

Identifying Resilience in Emergency Response Stories

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Abstract. In organizations, work done differs from work as prescribed. Workers are always innovating in an effort to respond to unforeseen conditions that arise in production processes. In emergency response situations, where production processes are myriad and poorly defined, this improvisation is augmented. Successful actions that result from these improvisations remain tacit, accessible only to those who participated in the action, and become unavailable to the organization when those people leave. Formalizing and divulging those actions is a means to increase operational and organizational efficiency as they get incorporated into the organization's plans. Additionally, they are important content for preparation and training programs. This text reports on the implementation and use of a method to make explicit and recover resilient actions undertaken in emergency response events, based on the collective story creation technique called Group Storytelling. The method was used to analyze the participation of firefighters of the Rio de Janeiro State Military Firefighting Corps in Brazil, in two emergency response events, one an incident involving hazardous products, and the other a commercial building fire, which happened in 2004 and 2005, respectively.

1 INTRODUCTION

Daily, unexpected situations arise during the execution of organizational processes. Work as designed differs from the way it happens in the real world due to unforeseen elements [MCDONALD, 2005]. People are challenged to improvise and innovate so as to maintain production efficiency.

The knowledge resulting from these improvisations, in general, is not made explicit and formalized, and is incorporated only temporarily into the organization's intellectual assets base, as it is stored only in the minds of its creators or of people close by who witnessed these situations, who for various reasons may become unavailable to the organization.

In emergency response activities, problems inherent to improvisation during the realization of work are aggravated by other factors. In these activities, where the

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scenario and environment are notoriously variable, it is very difficult to define processes to deal with them, and consequently workers involved in these processes come to improvise during much of their work.

Resilient actions [HOLLNAGEL & SUNDSTRÖM, 2005] adopted during emergency responses are part of this knowledge and their externalization and inclusion in organizational plans is very important. With these actions organizations are able to make their processes more encompassing as well as increase their ability to deal with the unforeseen, through the use of this type of knowledge to train less experienced workers.

Many initiatives and techniques are created and applied so as to make this knowledge explicit, such as interviews, reports, etc. Unfortunately, a good portion of these does not produce satisfactory results, generating opportunity and incentives for new approaches to be tested.

These resilient actions are often the result of the articulation of several participants in some process where some unforeseen event occurred. In emergency responses this becomes more evident, especially when there are people from different organizations collaborating do solve some problem. The knowledge produced by these inter-organizational interactions is fragmented among the organizations, and each of the participants may end up knowing only part of the events.

The need arises, then, for a technique that is able to recover the knowledge dispersed among the participants, in an attempt to reconstruct the events and represent them by means of a shared image. One of the ways people transmit knowledge is through stories. Recognized as an intuitive and age old technique, stories allow people to share their knowledge of past events.

It is also possible for stories to be built collectively, in a group, by those who participated in or witnessed events. This technique, called Group Storytelling [VALLE, PRINZ & BORGES, 2002; CARMINATTI, BORGES & GOMES, 2006], allows the people who use it to make the collective knowledge explicit, facilitating its appropriation.

In this text we report on the use of a computer supported method proposed to make explicit and recover resilient actions undertaken in emergency responses [REIS, 2008; REIS, BORGES & GOMES, 2007; REIS, BORGES & GOMES, 2008]. The method was employed in the analysis of actions by members of the Military Firefighting Corps of Rio de Janeiro State, in Brazil, in two emergency response events, one an incident involving hazardous products, and the other a commercial building fire, which happened in 2004 and 2005 [REIS, 2008]. The analysis assessed and identified some measures adopted during the emergency responses that were deemed resilient actions.

2 STORIES AND KNOWLEDGE RECOVERY

Knowledge recovery can be done individually or collectively. When the first option is adopted, the result obtained from the externalization of the knowledge is a report that presents the view of only one person. This often seen, for example, in military organizations, where the highest ranking participant in an event is required to prepare a report of the events.

A slightly more encompassing situation is the case where the report is drawn up by

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someone who interviews others who witnessed the events. Even so, in this case, the individual impressions will be subject to the beliefs, emotions, and mental model of the interviewer, who will build the report through synthesis.

