



Elaboration of Tools to Facilitate the Scenario Development of Crisis Management Training

Noémie Frealle, Florian Tena-Chollet, Sophie Sauvagnargues

► To cite this version:

Noémie Frealle, Florian Tena-Chollet, Sophie Sauvagnargues. Elaboration of Tools to Facilitate the Scenario Development of Crisis Management Training. *Decision-making in Crisis Situations: Research and Innovation for Optimal Training*, , p. 79-102, 2018, 978-1-119-55782-1. 10.1002/9781119557869.ch4 . hal-02923813

HAL Id: hal-02923813

<https://imt-mines-ales.hal.science/hal-02923813>

Submitted on 11 Aug 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Elaboration of Tools to Facilitate the Scenario Development of Crisis Management Training

4.1. Introduction

A crisis may have important consequences, whether at the human, material or economic level. While regulation is an important lever for organizations to be prepared to confront major events through the implementation of plans and procedures, feedback is also stimulating to implement crisis management exercises. Among the different types of crisis exercises, simulations enable crisis units to test their organization and to gain experience (Goutx 2014). In order to implement simulation, it is necessary to develop a scenario that is credible (Boin *et al.* 2004; Dautun *et al.* 2011), educational (Baubion *et al.* 2014a) and interactive at the same time (Barot *et al.* 2013; Barot 2014), so as to encourage trainees to immerse themselves in a situation that seems realistic and allows them to acquire knowledge, skills and experience. This scenario is implemented by a team of facilitators, also known as a facilitation team (Fréalles *et al.* 2017). Facilitators are then led to share scripted messages with trainees and

to encourage interaction with them. Here, we are interested in the resources of these facilitators for the implementation of credible, educational and interactive scenarios.

4.2. State of the art

In order to run a script, it is possible to proceed methodically and make use of computer tools. In the specialized literature, it is possible to observe a trend: the execution of the script is mainly ensured by a team of facilitators (Boin *et al.* 2004; Dautun 2007; Gregori *et al.* 2009; Verdel *et al.* 2010; Tena-Chollet 2012; Teclemariam *et al.* in Stern 2014; Fréalles *et al.* 2017; November *et al.* 2017). These facilitators have a script prepared in advance and interact with trainees via different vectors of communication: phone, e-mail, social networks, media, fax and voice (Fréalles *et al.* 2017). Facilitators are at the interface between the script and trainees, and the deployment of the scenario is their responsibility. Yet, to our knowledge, there is no methodology which enables facilitators to run a scenario while respecting credibility, pedagogy and interactivity criteria. Nevertheless, some limitations can be observed as regards the implementation of the three criteria.

4.2.1. The limitations encountered

4.2.1.1. The scenario's credibility called into question

Credibility is the key ingredient for an efficient simulation (Dautun *et al.* 2011) which has to be effective (Boin *et al.* 2004). However, verisimilitude defects are observed, and the credibility of scenarios are called into question by participants (Boin *et al.* 2004; Gaultier-Gaillard *et al.* 2012; Baubion *et al.* 2014a). These credibility defects may be due to:

- inconsistencies due to the initial scenario or to inadequate responses from the facilitation team (DGSCGC 2013);
- anomalies related to a lack of technical data in the scenario or a lack of feedback during simulation (Verdel *et al.* 2010).

The issue of credibility for crisis management training is essential. Verisimilitude bias can penalize trainees during the learning process. For example, we can observe misunderstandings due to unrealistic elements, such as the absence of victims following an event which might have provoked some (DGSCGC 2013). As a result, we can observe that trainees become disengaged from the simulation (Boin *et al.* 2004). If they do not, they may retain response strategies from the simulation which could actually deteriorate crisis management in future situations.

A priori, credibility defects may be encountered at different levels. They can be found in relation to the development of the hazard, the impact on the territory and the stakes involved, the availability of resources, scheduled deadlines or even the choice of representatives. If the facilitator has no other choice than to admit to a credibility bias, it is possible to announce it before the exercise and to incorporate it as a “rule of the game” (November *et al.* 2017). While this does not totally prevent the lack of credibility, it is useful for avoiding the consequences it could have on the educational reach of the simulation.

4.2.1.2. *Restrained educational reach*

A crisis scenario makes trainees familiar with the situation and grants the immersion of participants when it is associated with environmental and contextual elements (Tena-Chollet 2012; Tena-Chollet *et al.* 2016). However, the educational impact of each message is not clearly established. Without calling it into question, it is nonetheless necessary to consider the impact of the scenario on the learning process.

It is often said that educational goals should be determined before the scripting phase. However, there is no existing method for structuring the selection of these objectives and their integration in the scenario. Only recommendations are made, for example, regarding the number of objectives that it is possible to use (Tena-Chollet 2012) or concerning the fact that trainees should not be overloaded, for fear of losing their attention during the exercise (Renger *et al.* 2009). In order to ensure the educational reach of the scenario, the facilitator should draw on their experience as a scriptwriter.

Specialized literature has never made reference to the difficulty of building a scenario which sufficiently values the contribution of each member of the crisis unit. It sometimes happens that in a group of trainees, some feel less involved, and therefore the phenomenon of disengagement emerges.

4.2.1.3. *Rigid scenarios*

At present, the main information available to facilitators is present in the scenario (Verdel *et al.* 2010; Dautun *et al.* 2011; November *et al.* 2017).

