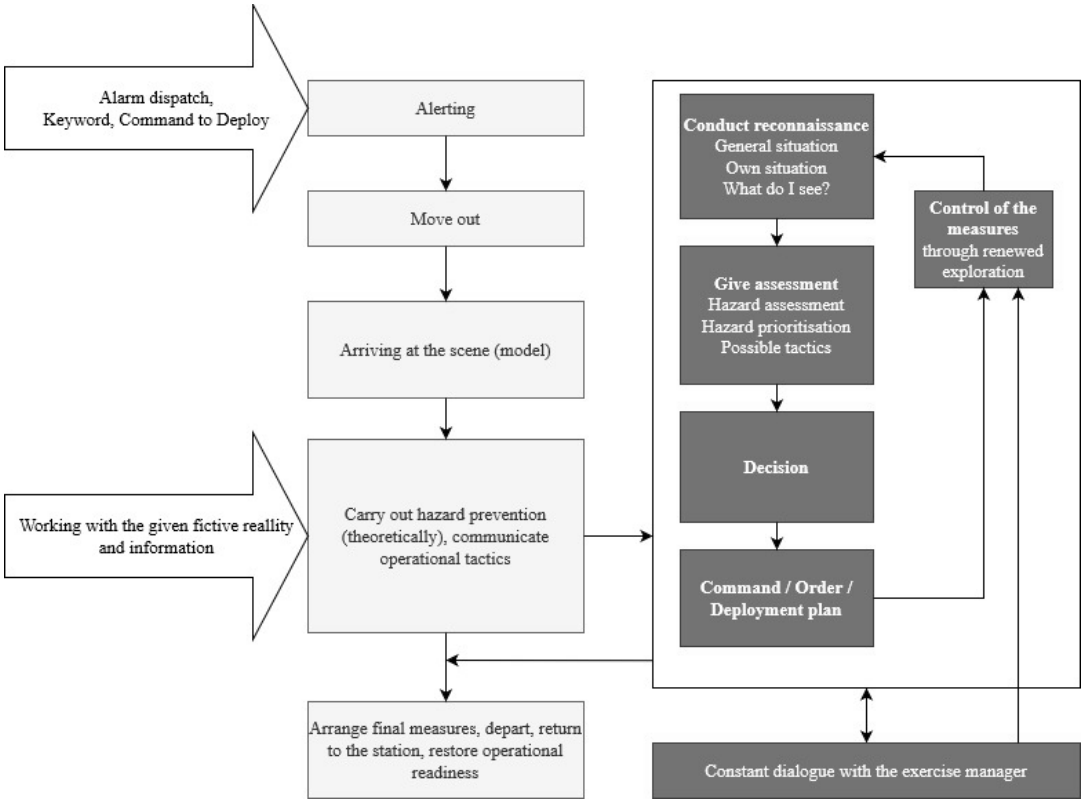

Figure 1: Procedure of a tabletop exercise based on the German FwDV100

The participants must constantly communicate their thought processes to the exercise manager during the tabletop exercise, justify their decisions and reflect on them, so the exercise manager helps them with this or communicates changes in the situation as a reaction to the measures taken (Rempe et al., 2014, p. 19). During the tabletop exercise and afterwards, observation and self-reflection or feedback by the observer and exercise manager must be possible (Hofinger and Heimann, 2016, p. 258).

Application in Research

Tabletop exercises are also used to evaluate research in emergency response. The LÜKEX exercises ("Federal and Interdepartmental Crisis Management Exercise" of the Federal Office for Civil Protection and Disaster Assistance and the Federal Ministry of the Interior) in Germany are conducted annually and serve to review national crisis management and the cooperation of the government and the federal states with critical infrastructures based on fictitious crisis and threat situations, and to identify a further need for action. Topics already covered in the past include Critical Infrastructure Failure (2004, 2011 and 2018), Natural Hazards (2004 and 2015), Biological Hazards (2013 and 2007) and Terrorist Threats (2005, 2009 and 2010). (Breuer et al., 2019, p. 15)

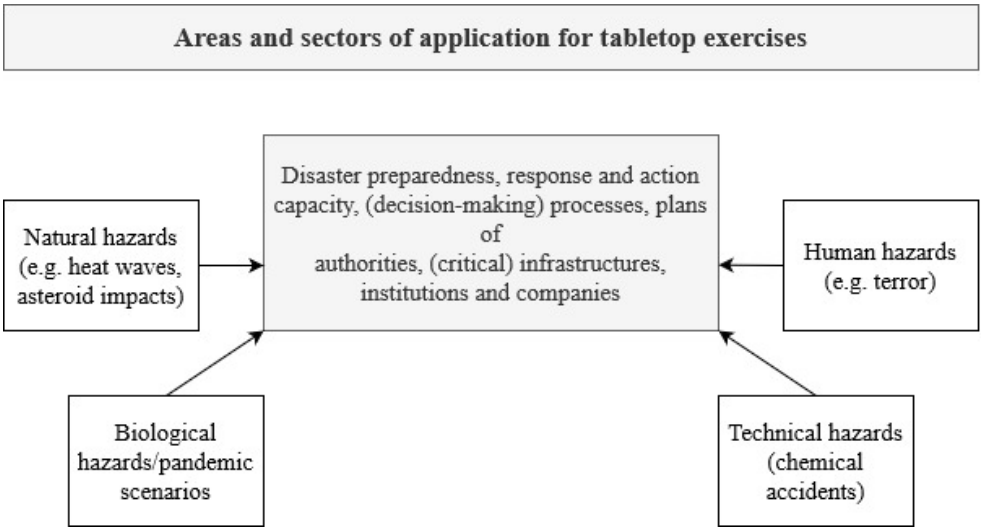

Figure 2: Some possible areas of application that have already been processed (according to Boslough et. al., 2015, p. 43; Breuer et al., 2019, p. 15; Chandra et. al., 2015; High et. al., 2010; Wendelboe et. al., 2020, p. 4)

