Sources of resilience and brittleness of team performance in nuclear emergency response exercises

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This report presents some results from a cognitive task analysis (CTA) of a nuclear disaster simulation[1]. Audio-visual records were collected from an emergency room team composed of individuals from 26 different agencies as they responded to multiple scenarios in a simulated nuclear disaster. This simulation was part of a national emergency response training activity for a nuclear power plant located in a Brazil. The objectives of this paper are to describe sources of resilience and brittleness in these activities, identify cues of potential improvements for future emergency simulations, and leveraging the resilience of the emergency response system in case of a real disaster. Multiple CTA techniques were used to gain a better understanding of the cognitive dimensions of the activity and to identify team coordination and crisis management patterns that emerged from the simulation exercises.

Method

The method is based on direct observation of the nuclear emergency response simulation exercise for the identification of sources of resilience and brittleness in team coordination activities. Resilience can be very widely defined as the capacity of the system/organization to successfully handle disturbances, including the unexpected ones [2]. Our research method can be described as a case study research that uses CTA techniques in its analysis. We collected data during the simulation of a nuclear power plant emergency where the External Emergency Plan was employed to test and better prepare agencies and people for a real event. The exercise we observed included both coordination and field activities. Our observation, however, was limited to the coordination activities component carried out within the confines of the Nuclear Emergency Coordination Center. The NPP, where the simulation was conducted, is located in Angra dos Reis, Brazil. In addition to the normal challenges typical of emergency response situations, we also had to face other challenges which stemmed from the basic local infrastructure of the area itself and to deal with the need to organize the interplay of different agencies that normally do not work together. The sources of resilience and brittleness identified, based on the data analysis, are of different natures. Some of them concern the design of the exercise itself (realism, dynamics, simulation development, validity), others, on the other hand, concern the challenges of the nuclear emergency response coordination activities.

Results

Sources of resilience have been noted during team coordinator briefing/debriefing dialogs to achieve a common ground and mutual situation awareness, as agents acts achieving interpredictability: (1) acting predictably and being directable, (2) signaling their status and intentions, and (3) interpreting signals that indicate the status and intentions of other team members. Due to the dynamic characteristics of an emergency response, cross check interactions through constant briefing and debriefing are extremely important to achieve a mutual situation awareness and interpredictability. The source of brittleness was related to the design of the exercise, which was quite static, while a nuclear accident is highly complex and dynamic. The emergency response team received a relatively small number of predetermined situations in a predetermined sequence, creating a less complex and challenging environment. Team behavior changed markedly when a group of activists started blocking roads in a surprising real-world situation. Agency participants became noticeably more serious and marginal activities (those among people not directly involved in dealing with the situation) dropped. A "learning laboratory" approach might mitigate this issue, enabling the abstraction of valuable lessons from and better design of these large-scale exercises.

References

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