Measurement of information flows in rescue exercises in the aftermath of the collapse of a building

Andreas Lotter
Technische Hochschule Koeln – University of Applied Sciences, Germany
andreas.lotter@th-koeln.de

Konrad Barth
Technische Hochschule Koeln – University of Applied Sciences, Germany
konrad.barth@th-koeln.de

Florian Brauner
Bergische Universität Wuppertal, Germany
brauner@uni-wuppertal.de

Florian Steyer
Technische Hochschule Koeln – University of Applied Sciences, Germany
florian.steyer@th-koeln.de

Ompe Aimé Mudimu
Technische Hochschule Koeln – University of Applied Sciences, Germany
ompe_aime.mudimu@th-koeln.de

Alex Lechleuthner
Technische Hochschule Koeln – University of Applied Sciences, Germany
alex.lechleuthner@th-koeln.de

ABSTRACT

Collapsed buildings are one of the most complex challenges for rescue forces. The large amount of incoming information in particular is a major challenge to handle for the involved forces. The Assessment of this information is necessary in order to be able to give reliable statements about the number of buried and missing victims.

To improve the handling of the information, *the authors* have developed a method to measure information flow during rescue exercises after the collapse of a building. This method has been developed within VERVE, a research project subsidized by the German Federal Ministry of Education and Research (BMBF).

The method has been evaluated and tested through two exercises.

Keywords

Collapsed buildings, information flow, table-top exercises, in-field exercises.

INTRODUCTION

While the collapse of building structures is a very rare scenario, especially for German emergency services, addressing such a scenario involves a huge challenge due to the bulk of incoming information. Managing information with regard to the whereabouts of possible victims - people known to be trapped and people already

rescued - is especially complex. Such information is generated from very different sources and is of inconsistent quality. Thus, the handling of the aftermath of a collapsed building bears special complexities and very few emergency practitioners are experienced in this area.

To be able to improve the handling of such information, a common understanding of how information is been transported, is required. Therefore, a process model of information flows helps. In a second step, to validate the process model for the information flow in such situations during exercises (cp. Lotter, Brauner, Barth, Mudimu and Lechleuthner 2015), an applicable method for the measurement of information handling has to be found.

As the handling of such a scenario is a very complex and time-consuming process, it is not possible to reiteratively observe the information management in such a situation. Furthermore, the knowledge -acquired by the responders during one passage of a repeated exercise- is expected to have influence on the handling of forthcoming passages. Therefore, a technique is needed for the measurement of the information flows in a single-passage exercise in the aftermath of a building collapse.

Although the developed method is focusing on the German system, it could be easily adapted for other countries and systems.

INFORMATION FLOWS IN EVENTS CAUSED BY COLLAPSED BUILDINGS

Rescue efforts in collapsed buildings usually follow a standard guideline in Germany. The German Fire Protection Association (vfdb) has developed a system for structuring the task of rescue forces. For effectively dealing with the situation, four different operational sections have been recommended (vfdb 2005). Each operational section gathers a lot of information, which it has to evaluate; the important pieces of information are selected and transmitted to the incident commander (IC). The IC has also to deal with information from third parties such as the police, command and control centers, media, etc. Due to the high amount of incoming information, it is important for the information flows to be well-structured, otherwise it is impossible to ensure important information processing. (Lotter, et al. 2015).

METHOD FOR THE ANALYSIS OF INFORMATION FLOW

To measure the transmitting and handling of information during the response to a collapse of building structures, two concepts have been developed and practically tested. The first concept is to be used in table-top exercises, while the second one is intended for full-scale exercises. Both concepts need an elaborate scenario that includes a thorough definition of all possible pieces of information that the various responders would be required to gather during the exercise.

Table-top Exercise

The table-top exercise has the advantage of controlling all possible sources of information in the following kind of way: The observing team knows which piece of information (object) is given to the participants (subjects), when (time) and how (transmitting way). To be able to monitor the progress of information through communication channels, a tight schedule of the events in the exercise has to be established. Using the schedule, it is possible to predefine every expected piece of information that the participants could acquire during the exercise.