The development of crisis scenarios is often interrupted, even before the start of the simulation (Boin *et al.* 2004; Noori *et al.* 2017). The story structure is called into question and might be responsible for the lack of adaptability and interactivity (Mercan *et al.* 2011). Apparently, the most interactive scenarios might be the less developed ones and those in which trainees can freely exchange among each other (Baubion *et al.* 2014b). It can also be observed that this rigid aspect deprives participants of the necessary margin for taking the initiative (Barot 2014). Among basic psychological needs, we can mention the feeling of living an optimal experience and of having our own choices respected or followed (Deci *et al.* 2000, 2008). It is therefore necessary for the scenario to fit the decisions made by trainees.

For others, responsibility is beyond their scope of action. This can be due to the absence of a method for dynamically generating scenarios which focus on coordination and the unexpected (Comes *et al.* 2013; Steelman *et al.* 2013). For Noori *et al.*, the unexpected element is important and should be taken into consideration, since it is necessary to acquire training in handling unusual situations or those situations in which procedures established in plans are not enough (Noori *et al.* 2017). Nevertheless, the rigid aspect of the scenario leaves no room for original behavior and thought (Lagadec 2007; Reason in Noori *et al.* 2017).

It thus becomes necessary to produce more flexible scenarios (Carroll 1999; Mercan *et al.* 2009; Renger *et al.* 2009). In order

to adapt the scenario, a possible solution could be to thoroughly understand what participants can initially do and what they are concretely able to accomplish later (Amokrane-Ferka *et al.* 2013). A way of anticipating the actions of participants is to adopt the *brainstorming* technique. However, it is not possible to predict everything, because people interpret their experience and adjust their perception based on these interpretations (Nisbett *et al.* 1977; Renger *et al.* 2009). This bias induces a reconstruction of reality that is often ill-equipped for identifying dysfunctions (Carroll 1999). Expecting to anticipate all the decisions that trainees may make is laborious and illusory and leads to screenwriting instability (Carroll 2000).

The real challenge is therefore to find a structure that makes it possible to control the scenario, but without providing all the possibilities. In order to meet this requirement, Szilas proposes to delinearize the scenario. In addition, he suggests no longer apprehending the scenario as a chronological sequence of events (Szilas *et al.* 2003). However, once the idea has been submitted, he admits that the intellectual process is still complex.

4.2.1.4. *The impact of the human factor in the implementation of the scenario*

After having studied the limits of credibility, pedagogy and interactivity, it is possible to address the organizational boundaries regarding the execution of the crisis scenario. In the same way it occurs with crisis management, the human factor is essential for managing facilitation. In fact, facilitators experience the same uncertainties, time pressure and management of the unexpected as crisis managers during a major event. Therefore, it is clear that in crisis units, we are often pushed to manage situations that are similar to a real crisis (Verdel *et al.* 2010). Also, as in crisis units, it is possible to observe that there are communication problems between facilitators. Several elements may be the cause: the importance of the number of requests by trainees, the lack of methodology, the complex use of a technology platform, the spatial organization of the animation team or even the number of facilitators.

4.2.2. Analogy with interactive narratives

To overcome the limits identified in terms of credibility, pedagogy and interactivity, here we suggest resorting to an analogy between the facilitation of a crisis scenario and interactive drama. Drawing an analogy between interactive narratives and crisis scenarios makes it possible to identify similarities between one and the other. It is by discerning the similarities that it seems possible to determine which strategies used in interactive narratives could be adapted to counteract the previously identified limitations in scriptwriting.

Szilas defines interactive narratives as “a narrative genre on computers where the user is one main character in the story and the other characters and events are automated through a program written by an author. Being a character means choosing all narrative actions of this character” (Szilas 2007). It is a tool that should both offer freedom to the player in terms of action and ensure that the story the scriptwriter has written is unfolded in a consistent manner (Riedl *et al.* 2006; Barot 2014).

The interactive narrative is not only used in video games but also found in various media such as theater and documentaries (Shilkrot *et al.* 2014). We also encounter an interactive narrative in texts based on interactive fiction or “choose your own adventure” books (Mateas *et al.* 2002a; Barot 2014). Conventional narrative forms such as those used in novels or movies do not solve the problems of consistency and control which are necessary for the interactive narratives, due to the passive status of the observer (Riedl *et al.* 2003). Shilkrot even claims that video games have the most similarities with computer-assisted interactive narratives, in terms of graphics and the interactivity produced by artificial intelligence (Shilkrot *et al.* 2014). Besides, it is the use of artificial intelligence that makes it possible to create a narrative manager for handling the story in real time, according to the choice of players. We can therefore ask ourselves, what the value of an interactive narrative architecture is and whether it actually contributes to grant freedom to the player, while preserving the coherence of the story.

4.2.2.1. *The master facilitator and the narrative manager*

Whether it is the master facilitator of a crisis management training exercise – also known as the exercise coordinator (Dautun *et al.* 2011) – or the narrative manager of an interactive narrative system (Marsella *et al.* 2000; Mateas *et al.* 2002b; Riedl *et al.* 2003; Mott *et al.* 2006; Si *et al.* 2007; Szilas 2007), their mission is to ensure the consistent unfolding of the scenario, and, if necessary, to influence it following the criteria of consistency or its goals. Yet, their methodology differs in how they carry out their mission. The narrative manager appeals to a logic established using algorithms (Si *et al.* 2007; Szilas 2007; Barot 2014), whereas the master facilitator draws on his/her experience and discernment.¹ The master facilitator should be allowed to work in the same conditions. In addition, it is not necessary for the master facilitator to have thorough knowledge of everything that is happening, but to be in contact only with those needed for orchestrating the scenario in a credible and interactive way.