In the literature, various areas of application of the tabletop exercise can be found with regard to hazard prevention research (Fig. 2). However, a higher tactical level seems to be tested here for the most part. In SORTIE, a tabletop exercise was used, which concentrated on the work at the damage site.

Among other things, the implementation of an unmanned aerial vehicle to search for buried victims in existing national and international emergency response and command structures was tested on a diorama (Schmitz et al., 2019; TH Köln, 2021). The ongoing project SORTIE is developing and implementing a modular platform with different detection technologies for the search for buried persons with an unmanned aerial vehicle. To this end, a planning exercise has been carried out in the laboratory to check the implementation of the system in the existing operational procedures and the flow of information and, if necessary, to identify further needs for improvements to the system. (TH Köln, 2021)

As part of the SORTIE project, an adapted command and control structure was designed to integrate new technology into existing operational procedures. The aim of the tabletop exercise was to evaluate the interaction of the participants in this new and unfamiliar command structure, with several functions to be observed simultaneously. Due to easier observation and evaluation, it was therefore decided to conduct a planning exercise on a diorama on site, which was built specifically for the defined scenarios and equipped with corresponding building models made for the project. The focus of the project was not on the development of the tabletop exercise or the realisation of a virtual reality implementation. The realism should be ensured in the further course of the project through a real exercise. The participants in the exercise were emergency forces who had experience from national and international operations and would later use the system in this context. The feedback from the participants showed that such tabletop exercises are rarely conducted for international operations.

EVALUATION OF TABLETOP EXERCISES

Evaluations systematically examine and record content or methods, and must be related in time to the tabletop exercise (Renneberg and Hammelstein, 2006; Keim, 1992, p. 202). In evaluations, a distinction must be made between quantitative and qualitative evaluation methods and evaluation methods within and outside of emergency response.

In quantitative evaluations, standardised measuring instruments are used on the one hand, and on the other hand, numerical measured values are collected under controlled conditions and statistically analysed. This makes it possible to test theoretical hypotheses. (Döring and Bortz, 2016, p. 23) Methodologically, standardised surveys, standardised observation and standardised content analyses are used (Möhring and Schlütz, 2013, p. 184). In the standardised survey, the participants provide information about themselves and their sensitivities, and their personal opinions can be recorded. However, the disadvantage of this method is that the answers are only limited to the questions used in the survey. (Möhring and Schlütz, 2013, pp. 184 - 185; Braukmann and Hübsch, 2010b, p. 113) Standardised observation involves the recording of participants' behaviour and reactions and a subsequent objective assessment of these (Braukmann and Hübsch, 2010b, p. 111; Gehrau and Schulze, 2013, p. 329). In systematic content analysis, textual and visual messages are evaluated descriptively using defined categories to

minimise complexity. For this reason, the content analyses are irrelevant for the evaluation of the tabletop exercise. (Rössler and Geise, 2013, pp. 271, 330)

In qualitative evaluations, the main methods used are group discussions and expert or leading question interviews (Flick, 2007, p. 11, 2009, pp. 14 - 15). In group discussions, the individual opinions of the individual participants can be recorded. The advantage here is that individual opinions can be recorded spontaneously through discussion and referenced to differentiated views (Liebig and Nentwig-Gesemann, 2009, p. 103). The interviews, especially the guided expert interview, make it possible to capture knowledge. In doing so, the interviews are structured thematically and with questions that encourage storytelling. (Liebold and Trinczek, 2009, p. 35)

Evaluation outside of Emergency Response

For tabletop exercises, in addition to the evaluation methods already presented, there are other methods such as the learning diary and the follow-up: episodic interview.

The learning diary is intended to support the processing of the learning material by sorting, filtering and organising thoughts through writing (Braukmann and Hübsch, 2010a, p. 57, 58). In addition, the learning diary can be used to apply survey and analysis methods for quantitative and qualitative analysis of the (learning) process (Ehmann, 2009, pp. 73, 87).

The follow up: episodic interview is intended to check the sustainability of the learning success from the tabletop exercise and its implementation in everyday life. It takes place within a defined period of time after the simulation (Amelang and Schmidt-Atzert, 2006; Lamnek and Krell, 2005).

Finally, the subjective impressions of the exercise manager and the observers can be recorded and taken into account. Here, too, the resulting holistic view of the tabletop exercise can provide further important data, even if it does not correspond to a scientific method. (Braukmann and Hübsch, 2010b, p. 122).

Evaluation within Emergency Response

In emergency response, tabletop exercises are used to objectively and verifiably assess the performance of participants in career or selection examinations. It is important that the personal opinions of the examiners cannot determine success or failure. In order to be able to guarantee this necessary objectivity, a proper evaluation must be carried out and recorded. (Rempe et al., 2014, p. 145)

Within emergency response, so-called tabletop exercise evaluation forms are predominantly used for evaluation (Rempe et al., 2014, pp. 145-146). One variant is the evaluation sheet of the NRW State Fire Brigade School, the “Institut der Feuerwehr (IdF) NRW”. Another variant is presented within the book "Das Planspiel als Entscheidungstraining" (The tabletop exercise as decision-making training).

