



Research note

Evaluating emergency management capability of a water utility: A pilot study using exercise metrics

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ABSTRACT

There is a societal expectation that we will still have access to essential services in the immediate aftermath of a disaster. This necessitates that utility organisations are resilient and therefore prepared for unexpected threats. One important type of preparedness activity is exercising. This research note presents findings from a pilot study in which performance evaluation metrics were developed for an emergency management exercise conducted by a water utility. Initial findings suggest that metrics and benchmarks can be successfully applied in this domain with positive implications for planning and policy across the utilities sector.

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1. Introduction

Internationally, natural and man-made disasters such as the World Trade Centre attacks in 2001, Hurricane Katrina in 2005, the Haiti earthquake in 2010, the Fukushima nuclear incident in 2011, and the Nepalese earthquake in 2015 are becoming an increasingly common occurrence. The 7.8 magnitude earthquake that ravaged Nepal in 2015 caused widespread devastation, and essential services such as water and electricity supplies remained disrupted in the capital city of Kathmandu for almost a week after the event (Sharma, 2015). If disasters are not managed well, they will continue to disrupt and threaten individual lives, communities, organisations, and economies. Disasters of any magnitude necessitate comprehensive yet effective emergency management arrangements across all relevant public, private, and non-government organisations. In the 21st Century our modern society is reliant on the effective functioning of utilities to provide public services, maintain a quality of life, and support economic growth (Boin and McConnell, 2007). Certain utilities such as energy, water, and communications are so vital and ubiquitous that disruption or destruction of their capacity can affect the security

and social welfare of any nation (Gheorghe et al., 2007). There is an expectation in today's societies that essential utility services will still be available during extreme disaster conditions despite their vulnerability (de Bruijne and van Eeten, 2007; Marti and Hollman, 2008). Notwithstanding this belief, recent disasters such as Hurricane Katrina still caused untold damage to utility services, deprived citizens of basic services, and resulted in huge economic losses (Fritzon et al., 2007; Leavitt, 2006). The utility industry has a civic responsibility to enhance organisational resilience in an effort to reduce the impact of disasters on communities.

Anticipation can be considered the first dimension of organisational resilience and includes capabilities to observe the environment, identify potential threats, and as far as possible, prepare for unexpected events (Duchek, 2014). Utility organisations can prepare for disasters by testing their preparedness in emergency management exercises. Exercises can assist organisations by improving their capacity to cope with disasters (Berlin and Carlström, 2015). However, a lack of performance measurement tools can thwart evaluation of the effectiveness of an exercise (Sinclair et al., 2012). One option is to utilise evaluation metrics for key criteria. Exercise metrics can be used to identify discrepancies between intended and actual performance (International Organization for Standardization, 2013). Unfortunately, the emergency management literature is limited with respect to the use of exercise metrics. However, there is some application of metrics in

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health-related disaster exercises, as documented in the medical-sciences literature (Gryth et al., 2010; Ingrassia et al., 2013). By using metrics in the evaluation of health-related disaster exercises, it was possible to demonstrate results quantitatively. This enabled the unbiased identification of the strengths and weaknesses of the exercises and the establishment of benchmarks for evaluating future exercises (Gryth et al., 2010; Ingrassia et al., 2013; Wakasugi et al., 2009).

If emergency management exercises are viewed as an investment for a safer and more secure society (see Kim, 2013), it is imperative that utility organisations have the capability to measure the degree of success achieved in their exercises and therefore the status of their disaster preparedness. Nevertheless, there remains a lack of guidelines for developing such metrics (Heumüller et al., 2012). The aim of this study is to describe the use of exercise evaluation metrics in a water-services emergency management exercise that in turn can be used to assess disaster preparedness. This research note will focus primarily on the methodology used in this study before briefly presenting the results and discussing the potential implications for the broader utilities sector.