4.2.2.2. *Facilitators, a dynamic, but troubled interface*

The main difference between the interactive narrative and crisis scenarios is the interface that exists between users and the narrative manager. In interactive narrative structures, a human-machine interface makes it possible to feed the narrative manager with users' choices (Mateas *et al.* 2005; Si *et al.* 2005; Mott *et al.* 2006). The structure of the interface does not affect data feeding the narrative manager. The latter reacts impartially in view of the elements in its possession or the algorithms that make it up (Si *et al.* 2007; Szilas 2007; Barot 2014). For the crisis scenario, this is different, because it is the facilitators who collect the choices of trainees. Thus, they are confronted with a difficulty: they have to respond to these choices in an adapted and almost immediate way. Despite being transmitted to the master facilitator and validated by him/her, the responses contributed by facilitators are sometimes subjective. In this case, the executive processes, which do not fit into a formal frame, risk providing differing answers in identical contexts.

¹ Taken from the observations of crisis simulations carried out in the context of thesis research (Fréalles 2018).

Another difficulty that facilitators may encounter is due to their more or less incomplete knowledge of the characters they are simulating. In interactive narrative systems, the authors provide everything that should be known about the characters (Riedl *et al.* 2003). From there, the computing system identifies the necessary knowledge to be mobilized and can use it effectively. The human factor makes the operation different when people perform the animation and simulate the characters. It is necessary to allow scenario facilitators to access knowledge by providing them with the elements required. It is also a question of organizing this knowledge and providing the necessary indications in order not to jeopardize the credibility of the scenario or its educational reach.

4.2.2.3. Individual or group learning

The interactive narrative involves a human-machine interface that is designed for one individual. For crisis management training, it is necessary to understand the training at group scale, since these groups, the crisis units, are the ones that will manage crises. The shift from the individual to the group sphere creates a scale difficulty. The information about what participants do is distributed among all the facilitators and does not go through a single circuit. In fact, unlike interactive storytelling, where there is a single circuit between the scenario and the participant, there are various circuits in crisis management training. If the interactive narrative process is difficult to set up for a single participant, we imagine that it can be rather difficult to implement for a group.

4.2.2.4. Contribution of the interactive narrative to improve facilitation

Everything is interconnected in the interactive narrative structure: the world of history, the actions of the players, the behavior of characters and the narrative logic. Therefore, it seems reasonable to offer facilitators the opportunity to share the elements which are necessary to the scenario's interactivity.

The analogy between interactive narrative and the crisis scenario makes it possible to identify the elements that should be made available to facilitators for them to successfully carry out their mission:

- provide the master facilitator with sufficient knowledge for him/her to orchestrate the scenario. These elements will have to be identified and organized;
- reinforce the evolutionary process of the scenario by providing facilitators with the elements they will need. It will also be necessary to identify and organize these elements. This point also helps to increase the credibility of the scenario and its pedagogical reach;
- provide facilitators with the opportunity to share their knowledge concerning the scenario in progress. This makes it possible to counterbalance the dissolution of information at a group scale.

4.3. Method

To meet the previously identified needs, we propose considering facilitation aids so as to support facilitators in carrying out their task. As part of the analogy between the interactive narrative and the facilitation of crisis scenarios, previously identified elements should be concretely harmonized with facilitation tools. Here, we can identify two tools that should be made available to facilitators: a facilitation form and a shared facilitation support.

4.3.1. Facilitation form

4.3.1.1. Structure of the facilitation form

The facilitation form is an aid which should help the facilitator to play his/her role in the context of the simulated scenario. It is therefore complementary to the scenario. In the form, the facilitator should be able to find all the necessary information to interact with trainees. Its first purpose is to provide the facilitator with enough

elements to be credible. The second objective ensures that the elements are consistent with the scenario in order to guarantee the educational reach of the learning situation. Finally, the third objective is that the structure of the facilitation form helps the facilitator to quickly find the data he/she needs at the moment of the simulation.

We can identify three types of data which are necessary for the facilitator:

- Contextual data: these are data strictly linked to the role. Thus, we can find the patronym, the setting where the character is found and, if applicable, the human, material and logistical resources.

- Data related to the major mission that the crisis unit has to solve, assumed by trainees. The nature of the mission will vary depending on the type of crisis unit (industrial, local, departmental or national). It is important to identify the type of mission in order to structure data in an intelligible way. Every large mission (e.g. the alert) can be broken down into several actions. Then, it is possible to characterize these actions by describing the following traits: (1) those likely to implement the action, (2) the place where the actions unfold or the beneficiaries of such an action, (3) the action's implementation period and (4) the required resources for carrying it out. Depending on the action, it may also be relevant to specify other elements.

- Data related to the scripted events. In fact, facilitators need data that do not fall within the missions assumed by the crisis unit. These data are related to the disruptive events injected into the scenario. If these events concern the role simulated by the facilitator, this should be specified in the facilitation form: the background of this event, the consequences that should be taken into consideration and, if it is known, the response that the communal crisis unit should give.