Evaluation within the Research Project SORTIE

Within the project SORTIE, a new method was developed from known social science methods to evaluate the tabletop exercise in the best possible way with the existing extraordinary evaluation techniques. The advantage here is that the basic methods are easier to apply and already known to many participants of the tabletop exercise, and moreover, more valid results can be obtained. In addition, the interaction of different parts of the method enables a holistic data collection, which means that the results needed for the project can be reliably collected. Furthermore, the exact alignment of the method with the objectives of the tabletop exercise and the SORTIE project ensured comprehensive data collection. Another advantage is that the predominantly quantitative design of the method greatly simplified the evaluation. Qualitative methods were often used in the past, which take much time to evaluate and do not necessarily provide comparable results. A disadvantage of the quantitative design can be a possible loss of data due to the preconceived questions and answer options; this is counteracted in the evaluation method by formulating a few open-ended questions.

The subject of the evaluation method was the implementation of the system in the national and international operational command structure and the operational procedure. The primary objective was to check the implementation, the procedure in existing standards and guidelines, the acquisition of information, the selection of the sensor packages to be used, the transmission of information and the increase of speed in the rescue of buried victims.

The evaluation method used in the project SORTIE consists of three parts:

1. questionnaires for interviewing the participants
2. observation sheets for the exercise observers
3. photo, video and audio recordings

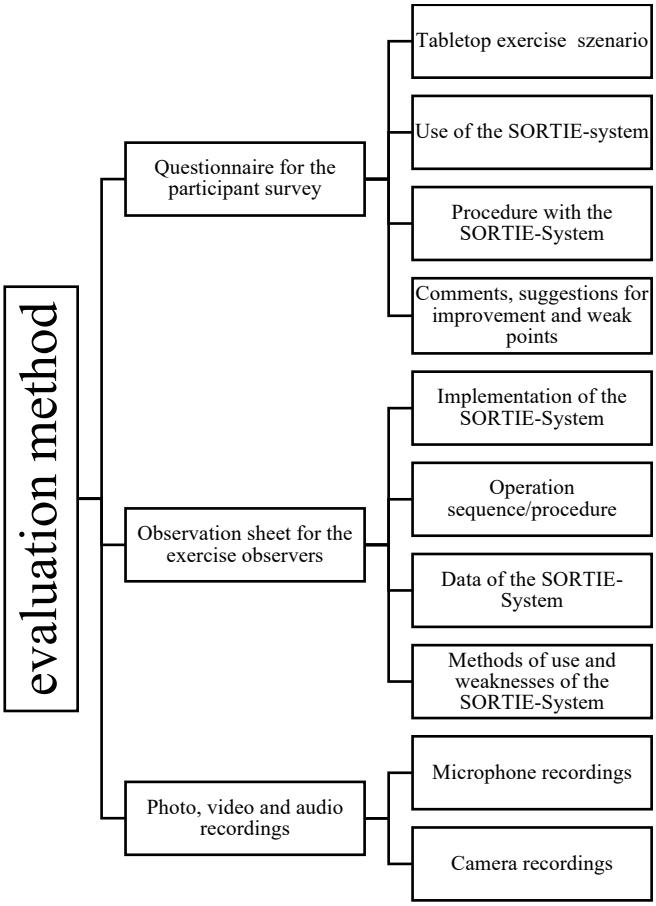

Figure 3: Evaluation method in the research project SORTIE and its thematic areas

Questionnaire for the Participant Survey

When formulating and designing the questionnaire, it is important to remember that the participants are experts in their respective fields, and therefore the data collected is of corresponding quality. The fact that the survey is conducted in a standardised form ensures comparability, assessment, evaluation and interpretation of the evaluation object. For this purpose, an evaluation questionnaire consisting of closed and multiple-choice questions was developed in the quantitative evaluation method.

Due to the described design of the questionnaire, some aspects of the tabletop exercise may not be covered. For this reason, the standardised survey must be supplemented with some open questions. In this way, a holistic view of the tabletop exercise and, based on this, a fully comprehensive data collection can be assumed.

The developed questionnaire includes the name and position of the participant and the following four topics:

1. tabletop exercise scenario
2. use of the SORTIE-System
3. procedure with the SORTIE-System
4. comments, suggestions for improvement and weak points.

The questionnaire is three pages long and contains 20 mainly closed-ended questions. Respondents are given four possible answers (agree, tend to agree, tend to disagree, disagree), which ensures that the participants' answers always show a tendency. Four questions are open-ended, and closed-ended ones are followed by two other open-ended questions. The questionnaires were adapted to the national and international tabletop exercise scenario, whereby only the underlying standards and guidelines and the procedure were adapted for the comparability of the data.

Figure 4 shows an excerpt of the developed questionnaire:

Subject area 1: Simulation scenario

Please tick the appropriate box	Agree	Rather Agree	Rather Disagree	Disagree
(1) The scenario of the simulation game was realistic.				
(2) The scenario was realistically presented on the simulation board.				

(3) What praise and/or criticism do you have of the simulation and/or the scenario?