Another possibility, studied in this work, concerns the collective construction of reports. This construction tends to be broader and richer, as it joins the individual knowledge of all the participants under the group's consensus, which tends to build, through synergy, a report closer to the reality being studied. People, as they interact in this construction, tend to fill in one another's gaps, stimulating the group's memory, discussing their perception about the witnessed events.

Carminatti, Borges and Gomes, 2006, present the idea of the existence of four versions of a report. The first version is that which is stored in the minds of the people who witnessed or participated in the event. The second version is the one reported by these people, that is, the externalization of their tacit knowledge. The third version is the one known by these people, that is, the knowledge, even if tacit, that the participants collectively have. The fourth version is the real or true description of events, and is probably unavailable.

The objective of the knowledge recovery process is to get the reported version as close to the known version as possible. Once the recovery process participants have constructed the known version, through their individual contributions, it is necessary for them to externalize this collective mental image.

For Valle, Prinz and Borges, 2002, a story is "a narrative of a chain of events said or written in prose or verse". Stories can be told by a person or a group of persons. Valle et al., 2003, define Group Storytelling as the technique for telling stories where more than one person contributes, synchronously or asynchronously, locally or remotely, at various stages of the process, through several media.

The process of creating stories as a group produces richer results, as it presents a collective vision of the narrated event. In the case of an emergency response event, several people that witnessed it contribute with their individual perceptions, so as to create a collective image of what happened, producing a richer report.

The idea of using the Group Storytelling technique is simple, but its execution is not. It depends on the existence of a knowledge management culture in the organizations, as well as a culture of collaboration. A collective story is harder to obtain, but when obtained, it is richer.

3 THE METHOD

The method for identifying and recovering resilient actions undertaken in emergency responses is composed of six phases. During the first phase, the emergency response system to be analyzed, along with its possible working states, is characterized as proposed by Hollnagel and Sundström, 2005.

During the second phase the story of the response to the emergency is developed. The people who participated or witnessed the emergency response event get together to tell, using the Group Storytelling technique, a story of what they witnessed.

During the third phase, the process facilitator develops a time line that represents the chronological ordering of the actions undertaken during the emergency response. This timeline is defined based on the facts reported by the witnesses who told the story.

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The fourth phase handles the identification of the resilience characteristics of the actions described in the story. In this phase a resilience analyst is brought in to identify, from among the listed actions, the ones that have one or more characteristics of resilience. Reis, 2008, identifies relevant literature and demonstrates how to identify resilience characteristics in the narrated events.

The fifth phase is where the system components' working states are analyzed. A domain specialist indicates the state each given component was in before and after some given action reported in the story

In the sixth phase, the domain specialist does a cost-benefit analysis of adopting the actions identified as resilient. The actions deemed beneficial become part of the organization's emergency plans, and are adopted as good practice and will be divulged to other workers through training.

4 CASE STUDY

In our case study the performance of members the Rio de Janeiro State Military Firefighting Corps in fighting a fire in a commercial building in 2005 was analyzed. The building was a supermarket, which due to the season had a large quantity of products in stock which favored the spread of the fire.

The domain specialist invited to use the method and assist in the analysis of the event was a fireman with twenty years of experience, six of which in command positions.

Initially the domain specialist helped define the firefighting system, its states and components. Table 1 presents a summary of this phase.

Table 1. System definition

System	Objective	Components
System for fighting fires in small to medium sized commercial buildings	Tackle fires in commercial buildings, keeping all involved, whether victims or firefighters, free from harm, as well as any property present	Water supply, physical integrity of all people and property involved

The state model proposed by Hollnagel and Sundström, 2005, for characterizing services organizations was considered adequate to represent the case being studied.

Characteristics that define each system component's state at a given moment were defined. Table 2 presents the characteristics of the water supply component.

Table 2. System states and monitoring variables

Component : Water supply	
Normal functioning	Existence of a water pumping system for fire-fighting, comprised of two inexhaustible water supplies

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Reduced functioning (regular)	Foreseen temporary partial interruption in water pumping, due to the depletion of one of the truck's fuel supply
Reduced functioning (irregular)	The unforeseen temporary partial interruption in water pumping, due to a mechanical malfunction in one of the pumps
Disturbed functioning	Total interruption of fire-fighting water pumping, due to simultaneous mechanical failure in the two pumps
Repair	Re-establishment of total water pumping capacity, due to the mechanical repair of the pumps

The event's story was developed by a group of officers from the firefighting unit stationed on Ilha do Governador, Rio de Janeiro. They used tellstory, a computer tool that supports the Group Storytelling story construction technique. The officers input thirty seven story fragments, which together formed the event's story.