Figure 4.1 specifies all of the elements that should be informed by the facilitation form established for each role.

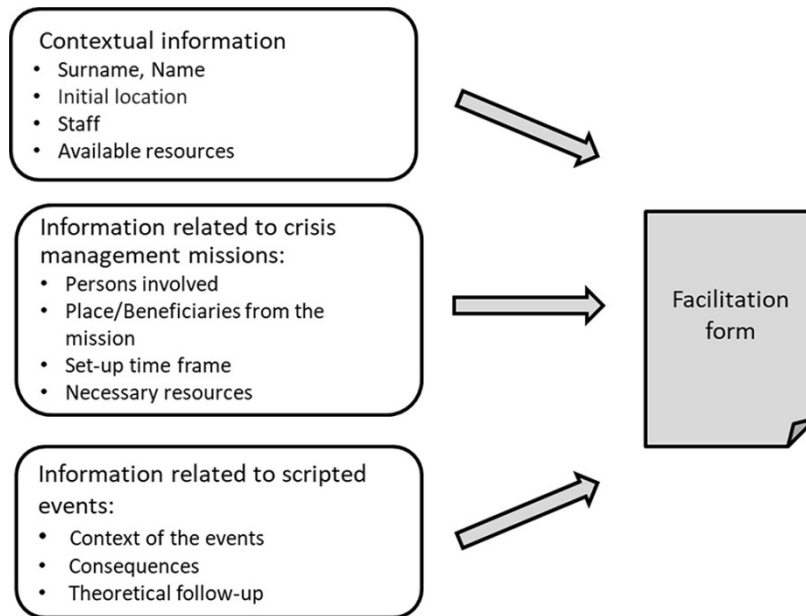


Figure 4.1. Building blocks of the facilitation form

4.3.1.2. Development of role forms to be used in an exercise

Once we have identified the type of information that the facilitator should find in their facilitation form, it is necessary to establish how this can be developed in a practical way.

For this purpose, it is necessary to use two types of resources: (1) everything related to regulation and habitual practices and (2) crisis management plans, implemented for the crisis unit. Therefore, it is necessary to analyze data in order to identify (1) the roles considered as well as those that will have to be simulated, (2) the responsibilities of each of these roles and their habits, (3) the missions and actions that the simulated roles are likely to carry out, either on request of the crisis unit simulated by trainees or not, and (4) the human, material and logistical resources that each of these roles has at its disposal. Figure 4.2 thus summarizes the possible ways to create facilitation forms.

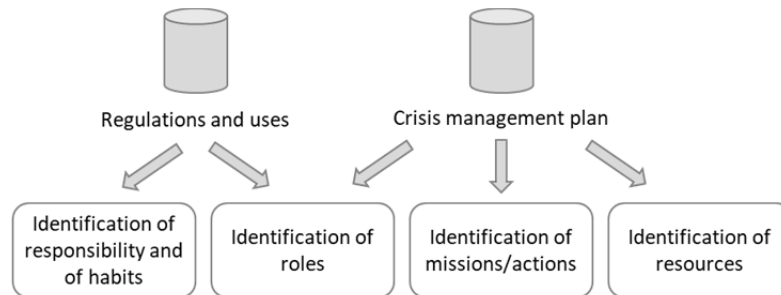


Figure 4.2. *Managing information for filling out facilitation forms*

4.3.2. Management of facilitation data

During simulation, facilitators are invited to exchange information. It is possible to distinguish two types of information (Fréalles 2018): information transmitted to trainees and information produced by the facilitator, following the decisions made by trainees. As regards the information produced by facilitators, we can establish a distinction between information prepared before the simulation and information improvised during the simulation. The facilitation form, which was previously introduced, enables facilitators to have the maximum amount of pre-established information and to reduce improvisation by facilitators. However, facilitators have to manage a lot of information, in the same way as the members of a crisis unit. We can identify four types of problems related to poor information management: unverified information, mistakenly transmitted information, information inappropriate that is for matching pre-established educational objectives and late information. These problems may have more or less general consequences on the quality of the scenario. Credibility might be undermined, or the educational reach and the scenario's interactivity might be altered.

In terms of management of facilitation-related information, the challenge is to have access to the right information at the right time. In view of the large amount of information that needs to be exchanged, it seems necessary to make access to information easier for facilitators. In order to make information more accessible, we suggest the

development of an information flow diagram within the facilitation process, so as to master its sequencing. Two main steps are identified to elaborate this model: identifying the information that needs to circulate within the facilitation and the development of information flow diagrams.

4.3.2.1. Identification of the facilitation information flow

Before producing an information flow diagram at the core of the facilitation process, it is necessary to spot the kind of information that circulates effectively. To do this, it is necessary to have determined the roles that should be played by facilitators, in advance. It is then necessary to distinguish the missions which are likely to be addressed for each of these roles, as well as the actions related to these missions. For each of these actions, the necessary information for the role has to be defined. At this stage, we can identify five types of information: (1) the actors involved in the implementation of the action, (2) the place affected by the action or its beneficiaries, (3) the time frame or the duration, as well as the status of the action (requested, underway, completed), (4) the details which characterize the action and (5) the resources mobilized for carrying it out.

Figure 4.3 schematizes this stage.