_____

_____

_____

_____

Figure 4: Subject area 1 of the Questionnaire for the Participant Survey

When conducting the survey, it was decided to use analogue questionnaires in paper format, as it could not be ensured that all participants of the tabletop exercise would carry a mobile device with them and thus be able to participate in the context of a digital questionnaire. In this way, it was ensured that all important data could be collected immediately on site by all participants.

Observation Sheet for the Exercise Observers

The assigned exercise observers monitore the participants of the tabletop exercise and the use of the system and document this. For targeted and objective data collection based on a standardised observation, so-called observation criteria are defined. These are answered by category systems. For a comprehensive data collection and a holistic view of the tabletop exercise, an additional open-ended observation is necessary. For this purpose, measurability criteria and tools for open observation were developed to ensure objectivity, precision and uniform documentation of the open observations and contribute to a simplified evaluation. The measurability criteria specify which observations are to be documented within the framework of the observation criteria. The tools include various documentation specifications, such as tables or management organisations, which are only to be supplemented by the observers. The observations are to be documented in a prefabricated observation form.

Within the evaluation concept, the exercise observers were divided according to the subject areas specified in the observation sheet; in addition, there is a free and person-related observer. The exercise observers must be trained in advance to coordinate the understanding of the individual observation criteria.

The developed observation sheet includes the name and the function to be observed as well as the following four topics:

1. implementation of the SORTIE-System
2. operational sequence/procedure
3. data of the SORTIE-System
4. modes of operation and weaknesses of the SORTIE-System.

The observation sheet includes 16 observation criteria, which can be considered both closed-ended and open-ended for holistic data collection. The same category system was used for the questionnaires for the closed observations. For the open-ended observations, measurability criteria were defined, and tools for documentation were developed to match them, thus ensuring the objectivity of the observations. The observation forms were also adapted to the national and international tabletop exercise, whereby only the underlying standards and guidelines and the procedure were adapted for the comparability of the data.

Figure 5 shows an excerpt of the developed observation sheet:

Subject area		Observation criteria	Quantitative observation Please tick the appropriate box				Open Observation Measurable by
Operation sequence/procedure	3	The SORTIE system is used within the model situation.	Agree	Rather Agree	Rather Disagree	Disagree	Documentation of when and for what the SORTIE system is used in the simulation.
	4	The SORTIE system is used as quickly as possible after arriving at the scene.	Agree	Rather Agree	Rather Disagree	Disagree	Documentation of the time span between arrival and first use of the SORTIE system.

Time	Type of operation
	Arrival of the SORTIE system
	First command to deploy the SORTIE system
	First start or deployment of the SORTIE system, Deployment type:

Figure 5: Observation criteria 3 and 4 of the Observation Sheet for the Exercise Observers

An observation room was set up so that the observers did not influence the course of the tabletop exercise, the participants and thus also the results of the tabletop exercise. The evaluation technique already presented enables precise observation through video and audio transmissions, whereby the observers can switch between different camera perspectives to be able to fulfil their observing task.

Photo, Video and Audio Recordings

Photo, video and audio recordings enable later observation after the tabletop exercise, reduces the exercise observers' workload and make the tabletop exercise reproducible and verifiable, so that questions that were still open or arise later can be answered afterwards. For this purpose, the camera and microphone positions must be determined and tested in advance to obtain usable and comprehensive recordings.

Observations from a tabletop exercise already carried out by the TH Köln in 2018 show that it is possible to carry out observation assignments in a separate observation room utilizing audio and video transmission. However, the technical implementation required improvement, as the number of microphones seemed too small to understand and assign individual spoken contributions in the lab. Moreover, audio and video signals were not well synchronized. (Schmitz et al., 2019, p. 259) The revised evaluation concept for SORTIE is shown in Figure 6.

Due to the change in evaluation technology, the audio recording in SORTIE was done by a camera placed in a bird's eye view above the diorama, which meant that the image and audio signal were matched. The sensitivity was sufficient to follow all conversations in the room. In order to record and evaluate the spoken word of

particularly relevant decision-makers, the incident commander and the operator of the drone were also equipped with a bodycam, which additionally recorded images and audio and transmitted them to function-specific observers (1 and 2, Figure 6). By using cameras with audio recording, all audio signals were transmitted synchronously with the corresponding image track. In addition, an independent observer was equipped with a bodycam, which recorded the events in the laboratory. This material was only viewed after the exercise. One camera showed a room overview, including the clock located in the laboratory. By transmitting the time from the lab room to the observer room, any time offset (1.5 sec.) that might have occurred was counteracted. The participants and observers could thus assign all actions to the same time.