2. Methods

As designing and conducting an exercise requires extensive organisational resources, it is necessary for these processes to be efficient. This means that the exercise design follows the exercise goal and purpose, and that valid evaluation results are recorded. Exercises have different purposes, such as assessing and validating policies, plans, or procedures; evaluating personnel training; or identifying areas for improvement (US Dept of Homeland Security, 2007). These purposes are relevant in organisations most commonly associated with disaster response, such as the emergency services (e.g., police, fire, and ambulance agencies), but are also transferable to public utilities. From an evaluation perspective, exercises in this area are primarily focussed on training, testing and experimentation. Heumüller, Richter & Lechner (2013) propose a goal and evaluation oriented classification of exercises and distinguish between Training, Testing, and Experimental Exercises. They offer characteristics for each exercise type for consideration by exercise designers. These characteristics help to design exercises in a goal and evaluation oriented manner, which requires the design of metrics as well. Table 1 provides a comprehensive description of each exercise type. The following description of the exercise conducted as part of this the study is based on the concept of a Test Exercise, as two emergency management plans were to be tested (“goal and purpose”). All the participants involved in the exercise were knowledgeable in the organisations’ emergency management arrangements and thus deemed to be trained personnel (“participants”).

The “evaluation content and output” were based on standard operating procedures, in this case two emergency management plans, so that the exercise evaluators could record specific behaviours of the exercise participants according to specific tasks. Based on these observations, a respective conformity check with the existing emergency management plans was possible. In accordance with this exercise type, metrics must be measurable and comparable. Consequently, time objectives and a scoring system were developed. The “evaluation methodology” consisted of specific single measurements for the criteria, which were defined in the emergency management plans. The process for identifying the metrics is described in section 2.2 and the scoring system for the metrics is described in section 2.3.

The “role of the evaluators” in the exercise was to be neutral and passive with respect to observing and evaluating the exercise according to the metrics. The “scenario complexity” was appropriate

with regard to the training level of personnel in that it was an extreme yet relatively “feasible” emergency event. As the exercise was a Test Exercise, no innovations were expected (“potential for innovation”) or analysed. Expected “results” involved an assessment of the organisation’s preparedness based on the ability of participants to meet the requirements of the emergency plans.

2.1. Study setting

The exercise was conducted in a water services organisation and based on a scenario involving a catastrophic failure of a storage dam. The test exercise sought to use two emergency management plans that were required during this type of incident. The water organisation in this study uses an incident command system grounded on the Australasian Inter-Service Incident Management System (Australasian Fire And Emergency Service Authorities Council, 2013). This system advocates the use of an incident-management team that can provide the numerous functions that may be required by the incident controller during a disaster (Fig. 1).

For the purpose of this test exercise the incident-management team was located in the organisations emergency operations centre where all actions subsequent to the event were coordinated. Ten employees from the water organisation participated and each had a role in the incident-management team for the duration of the exercise (Fig. 2). The exercise was conducted in real time over a period of three hours and involved the participation of multiple agencies (e.g., the police force, the regulatory agency, and local councils) that would be involved in such a catastrophe. Agency personnel were contacted by members of the incident-management team by telephone or they were present in the emergency operations centre for face-to-face briefings in order to provide a realistic simulation experience for the participants.

2.2. Identifying the metrics

The metrics were identified from two emergency management plans. The first was a generic all hazards emergency management response process that is used in the management of any type of incident by the organisation involved in this study. The second was a specific dam-safety emergency plan. From these two documents the exercise committee identified twenty measurable activities for which time objectives could be established (Table 2).

The exercise evaluation metrics were derived from some of the performance indicators described for health disasters in the medical-science literature (Gryth et al., 2010; Ingrassia et al., 2013) but modified and made relevant to the emergency management arrangements for the water organisation in this study. The exercise evaluation metrics were constructed for the time period in which it was expected that action should be completed. Initially, internal stakeholders and personnel from external agencies participating in the exercise were consulted to determine the timing for the actions. The zero hour was defined as when the incident controller confirmed the incident level; all actions had to be completed within a certain number of minutes from this point in time unless otherwise stated (see Table 2 and activities 4, 19 and 20 for contingencies). Once the actions and associated timings were devised and agreed upon by the exercise committee, they were further reviewed by four external specialists familiar with the emergency management in the water industry and specifically catastrophic dam-failure exercises. Recommendations from these experts were incorporated into the evaluation scheme and time objectives.

2.3. Evaluation and analysis

Four experienced evaluators were recruited to evaluate the

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