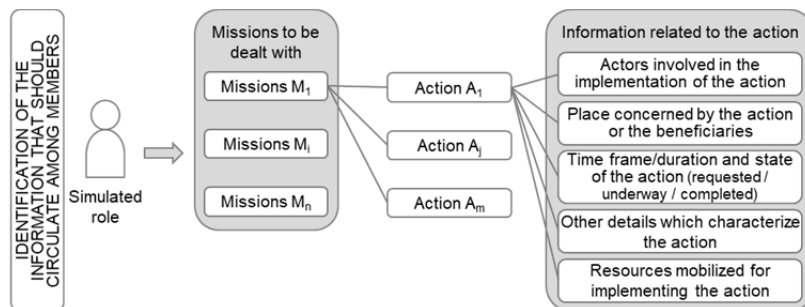


Figure 4.3. Process for identifying the information that circulates within the facilitation meeting

At the end of this first stage, it is possible to account for the necessary information for each simulated role. *A fortiori*, after having distributed the roles to the members of the facilitation team (Fréalles *et al.* 2017), we can establish the necessary information to each facilitator.

4.3.2.2. Formulation of information flow diagrams

In this second stage of modeling the information flow within the facilitation process, the idea is to describe all of the six steps necessary for formulating information flow diagrams. The first step is to sketch all of the actions that may be implemented by the roles simulated during the facilitation process. The second step should make it possible to determine the roles affected by each piece of information, so as to decide which information flow should be established. For this purpose, we may distinguish between two possible groups of roles: those implementing the action and those benefiting from such an action. After having established the different flow channels needed between roles, we must decide on the kind of information that should circulate through these channels. Starting from the work done in the first stage, it is necessary to identify what kind of information needs to be exchanged for each action and between the different groups of roles. We thus obtain an information flow diagram for each identified action. However, information can be similar from one action to another. Besides, there may be a large number of identified actions, and it is interesting to rationalize the modeling of the information flow. The fifth step merges information flow diagrams produced for each action with the major missions previously defined for identifying the flow of information circulating within the facilitation. The last step distinguishes information which can be prepared beforehand from that which can be produced during the simulation. This makes it possible to (1) ensure that facilitation forms contain all the information which can be previously established and (2) identify the information which can be produced and exchanged by facilitators during the simulation. Figure 4.4 illustrates these different steps.

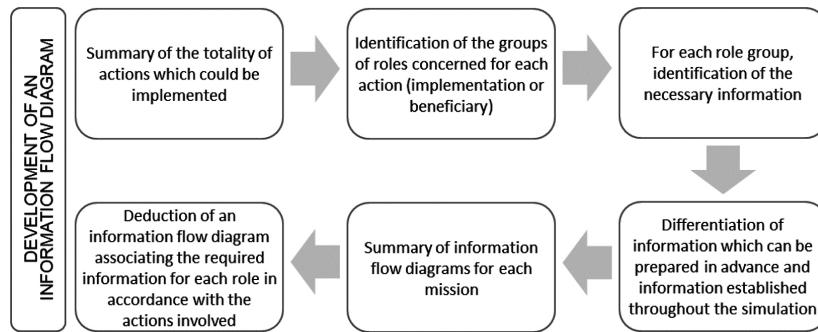


Figure 4.4. *Process for modeling the flow of information within the facilitation exercise*

Information flow diagrams within the facilitation process make it possible to establish the kind of information that needs to be exchanged and the roles affected by this information exchange. It is therefore possible to streamline such exchanges among the members of the facilitation team.

4.4. Results

The method for managing facilitation-related information was implemented for exercises at the communal level – trainees were encouraged to simulate a municipal crisis unit. In this section, we will present a facilitation form for the role of a technical field team leader, the ways in which the facilitator can use it and an information flow diagram for the lockdown mission.

4.4.1. Facilitation form for the technical field team leader

For a simulation of a crisis at the communal level, a total of 24 roles must be simulated (Fréalles 2018). Here, we choose to introduce a role belonging to a low facilitation level (Fréalles *et al.* 2017): the communal technical field team leader implementing all the actions related to the technical services. The facilitation form enables the facilitator to contextualize their role, thanks to the elements

mentioned in the “general information” section. Then, for each of the missions identified at the communal level (alert, lockdown, evacuation, accommodation, safety and post-crisis), the facilitator can find actions which the crisis unit is likely to ask him/her to implement within the context of the crisis simulation. For example, if trainees decide to implement a lockdown measure, the safety field team leader will be contacted *a priori* in order to support the containment perimeter at this school. In addition to the facilitation form, a monitoring chart of the resources deployed is made available to the facilitator.

| | | |
|---------------------|---|---|
| General information | Contact name from the technical field team | Emmanuel(le) DUBOIS |
| | Available staff | Four agents, including you |
| | Staff position at the outset | In a meeting at the technical pole (<i>address</i>) |
| | Available resources | Two light vehicles Road signs (at the technical pole – <i>address</i>) |
| Alert | Reception of the alert | Must be informed by the technical leader present at the crisis unit |
| Lockdown | Request for support for school lockdown – the safety field team may be concerned (<i>a priori</i> not requested) | <ul style="list-style-type: none"> – Resources: two agents + contribution of adhesive tape and wet cloths – Duration: 10 minutes to arrive on scene and 5 minutes for the intervention – Difficulties: respiratory + staff and resources management |
| Evacuation | Leading response teams to the premises | <ul style="list-style-type: none"> – Where: southern access (<i>address</i>) – Resources: two people/one car – Duration: 10 minutes to arrive on the scene and intervention until reception of counter-order – Difficulties: staff and resources management |
| Accommodation | Not concerned (for simplification reasons) | |