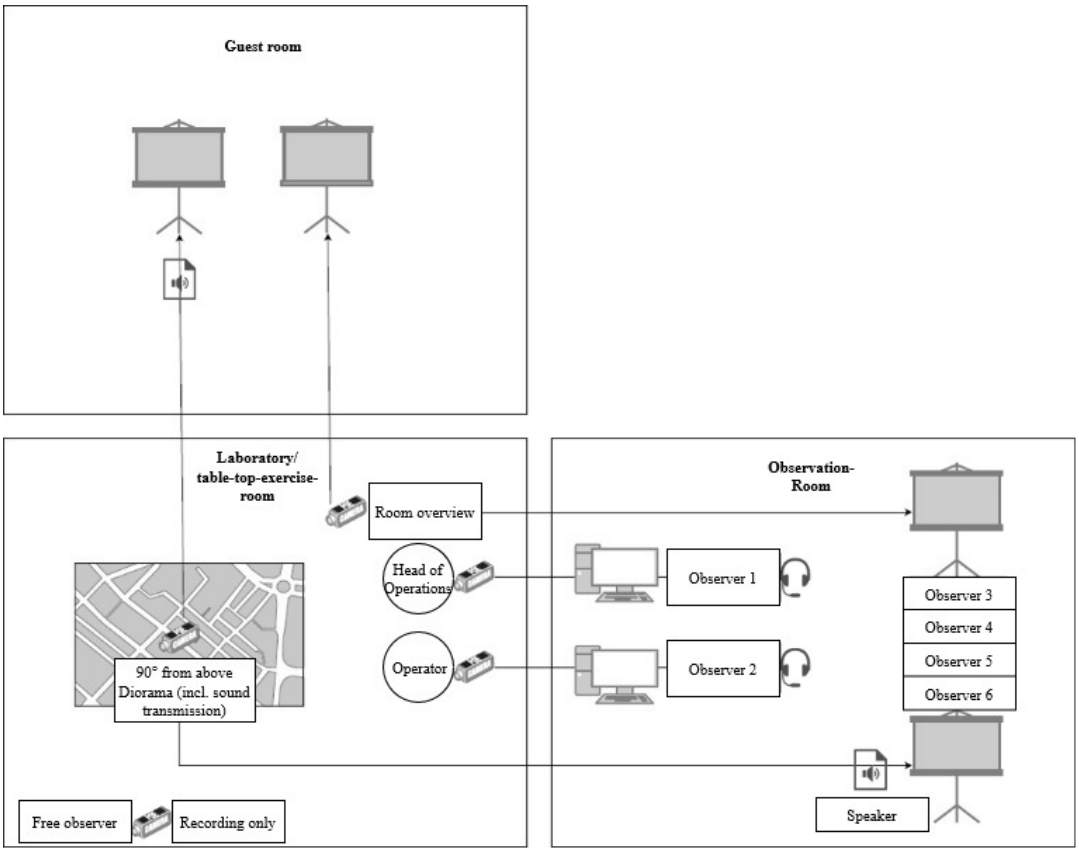

Figure 6: Exemplary technical structure of the evaluation in the tabletop exercise for the research project SORTIE

EXAMINATION OF A TABLETOP EXERCISE (USING THE SORTIE-PROJECT AS AN EXAMPLE)

Different methods were applied within the evaluation of the tabletop exercise for the project SORTIE. The answers of the participants and observers were translated into numbers (agree = 1, rather agree = 2, rather disagree = 3, disagree = 4) and entered into an Excel file. This file and its design should enable a quick and targeted evaluation and a meaningful presentation and comprehensibility of the results.

The methods used include a boxplot, a bar chart, a profile line for the evaluation of the mainly used closed-ended questions and the evaluation of the open-ended questions and observations, which only serve to support and understand the quantitatively collected data.