In phase three the time line extracted from the reported story fragments was put together. The time line obtained chained fifty six events, which are the actions undertaken by the firefighters to control the fire. Figure 1 presents an excerpt of this time line.

In phase four the existence of resilience characteristics in actions undertaken by firefighters was analyzed. Some excerpts of reported actions and the respective resilience characteristics identified in them are presented in table 3.

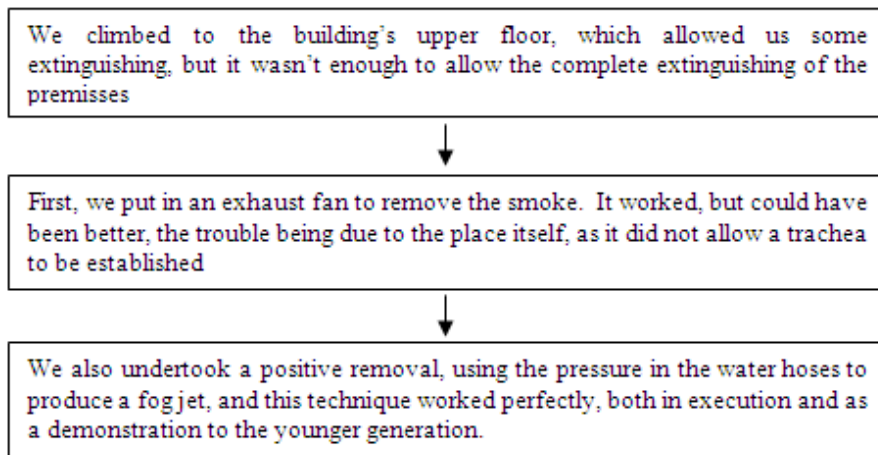


Fig. 1. Excerpt of time line

In phase five the domain specialist indicated the previous and following states of the analyzed component in the state model. In the first action reported in table 2 the water supply system component was in the reduced state before the action and changed to normal after the action. The second action affected workers' physical integrity, as the collapse of the structure could cause an accident and damage. It was reported in the story that the water trapped in the building was drained and the load on the structure relieved, which kept that system component in a normal state.

Table 3. Identifying resilience characteristics

Action	Resilience characteristics
« According to Lt. Leandro - Operations Commander, there was trouble controlling the fire due to the absence of hydrants in the area. Luckily a water company tanker-truck and shortly after a private one were passing by and stopped to help. This is what sustained the fight while our tanker went to refill. »	« Ability to articulate with other organizations – faced with the lack of water due to the absence of hydrants in the vicinity of the emergency the firemen requested the water necessary to continue firefighting from a water company tanker and a private tanker.
« Early on in the operations, I already had a worry: as the building was built of concrete and there was a lot of water, I feared for the load on the structure, as I knew from previous reports that the water-logged goods could bring the building down. It certainly wasn't built for that load. It was necessary to drain the water to relieve the weight. »	« Ability to anticipate threats and their consequences – the operations commander realized that the structure could collapse if the weight of the accumulated increased. Learning from experience – Previous reports of structure collapses due to the weight of accumulated water made the commander wary that he might be facing a similar situation. Flexibility – the firefighters improvised to get the water out and relieve the load on the building's structure »

Finally, in phase six of the method the domain specialist considered that the two reported actions were adequate and that they should be incorporated into the firefighting corps practices, as well as be communicated through training.

5 CONCLUSION

In this paper we presented the use of a method for the recovery and identification of resilient actions reported in emergency response stories, proposed by [REIS, BORGES & GOMES, 2007]. The method is based on the technique for elaborating collective stories known as Group Storytelling.

We believe that the use of Group Storytelling to analyze resilient actions is adequate as stories created through this technique contain a global perspective obtained from the various points of view of those who participated in or witnessed emergency response events.

The proposed method was used in a second case study, reported by Reis, 2008, about the performance of firefighters in an emergency response event involving dangerous products.

The method presented requires further evaluation and has limitations such as being highly dependent on the experience of the people participating in its preparation and

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analysis phases.

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