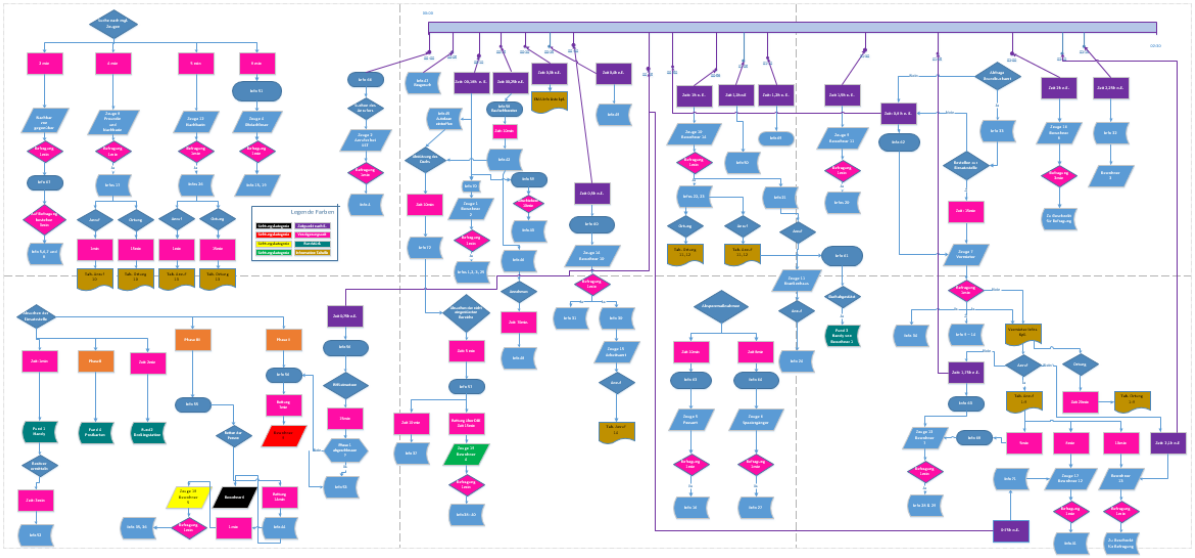

Figure 1. Schedule of events during the table-top exercise linked with information

Figure 1 shows an overview of all events and information that could be triggered and that were used during the table-top exercise. A detailed view of the sample flow of information and events is given in Figure 2.

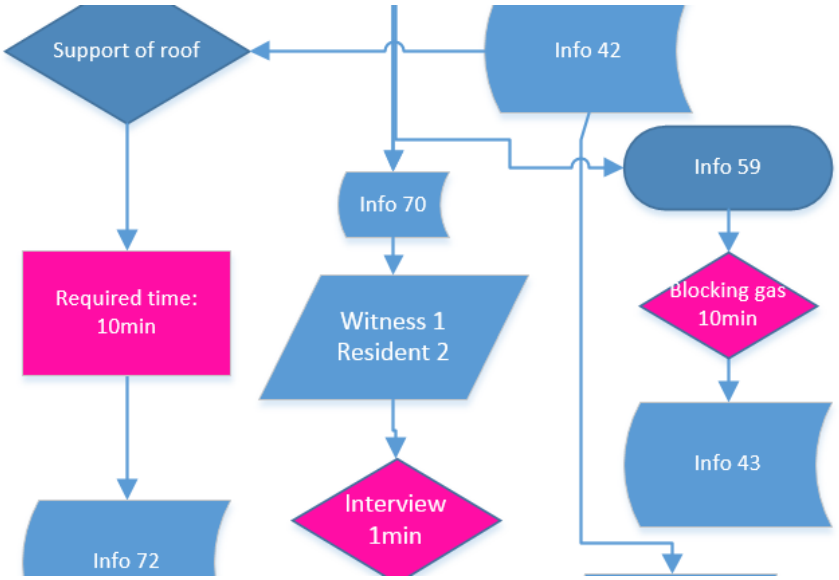

Figure 2. Sample flow of information and events during the table-top exercise

As it can be seen, certain information can only be accessed when they are triggered by specific actions, e.g. interviewing the witnesses or the residents of the collapsed building.

Based on the structure of this action framework each message gets a unique identifier to document the point of time the message was received by the participant. To study how the information are processed, one observer is assigned to each participant in order to capture when a certain piece of information is received, how it is received, when it is processed, and to whom and when it is forwarded. The basic content of the message is also documented.

Full-scale Exercise

Compared to table-top exercises, the monitoring of information flows is hindered in full-scale exercises because of two difficulties. The first difficulty is the fact that the exercise control does not have full control on the input of information to the command and control structure. Secondly it is more complicated to constantly observe the communication and decision making of every member of the command chains on site. Therefore, the approach for full-scale exercises needs to be modified.

Similar to the table-top exercises, an observer is assigned to each command role, starting at the platoon level. It is expected to be difficult for these observers to fully recognize the information management approach; therefore, structured interviews are carried out. These interviews are executed at predefined intervals in which the exercise pauses for this purpose. The duration of intervals and the extent of the interviews have to be chosen carefully, as they are crucial to the validity of the measurement results and may hinder the progress of the exercise.

The disadvantage of this approach is that currently available information handled by the command personnel has to be compared to reality and not to reported findings of on-site staff. This implies that the measurement is influenced by the quality of the information gathered by the exercise participants. This is not necessarily included in information management.

APPLICATION: TEST OF THE METHOD

Both method variations were tested in a practical exercise. The selection of the basic scenario was based on a survey conducted among the ICs of building collapse situations in which at least one trapped person was expected at the beginning of the response. To ensure reliable data, about historical events were examined, all happened in Germany between 1995 and 2013. The analysis of the acquired data showed that more than 60% of the events were caused by a gas explosion and eight out of 10 took place in single-family or multi-family houses; thus, only 20% of the affected buildings were public buildings or enterprises. Because of the size of the affected buildings, the rescue forces expected more than ten buried people in less than 20% of the situations (Mudimu, Lechleuthner, Lotter and Barth 2015, pp. 3).