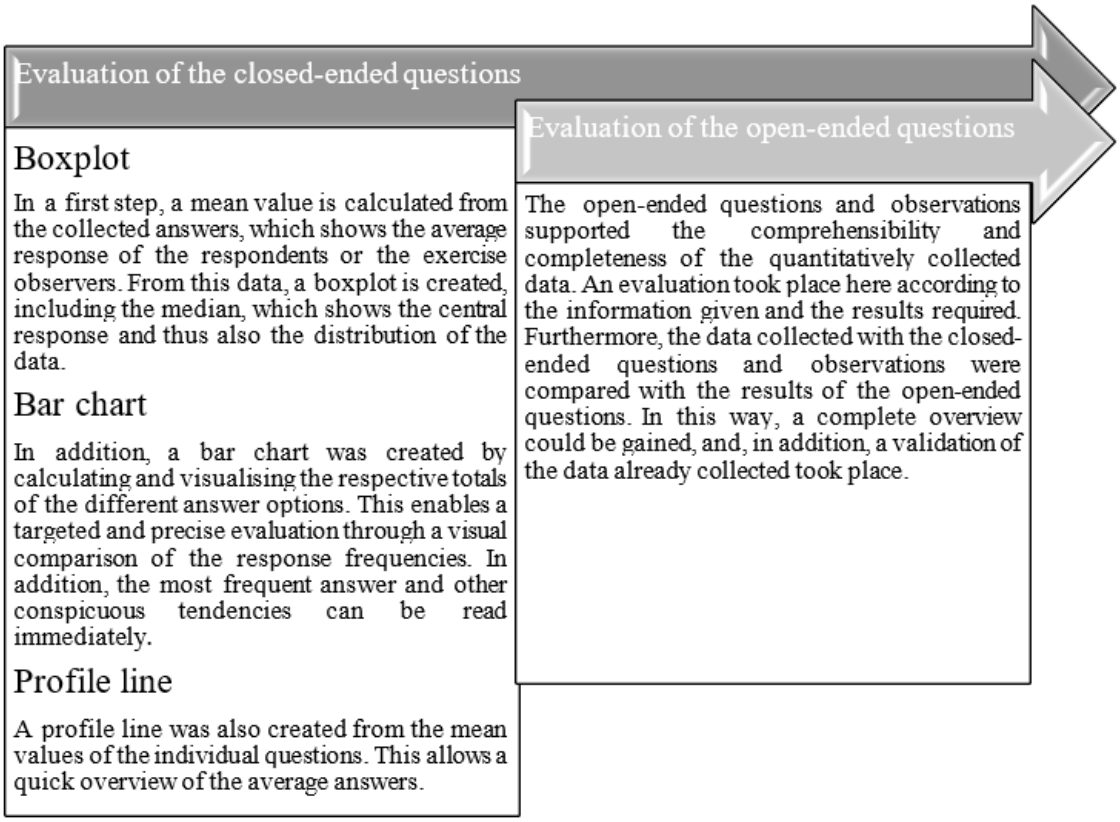

Figure 4: Evaluation of the closed-ended and open-ended questions

RESULTS

The tabletop exercise allows participants to re-enact situations in an artificial environment (Peters and Vissers, 2004, p. 75) and to teach mission leaders the correct behaviour during a mission using a model situation or to prepare and follow up missions according to the given tactical rules (Rempe et al., 2014, 11,18). This can always be tested through a planned exercise with less effort and in a protected environment.

The evaluation method can consist of quantitative or qualitative approaches, whereby mainly quantitative approaches were used within the tabletop exercise in the project SORTIE in order to enable a targeted and straightforward evaluation. For this purpose, an evaluation method consisting of three sub-areas: participant questioning; exercise observers; photo, video and audio recordings, was developed. The questionnaire and observation sheet consisted mainly of closed-ended questions and observation criteria, supplemented by open-ended questions and observation criteria for holistic data collection. Additional tools were provided for objective observation and easy evaluation for the open-ended observations, to enable precise observation and documentation. Social science methods are particularly suitable for the basic design of the evaluation, as they are easy to apply and already familiar to many participants. This also ensures the validity of the results. Through the interplay of different methods, a holistic data collection can be ensured within the framework of a project. It is important to adapt the methods of tabletop exercises and evaluation exactly to the goals to be achieved and the tactical level to be considered in the project SORTIE.

For the evaluation of the closed-ended questions and observation criteria, an Excel file was created in which the participants answers were translated into numbers. The results were then displayed, by calculating a mean value as a boxplot, bar chart and profile line of the mean values. This enabled a quick reading of the most important results, and it can be quickly recognised in which areas there is still potential for improvement. The open-ended questions were then evaluated for the comprehensibility and completeness of the quantitatively collected data. This also made it possible to compare the data collected with the closed-ended questions and observations with the results of the open-ended questions.

Within the tabletop exercise and afterwards, the developed evaluation method proved suitable for a targeted collection and evaluation of data. The closed-ended questions made it possible to generate important data and evaluate its significance quickly. It was also easy to deduce where improving the system was necessary. Through the supplementary questions and the free-text answers of the participants, it was possible to gain a comprehensive

insight into the tabletop exercise and record aspects that were unknown in advance.

The same applies to the closed-ended and open-ended observations of the observers. However, it must be taken into account that some observers stated that they did not hear all the relevant processes and conversations within the tabletop exercise or could not understand them via the microphones and the transmission. In the future, it must therefore be further considered whether a possible information deficit of the observers can and should be accepted if, in return, an undisturbed implementation of the tabletop exercise is possible in another room.

ERROR DISCUSSION

Sources of error within the tabletop exercise can lie in the data collection and the evaluation of the data, since the artificiality of the exercise must be taken into account here because not all contents of the scenario can be presented in detail and close to reality. Because of this, participants could behave differently within the tabletop exercise than they would in real operations.

The preparation of the participants can also be a source of error. Here, an introduction to the topic, the system and how the system is used is necessary to ensure that the system is used effectively and as realistically as possible within the tabletop exercise and thus also to collect evaluable data.

Furthermore, subjective impressions might flow into the results via the exercise observers and thus falsify the results. Through training in advance and a trial run of the tabletop exercise, as well as through standardised observation criteria with measurability criteria and suitably developed tools, an attempt was made to counteract this. Moreover, since the observers are not experts in the field of USAR operations and the system, an additional basis for error is possible.

Dishonest answers of the participants within the questionnaires can also falsify the results. In order to minimise these eventualities, the participants were trained before the tabletop exercise. In addition, the data within the evaluation was anonymised so that it cannot be traced back to individual persons.

Another source of error could be if the positions within the tabletop exercise are not filled in a way that is appropriate to the subject matter and qualifications. This would mean that the operational procedure and thus also the use of the system would not be implemented realistically, which would make the collected data worthless. This was counteracted by filling the positions according to previously asked qualifications within organisations and experiences from real operations.

CONCLUSION

Tabletop exercises enable situations to be played out in an artificial environment and thus enable the participants to acquire knowledge and skills.

Within the project SORTIE, an evaluation method consisting of three standardised areas enabled the evaluation of the tabletop exercise.

In summary, it can be said that the evaluation method and the preparation and implementation of the tabletop exercise made a fully comprehensive data collection possible, whereby the objectives of the tabletop exercise could be fully met.

REFERENCES

Amelang, M., & Schmidt-Atzert, L. (2006). *Psychologische Diagnostik und Intervention*. *Springer-Lehrbuch*. Berlin, Heidelberg: Springer-Verlag Berlin Heidelberg.