| | | |
|-------------------|--|---|
| Safety procedures | Road rehabilitation (sidewalks, public lighting and out of order red lights) | <ul style="list-style-type: none"> – Where: at the level of the accident – <i>address</i> – Resources: two agents + one vehicle – Duration: 1 hour – Difficulties: staff and resource management |
| | Installation of proper warning signs (in collaboration with the field safety team) | <ul style="list-style-type: none"> – Where: place of the accident/safety perimeter/retreat position/shelter – Resources: panels + two agents + one vehicle – Duration: 5 minutes to get to the place and 2 minutes for setting up – Difficulties: staff and resource management |
| | Closure of (water/gas) networks in communal establishments open to the public (EOPs) | <ul style="list-style-type: none"> – Where: school, social rehabilitation center – Resources: two agents + one vehicle – Duration: trip duration (immediate if already present on the spot or 10 minutes, and then 10 more minutes for implementation) |
| Post-crisis | Revamping of water, electricity networks | <ul style="list-style-type: none"> – Where: Louis Leprince Ringuet school – Resources: two to four people – Duration: 15/30 minutes per building (depending on the total number of persons involved) |

Table 4.1. *Facilitation form for the technical field team leader implemented during a crisis simulation*

A post-exercise questionnaire is submitted to facilitators at the end of the crisis simulation. In this questionnaire, facilitators are requested in particular to offer feedback regarding the facilitation forms. During a crisis simulation that aimed to validate the method, six facilitators who worked on facilitation forms expressed their satisfaction. It was found that the information was useful, making it possible to better understand and characterize roles, and to have the necessary

contextual elements for role facilitation. Therefore, implementing the facilitation form is important for the proper functioning of facilitation.

4.4.2. The “lockdown” mission’s information flow diagram used in a simulation exercise at the communal level

For each of the missions identified in the context of communal crisis simulation (alert, lockdown, evacuation, accommodation, safety and post-crisis), information flow diagrams were produced, based on the methodological elements previously introduced. In order to explain what these models correspond to, the model of the “lockdown” mission is introduced here (Figure 4.5). We can distinguish between two groups of roles involved in this mission: those who materially support the lockdown and the ones who are confined. When the members of the communal crisis unit decide to confine an area, they can ask three actors for support: the telephone company, firefighters and the safety and technical field team leaders. It is therefore necessary for these three roles to know the challenges present in the confinement perimeter, the prescribed period for the lockdown, the status of the action as well as the resources they will have to mobilize in order to mitigate the challenges of confinement. Apart from the status of the action which cannot be anticipated by the scenario writer, all of this information can be prepared before the simulation.

For the second group, the roles confined to a certain area may be the emergency shelter team leader, who may be encouraged to contain the emergency shelter, as well as the EOP leaders, and the residents present in the area to be confined. Once affected by a lockdown instruction, holders of these roles also need to know the number of people involved (if there are other people present with them), as well as their degree of vulnerability. They also need to know the duration of the lockdown provided by the authorities, the state of the action, as well as the resources that will be available to them during the confinement.

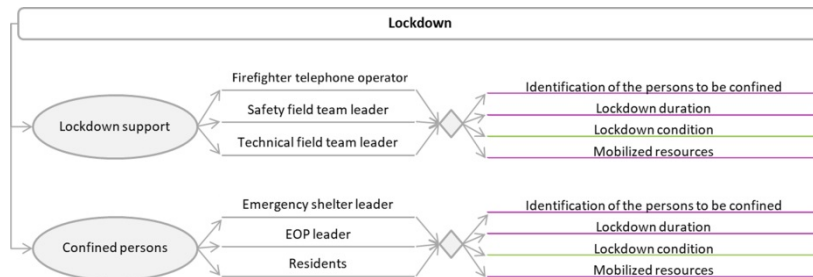


Figure 4.5. Information flow diagram for the “lockdown” mission

Such an information flow diagram makes it possible to identify clear roles and, *a fortiori*, facilitators, who must exchange information among themselves, as well as agree on the type of information needed. For the diagrams to be of use, it is also important to observe that:

- the formulation of information must be accurate. Indeed, regardless of the category of information, it is important that this is clear enough. Subsequently, information that may generate confusion or other interpretations can impair the credibility of the scenario;
- information should be disseminated quickly and simultaneously among all facilitators. This enables each facilitator to have access to the necessary information and to be consistent regarding the data disseminated during the simulation. This contributes both to the interactivity and the credibility of the scenario.

Good information flow favors easy access to information for all facilitators. The facilitation team has the necessary elements at hand to make a decision that will impact on the evolution of the scenario in line with the pre-established educational goals. The structure of the scenario is no longer rigid; facilitators can consider more possibilities and actually offer a suitable and tailor-made simulation to trainees.

4.5. Conclusion and perspectives

In order to overcome the scriptwriting limitations encountered in terms of credibility, pedagogy and interactivity, we propose the

development of a method to better manage information during facilitation exercises. To do this, it is important to identify the information that needs to be prepared before the crisis simulation and to structure the exchange of information between facilitators during the exercise. As a first step, we suggest a methodology for developing facilitation forms, including the accompanying responsibilities, actions and resources for each simulated role. To structure the facilitation form, we suggest compartmentalizing the facilitation form in three sections: the contextual elements, the elements related to missions that a communal crisis unit should lead and the elements related to the disruptive scripted events.