Based on this data, authors developed a basic scenario. The collapse of a three-story building with 12 residents, as the consequence of a gas explosion, was considered. To have as many different sources of information as possible, it was assumed that some of the residents were at home during the event while others were at work or on their way home during the ongoing response. Altogether, there were six buried and injured people, along with seven other injured people.

Table-top Exercise

In the table-top exercise, the expected actions as well as the questions asked were scripted and the pieces of information to be given to the participants were defined. The observers were equipped with a list of messages that their subjects could receive during the exercise.

Feedback from both observers and the exercise control show that it is generally feasible to use the described method to collect data about the flow of information. A deep knowledge of the possible developments of the exercise could be crucial for the successful collection of data. Additionally, at some point, the observers stopped using the prepared list of messages their subject was expected to receive, but rather took notes on their own, because it was too time-consuming to go through the list to find the piece of information just received or forwarded every time.

Full-scale Exercise

In the full-scale exercise, the background of every role to be played was thoroughly developed and presented in information charts handed out to the corresponding role-players. Additionally, the players were instructed to update descriptions of potentially missing persons to match the corresponding role-player. In this exercise, the observers were equipped with a set of forms to conduct the structured interview described earlier.

Figure 3. Observers (yellow/white checkered vests) and rescue forces during the full-scale exercise (Mudimu, et al. 2015, p.16)

There were breaks during the exercise so that the observers could interview the executive rescue forces without interruption. Breaks were about 90 seconds long. As shown in Table 1, the intervals between the interviews were shorter in the early part of the exercise. This is because the amount of information is a lot higher in the beginning of an operation.

Event	Time after start of the exercise
Start of Exercise	00:00:00
Interview 1	00:15:00
Interview 2	00:30:00
Interview 3	01:00:00
Interview 4	01:30:00
Interview 5	02:00:00
Interview 6	02:30:00
End of exercise	02:32:00

Table 1. Time of the interviews during the full-scale exercise

Résumé of the practical application

The approach used in the table-top exercise still is in the need of an improved, useable way for the observers to document the pieces of information received by their subject. The impromptu documentation of the information flows is generally feasible in such exercises and has the advantage of adding almost no obstacles to the continuity of the exercise.

When considering full-scale exercises, it is necessary to slightly adapt the method to the different circumstances. In general, the use of pre-planned interview breaks for the documentation of the command staff's current level of knowledge is an effective way. Its effect on the continuity of the exercise has proven to be acceptable.

In both cases the practical application prove, that the developed method is a helpful tool for the monitoring of information management in emergency management exercises and is useful for the evaluation of process models related to information management. Also it is expected to be helpful for the evaluation of information management concepts.

BENEFIT FOR THE INVOLVED FORCES OF THE EXERCISE

In a later debriefing, the involved forces get feedback about possible weak or critical links between different operational segments through the evaluation of the information flows. It is really important to identify these links in order to improve the information flows during rescue operations after a building collapse.

Afterwards, there has to be a discussion about the lost information as well as the transmitted information. IC and rescue forces have to be aware of the consequences of processing irrelevant or misdirected information. In critical situations such as a collapsed building and limited personnel resources, this could lead to a waste of time and wrong localization of the buried and missing people. An effective information management system improves the performance of rescue services to find victims much faster.

CONCLUSION

Three major lessons-learned statements can be derived:

Firstly, for the table-top and the full-scale exercises, it was possible to collect data about the information management processes in the way intended. Therefore, deploying observers to measure the information flows during an exercise is feasible.

Secondly, observers struggle with prepared lists containing all possible messages that can be received by their subject, this process needs still improvement. In full-scale exercises, it has to be ensured that all interview breaks are synchronized. This is crucial for both the validity of the results as well as the continuity of the exercise workflow.

And thirdly, in both exercise variations, the observers have to be well-trained in exercise observation to document the information flow without any personal rating in particular.

Overall, the developed approach is an effective tool for the evaluation of information management concepts used by rescue forces e.g. in case of collapsed buildings that eases up the identification of strengths and weaknesses in terms of information handling and forwarding. Hereby a strong additional benefit can be added to exercise evaluation.

ACKNOWLEDGMENTS

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REFERENCES

1. Lotter, Andreas; Brauner, Florian; Barth, Konrad; Mudimu, Ompe Aime; Lechleuthner, Alex (2015): Analysis Of Information Flow In Events Caused By Collapsed Building. In: International Journal of Civil Mechanical Engineering 5 (1), S. 1–6.
2. Mudimu, Ompe Aimé; Lechleuthner, Alex; Lotter, Andreas; Barth, Konrad (2015): VERVE: Prozessmodellierung, empirische Analyse und Standardisierung des informationsmanagements bei Großschadenslagen mit Gebäudeeinstürzen. Schlussbericht. TH Köln. Köln.
3. Vereinigung zur Förderung des Deutschen Brandschutzes - vfdb (Hg.) (2005): Hinweise für Maßnahmen der Feuerwehr und anderer Hilfskräfte nach Gebäudeeinstürzen (Richtlinien der Vereinigung zur Förderung des

Deutschen Brandschutzes - vfdb, 03-01).