Ameln, F. von and Kramer, J. (2016) Organisationen in Bewegung bringen, Berlin, Heidelberg, Springer

Bittner, T., Eller, C., Dombois, M., & Rüppel, U. (2018). BIM-unterstützte Erstellung interaktiver, immersiver VR-Szenarien am Beispiel der Brandbekämpfung. *Bauphysik*, *40*(6), 410–415. https://doi.org/10.1002/bapi.201800028

Blötz, U. (ed) (2015) *Planspiele und Serious Games in der beruflichen Bildung: Auswahl, Konzepte, Lernarrangements, Erfahrungen - aktueller Katalog für Planspiele und Serious Games 2015*, 5th edn, Bonn, Bielefeld, Bundesinstitut für Berufsbildung; W. Bertelsmann Verlag GmbH & Co. KG.

Boslough, M., Jennings, B., Carvey, B., & Fogleman, W. (2015). FEMA Asteroid Impact Tabletop Exercise Simulations. *Procedia Engineering*, *103*, 43–51. https://doi.org/10.1016/j.proeng.2015.04.007

Braukmann, J., & Hübsch, J. (2010a). Sind Planspiele als Trainingsmethode wirksam? Ein qualitativer Ansatz zur Evaluierung planspielbasierter Trainingskonzepte. In F. Trautwein, S. Hitzler, & B. Zürn (Eds.), *ZMS-Schriftreihe: Vol. 1. Planspiele - Entwicklung und Perspektiven: Rückblick auf den Deutschen Planspielpreis 2010* (pp. 103–127). Nordstedt: Books on Demand GmbH.

Braukmann, J., & Hübsch, J. (2010b). Sind Planspiele als Trainingsmethode wirksam? Ein qualitativer Ansatz zur Evaluierung planspielbasierter Trainingskonzepte. In F. Trautwein, S. Hitzler, & B. Zürn (Eds.), *ZMS-Schriftreihe: Vol. 1. Planspiele - Entwicklung und Perspektiven: Rückblick auf den Deutschen Planspielpreis 2010* (pp. 103–127). Nordstedt: Books on Demand GmbH.

Chandra, A., Williams, M. V., Lopez, C., Tang, J., Eisenman, D., & Magana, A. (2015). Developing a Tabletop Exercise to Test Community Resilience: Lessons from the Los Angeles County Community Disaster Resilience Project. *Disaster Medicine and Public Health Preparedness*, *9*(5), 484–488. https://doi.org/10.1017/dmp.2015.99

Chen, Kuo-Chih, M. D., Chen, Chien-Chih, M. D., & Wang, Tzong-Luen, MD, PhD (2003). The Role Tabletop Exercise Using START in Improving Triage Ability in Disaster Medical Assistance Team. *Ann Disaster Med.*, *1*(2), 78–84.

Dittmar, M., Schwarz, C. and Trabold, B. (2012) *Studentische Ausbildung in Katastrophenmedizin*. Notfall + Rettungsmedizin, 15(4), 319–326. https://doi.org/10.1007/s10049-011-1465-5

Döring, N., & Bortz, J. (2016). Empirische Sozialforschung im Überblick. In N. Döring & J. Bortz (Eds.), *Forschungsmethoden und Evaluation in den Sozial- und Humanwissenschaften* (5th ed., pp. 3–30). Springer-Verlag Berlin Heidelberg.

Ehmann, T. (2009). *Erfassung und Förderung metakognitiver und motivationaler Fähigkeiten: Ein halbstandardisiertes Lerntagebuch für Schülerinnen und Schüler mit Migrationshintergrund.* Universität Potsdam. Retrieved from https://publishup.uni-potsdam.de/opus4-ubp/frontdoor/deliver/index/docId/4938/file/ehmann_diss.pdf

Flick, U. (2007). Qualitative Evaluation - Methoden, Qualitätsstandards und Bewertung. In U. Kuckartz, S. Rädiker, C. Stefer, & T. Dresing (Eds.), *CAQD 2007: Computergestützte Analyse Qualitativer Daten; MAXQDA Anwenderkonferenz, Philipps-Universität Marburg, 7. bis 9. März 2007* (pp. 9–16). Universität Marburg. Retrieved from https://www.ssoar.info/ssoar/bitstream/handle/document/941/ssoar-2007-kuckartz_et_al-caqd_2007.pdf?sequence=1&isAllowed=y&lnkname=ssoar-2007-kuckartz_et_al-caqd_2007.pdf#page=10

Flick, U. (2009). Qualitative Methoden in der Evaluationsforschung. *Zeitschrift Für Qualitative Forschung*, *10*(1), 9–18. Retrieved from https://www.ssoar.info/ssoar/bitstream/handle/document/33655/ssoar-zqf-2009-1-flick-Qualitative_Methoden_in_der_Evaluationsforschung.pdf?sequence=1&isAllowed=y&lnkname=ssoar-zqf-2009-1-flick-Qualitative_Methoden_in_der_Evaluationsforschung.pdf

Gehrau, V., & Schulze, A. (2013). Quantitative Beobachtung: Grundprinzipien und Anwendungen. In W. Möhring & D. Schlütz (Eds.), *Handbuch standardisierter Erhebungsverfahren in der Kommunikationswissenschaft* (pp. 329–346). Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-531-18776-1_18

Geuting, M. (ed) (1992) *Planspiel und soziale Simulation im Bildungsbereich* (Zugl.: Aachen, Rheinisch-Westfälische Techn. Hochsch., Habil.-Schr., 1989), Frankfurt am Main, Lang.