Second, we propose the development of an information flow diagram within the facilitation exercise. This resource identifies the information that facilitators need and the exchange flow that should be implemented. Indeed, it does not seem satisfactory to provide all the information together, but rather to sequence it. After identifying all the information managed for each role simulated during the facilitation exercise, information flow diagrams are offered based on the major missions that the crisis unit assumed by trainees has to handle.

In order to illustrate these methods, we introduce a facilitation form and an information flow diagram deployed for a crisis simulation at the communal level.

To effectively implement information flow diagrams within the facilitation exercise, it seems necessary to propose a collaborative support for facilitators. It is also necessary to validate these methodological elements in the context of other crisis simulations, on several critical scales (industrial, local, regional and national).

4.6. References

Amokrane-Ferka, K., Lourdeaux, D., and Michel, G. (2013). Tracking and dynamic scenario adaptation system in virtual environment. In *Artificial Intelligence in Education*, Lane, H.C., Yacef, K., Mostow, J. and Pavlik, P. (eds). Springer, Berlin, Heidelberg.

- Barot, C. (2014). Scénarisation d'environnements virtuels. Vers un équilibre entre contrôle, cohérence et adaptabilité. PhD Thesis, University of Technology, Compiègne.
- Barot, C., Lourdeaux, D., and Lenne, D. (2013). Dynamic scenario adaptation balancing control, coherence and emergence. *Proceedings of the 5th International Conference on Agents and Artificial Intelligence (ICAART)*, Barcelona. doi:10.5220/0004213802320237.
- Baubion, C. and Radisch, J. (2014a). Toolkit background paper. *4th Meeting of the OECD High Level Risk Forum*, Paris.
- Baubion, C. and Jacobzone, S. (2014b). Strategic crisis management exercises: Challenges and design tools. *4th Meeting of the OECD High Level Risk Forum*, Paris. Available: [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=GOV/PGC/HLRF\(2014\)9&docLanguage=En](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=GOV/PGC/HLRF(2014)9&docLanguage=En)
- Boin, A., Kofman-Bos, C., and Overdijk, W. (2004). Crisis simulations: Exploring tomorrow's vulnerabilities and threats. *Simul. Gaming*, 35(3), 378–393. doi:10.1177/1046878104266220.
- Carroll, J.M. (1999). Designing and using simulations and role-play exercises. *Proceedings of the 32nd Hawaii International Conference on System Sciences*, Hawaii.
- Carroll, J.M. (2000). Five reasons for scenario-based design. *Interact. Comput.*, 13(1), 43–60. doi:10.1016/S0953-5438(00)00023-0.
- Comes, T., Bertsch, V., and French, S. (2013). Designing dynamic stress tests for improved critical infrastructure resilience. *International Conference on Information Systems for Crisis Response and Management (ISCRAM)*, Baden, Germany.
- Dautun, C. (2007). Contribution à l'étude des crises de grande ampleur: connaissance et aide à la décision pour la sécurité civile. PhD Thesis, École Nationale Supérieure des Mines, Saint-Etienne.
- Dautun, C., Pardini, G., and Roux-Dufort, C. (2011). La formation des acteurs publics à la gestion de crise. Le cas français. *11ème colloque sur la Sécurité Civile*.
- Deci, E.L. and Ryan, R.M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychol. Inq.*, 11(4), 227–268. doi:10.1207/S15327965PLI1104_01.

- Deci, E.L. and Ryan, R.M. (2008). Facilitating optimal motivation and psychological well-being across life's domains. *Can. Psychol.*, 49(1). doi:10.1037/0708-5591.49.3.262.
- Direction Générale de la Sécurité Civile et de la Gestion des Crises (2013). Synthèse des retours d'expériences des exercices 2013. Ministère de l'Intérieur.
- Fréalles, N. (2018). Formation à la gestion de crise à l'échelle communale: méthode d'élaboration et de mise en œuvre de scénarios de crise crédibles, pédagogiques et interactifs. PhD Thesis, IMT Mines Alès.
- Fréalles, N., Tena-Chollet, F., and Sauvagnargues, S. (2017). The key role of animation in the execution of crisis management exercises. In *Proceedings of the 14th International Conference on Information Systems for Crisis Response and Management (ISCRAM)*, Comes, T., Bénaben, F., Hanachi, C., Lauras, M., and Montarnal, A. (eds). Albi, France.
- Gaultier-Gaillard, S., Persin, M., and Vraie, B. (2012). *Gestion de crise, les exercices de simulation: de l'apprentissage à l'alerte*. AFNOR.
- Goutx, D. (2014). Réaliser la gravité d'enjeux abstraits à travers une simulation: comprendre COP-RW comme un rite de passage. *Négociations*, 22(2), 17–28. doi:10.3917/neg.022.0017
- Gregori, N., Brassac, C., and Sirvaut, A. (2009). Appropriation collective d'un dispositif de formation. *Epique'2009*, 73–81.
- Lagadec, P. (2007). *Enseigner la question des crises. Enjeux, Obstacles, Initiatives*. CECO-1568, Ecole Polytechnique.
- Marsella, S., Johnson, W., and LaBore, C. (2000). Interactive pedagogical drama. In *Proceedings of the Fourth International Conference on Autonomous Agents*, Barcelona, Spain, 301–308. doi:10.1145/336595.337507.
- Mateas, M. and Stern, A. (2002a). Towards integrating plot and character for interactive drama. *Socially Intelligent Agents*. Springer, Boston, MA, 221–228. doi:10.1007/0-306-47373-9_27.
- Mateas, M. and Stern, A. (2002b). *Architecture, Authorial Idioms and Early Observations of the Interactive Drama Façade*. School of Computer Science, Carnegie Mellon University.
- Mateas, M. and Stern, A. (2005). Structuring content in the Façade interactive drama architecture. *AIIDE*, 93–98. doi:10.1.1.101.4192.