Grob, H. L. (1995) 'Ereignisorientierte Planspiele', *arbeiten + lernen, Wirtschaft*, vol. 5, no. 18, pp. 15–20

High, E. H., Lovelace, K. A., Gansneder, B. M., Strack, R. W., Callahan, B., & Benson, P. (2010). Promoting community preparedness: Lessons learned from the implementation of a chemical disaster tabletop exercise. *Health Promotion Practice*, *11*(3), 310–319. https://doi.org/10.1177/1524839908325063

Hofinger, G. and Heimann, R. (2016) *Handbuch Stabsarbeit*, Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-662-48187-5

Keim, H. (1992) 'Planspiel, Rollenspiel, Fallstudie, Zur Praxis und Theorie lernaktiver Methoden', in Keim, H., Buddensieck, W. (eds) *Planspiel, Rollenspiel, Fallstudie: Zur Praxis und Theorie lernaktiver Methoden,* Köln, Wirtschaftsverl. Bachem, 372-335.

Kriz, J. and Lisch, R. (1988) *Methoden-Lexikon für Mediziner, Psychologen, Soziologen*, München, Weinheim, Psychologie-Verl.-Union.

Kriz, W. (2009) 'Planspiel', in Kühl, S., Strodtholz, P. and Taffertshofer, A. (eds) *Handbuch Methoden der Organisationsforschung: Quantitative und qualitative Methoden,* Wiesbaden, VS Verlag für Sozialwissenschaften, pp. 558–579.

Lamnek, S., & Krell, C. (2005). *Qualitative Sozialforschung* (4th ed.). Weinheim: Beltz.

Liebig, B., & Nentwig-Gesemann, I. (2009). Gruppendiskussion. In S. Kühl, P. Strodtholz, & A. Taffertshofer (Eds.), *Handbuch Methoden der Organisationsforschung: Quantitative und Qualitative Methoden* (pp. 102–123). VS Verlag für Sozialwissenschaften.

Liebold, R., & Trinczek, R. (2009). Experteninterview. In S. Kühl, P. Strodtholz, & A. Taffertshofer (Eds.), *Handbuch Methoden der Organisationsforschung: Quantitative und Qualitative Methoden* (pp. 32–56). VS Verlag für Sozialwissenschaften.

Massing, P. (2004) 'Planspiele und Entscheidungsspiele', in Frech, S. (ed) *Mikromethoden, Makromethoden: Lehrervortrag, Karikatur, Textanalyse, Unterrichtsgespräch, Internet; Fallanalyse, Talkshow, Pro-Contra-Debatte, Plan- und Entscheidungsspiel, Erkundung, Expertenbefragung,* Schwalbach/Ts., Wochenschau-Verl., pp. 163–194.

Möhring, W., & Schlütz, D. (Eds.) (2013). *Handbuch standardisierter Erhebungsverfahren in der Kommunikationswissenschaft*. Springer Fachmedien Wiesbaden.

Rathert, W. (2003) 'Simulationen: Mehr Motivation am "Lernort Wirklichkeit"', *Personalentwicklung*, no. 4 [Online]. Available at https://www.bibb.de/dokumente/pdf/1_15.pdf.

Rempe, A., Klösters, K. and Slaby, C. (2014) *Das Planspiel als Entscheidungstraining*, 3rd edn, Stuttgart, Kohlhammer.

Renneberg, B., & Hammelstein, P. (2006). *Gesundheitspsychologie* (1st ed.). Springer-Verlag Berlin Heidelberg.

Rössler, P., & Geise, S. (2013). Standardisierte Inhaltsanalyse: Grundprinzipien, Einsatz und Anwendung. In W. Möhring & D. Schlütz (Eds.), *Handbuch standardisierter Erhebungsverfahren in der Kommunikationswissenschaft* (pp. 269–288). Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-531-18776-1_15

Schmitz, S.; Brüstle, Tim; Barth, Konrad; Gleibs, Tobias; Mudimu, Ompe Aimé (2019*): Testing the implementation of a flying localization system into emergency response using a tabletop exercise.* WiPe Paper – Command & Control Studies. In: *Proceedings of the 16th ISCRAM Conference – València, Spain May 2019*.

Siemon, A. (2013). *Avatare in Katastrophensimulationen*. *Entwicklung eines Katastrophen-Trainings-Systems zur Darstellung von Beteiligten in Großschadenslagen*. Kassel Univ. Press.

TH Köln (Hg.) (2021): *Rettung von Verschütteten: Planübung im Forschungsprojekt SORTIE. Unter Mitarbeit von Institut für Rettungsingenieurwesen und Gefahrenabwehr*. Institut für Rettungsingenieurwesen und Gefahrenabwehr. Available: https://www.th-koeln.de/hochschule/sortie---planspieluebung-an-der-th-koeln_88108.php

Wendelboe, A. M., Miller, A., Drevets, D., Salinas, L., Miller, E. J., Jackson, D., Raines, J. (2020). Tabletop exercise to prepare institutions of higher education for an outbreak of COVID-19. *Journal of Emergency Management (Weston, Mass.)*, *18*(2), S1-S20. https://doi.org/10.5055/jem.2020.0464

Zhou, B., Sun, G., Zhang, X., Xu, J., Lai, J., Du, X., Sakurada, Y. (2015). Development of Web-Based Tabletop Emergency Earthquake Exercise System. *Journal of Disaster Research*, *10*(2), 217–224. https://doi.org/10.20965/jdr.2015.p0217