- Mercan, G., Morizot, C., Chauzel, J.M., and Rannou, G. (2009). Guide thématique sur les exercices PPI. Ministère de l'Intérieur.
- Mercan, G., Morizot, C., Chevallier, A., and Rannou, G. (2011). Guide méthodologique sur les exercices cadre et terrain. Ministère de l'Intérieur.
- Mott, B.W. and Lester, J.C. (2006). U-director: A decision-theoretic narrative planning architecture for storytelling environments. *Proceedings of the Fifth International Joint Conference on Autonomous Agents and Multiagents Systems*. ACM, 977–984. doi:10.1145/1160633.1160808.
- Nisbett, R.E. and Wilson, T.D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychol. Rev.*, 84(3), 231–259. doi:10.1037/0033-295X.84.3.231.
- Noori, N.S., Wang, Y., and Comes, T. (2017). Behind the scenes of scenario-based training: Understanding scenario design and requirements in high-risk and uncertain environments. *Proceedings of the 14th ISCRAM Conference*, Albi, France.
- November, V. and Créton-Cazanave, L. (2017). *La gestion de crise à l'épreuve de l'exercice – EU SEQUANA*. La Documentation française.
- Renger, R., Wakelee, J., Bradshaw, J., and Hites, L. (2009). Steps in writing an effective master scenario events list. *J. Emerg. Manag.*, 7(6), 51–60.
- Riedl, M.O. and Stern, A. (2006). Believable agents and intelligent story adaptation for interactive storytelling. *International Conference on Technologies for Interactive Digital Storytelling and Entertainment*, Springer, Berlin, Heidelberg, 1–12, December. doi:10.1007/11944577_1.
- Riedl, M., Saretto, C.J., and Young, R.M. (2003). Managing interaction between users and agents in a multi-agent storytelling environment. *Proceedings of the Second International Joint Conference on Autonomous Agents and Multiagent Systems*. ACM, 741–748, July. doi:http://doi.acm.org/10.1145/860575.860694.
- Shilkrot, R., Montfort, N., and Maes, P. (2014). Narratives of augmented worlds. *Mixed and Augmented Reality-Media, Art, Social Science, Humanities and Design (ISMAR-MASH'D), 2014 IEEE International Symposium*. IEEE, Munich, 35–42. doi:10.1109/ISMAR-AMH.2014.6935436.

- Si, M., Marsella, S.C., and Pynadath, D.V. (2005). Thespian: Using multi-agent fitting to craft interactive drama. *Proceedings of the Fourth International Joint Conference on Autonomous Agents and Multiagent Systems*. ACM, 21–28. doi:10.1145/1082473.1082477.
- Si, M., Marsella, S.C.S., and Pynadath, D.D. V. (2007). Proactive authoring for interactive drama: An author's assistant. *International Workshop on Intelligent Virtual Agents*. Springer, Berlin, Heidelberg, 225–237.
- Steelman, T.A. and McCaffrey, S. (2013). Best practices in risk and crisis communication: Implications for natural hazards management. *Nat. Hazards*, 65(1), 683–705. doi:10.1007/s11069-012-0386-z.
- Stern, E.K. (ed.). (2014). *Designing Crisis Management Training and Exercises for Strategic Leaders*. Försvarshögskolan, Stockholm.
- Szilas, N. (2007). A computational model of an intelligent narrator for interactive narratives. *Appl. Artif. Intel.*, 21(8), 753–801. doi:10.1080/08839510701526574.
- Szilas, N., Marty, O., and Réty, J.-H. (2003). Authoring highly generative interactive drama. *International Conference on Virtual Storytelling*. Springer, Berlin, Heidelberg. doi:10.1007/978-3-540-40014-1_5.
- Tena-Chollet, F. (2012). Elaboration d'un environnement semi-virtuel de formation à la gestion stratégique de crise, basé sur la simulation multi-agents. PhD Thesis, École Nationale Supérieure des Mines, Saint-Etienne.
- Tena-Chollet, F., Tixier, J., Dandrieux, A., and Slangen, P. (2016). Training decision-makers: Existing strategies for natural and technological crisis management and specifications of an improved simulation-based tool. *Safety Sci.*, 97, 144–153. doi:10.1016/j.ssci.2016.03.025
- Verdel, T., Tardy, A., Lopez, P., Hansen, C., and Deschanel, J. (2010). iCrisisTM : un dispositif original de simulation de gestion de crise. *17e Congrès de Maîtrise des Risques et de Sécurité de Fonctionnement*, La Rochelle, October.