Towards a Total Quality Framework for the Evaluation and Improvement of Emergency Plans Management

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ABSTRACT

The evaluation of the quality of emergency plans is an unresolved issue. While most research efforts have focused on the definition and improvement of planning methods and the associated tools, a reference framework allowing the assessment of emergency plans is still missing. In this paper, we report our initial work towards the definition of a quality framework for emergency plan management. To create it, we are borrowing results from more than one century of research on quality methods, with special emphasis in the newest Total Quality Management approaches that pay attention to technical, human and strategic concerns during the plan development process. The QuEP framework defines a number of planning principles and practices to define a maturity-driven layered model for the evaluation of organizations. We list the principles and practices, and describe its potential to be integrated with other emergency plan management frameworks.

Keywords

Emergency Plans Management, Quality Management, Principles and Practices.

INTRODUCTION AND MOTIVATION

The emergency plan is the major asset generated in the planning stage of the emergency management lifecycle. It is a document in which the actions to be performed in response to potential incidents are represented along with other information such as descriptions of the infrastructure and risks of an organization. In absence of any kind of standard of emergency plan, different countries have released guides or laws that define a minimum content of plans, to which organizations are recommended to adhere. Examples are the "Self-protection Law" (NBA, 2007) in Spain, the "Comprehensive Preparedness Guide" (CPG) 101, published by Federal Emergency Management Agency (FEMA) in the USA (CPG, 2010) , and the "Guidance-Emergency preparedness" (UK, 2014) at the United Kingdom (see (Canós et al, 2013) for more examples). In general, these guidelines are textual documents that planners use as templates that must be filled in using some word processing system, since very few tools for creating complete plans following some method are available.

The lack of a reference planning process model has other consequences. Specifically, making assessments about the capabilities of organizations with regard to emergency management is difficult. In the Information Technology (IT) age, very few organizations have embraced technology for planning, and still rely

on the printed document and manual responses.

In such a scenario, having methods for the development and evaluation of emergency plans can be the way to increase the quality of both the plan and planning processes than can lead to better emergency responses. Berke (Berke and Godschalk, 2009) pointed out the relevance of plan evaluation, as well as the need for evaluation tools since there are no general proposals in this direction. Moreover, plan quality evaluation is a topic more and more present in the discussions held during the "Planning and Foresight" sessions of the ISCRAM Conference series.

The goal of this work is the definition of an emergency plan quality model and its integration in a framework for plan management called QuEP. The model is intended to be the evaluation tool of a method in which not only the plan but also the planning process can be improved in order to increase the satisfaction of all the stakeholders in an organization. The quality model defines a framework that allows the identification, evaluation and measurement of the maturity of an organization with regard to emergency plan management. Maturity models have proven to be very successful in other domains such as Software Engineering (CMMI, 2014). We identify different dimensions or *levels* to evaluate, along with a number of good practices recommended to each level. These good practices are intended not only as evaluation criteria but also as guidelines to increase the planning capabilities that lead to better plans. As part of the work, several supporting tools will be developed and integrated in the plan management framework.

This paper is organized as follows. Section 2 provides some background on quality management in general and quality management in emergency plans. Section 3 introduces the QuEP framework, whose quality model and best practices identified for each maturity level are presented in section 4. Finally, Section 5 shows how the QuEP framework is being integrated with an emergency management framework. Section 6 concludes the paper and outlines further work.

RELATED WORK

Quality management is a discipline with a long history. Since the early 20th century pioneering works, a number of refinements have led to the most recent proposals built around the concept of Total Quality Management, or TQM for short (Oakland, 2003; Charantimath, 2011). The complexity of quality management has led to many different interpretations of the concept of quality, which in turn have resulted in different sets of principles and practices.

Quality models provide advice and guidance about the application of the three basic building blocks, as stated by (Dean and Bowen, 1994): principles, practices and techniques. Relevant TQM models are EFQM (EFQM, 2014), Baldrige (NIST, 2014), ISO 9000:2000 (Singhal, 2008), Deming (JUSE, 2014), and the Iberoamerican model (Fundibeq, 2014). All the above models allow the evaluation of the processes of organizations by means of sets of quantifiable values. The goal is to increase the excellence of the organizations services by continuous improvement processes. EFQM and the Iberoamerican model are quite similar in terms of the underlying principles and practices. The Baldrige model includes a larger set of practices, being a superset of all the other methods. EFQM is the most specific model since it includes a sub-practices hierarchy richer than the others.

There are very few works on the quality of emergency plans. Meyerson proposed a tool for evaluating plan quality of local governments (Meyerson, 2013). The tool is based on a checklist that can be used to evaluate local emergency plans from a set of planning principles based on Berke's works on mitigation plans (Berke 2009, 2012). TQM approaches have been applied to some stages of the emergency management cycle, namely, mitigation and recovery (Takeda et al., 2003). Besides this, and to the best of our knowledge, there are no TQM-based emergency plan quality management models, and hence we intend to work on the development of such a model and the corresponding supporting tools. We intend to apply TQM principles to the management of emergency plans to define a maturity-driven layered model for the evaluation of organizations, along with a number of guidelines to progress upward in the maturity ladder. In the remainder of the paper, we outline the initial foundations of our work.

THE QUEP FRAMEWORK

QuEP is a TQM framework that allows to evaluate how an organization manages

its emergency plans in terms of a hierarchy of maturity levels. A maturity level is a well-defined evolutionary phase toward achieving the total quality in the emergency plan management. Similarly to other maturity approaches (like the aforementioned CMMI model for software), each maturity level provides a collection of best practices to satisfy and serve as a foundation for continuous improvement.

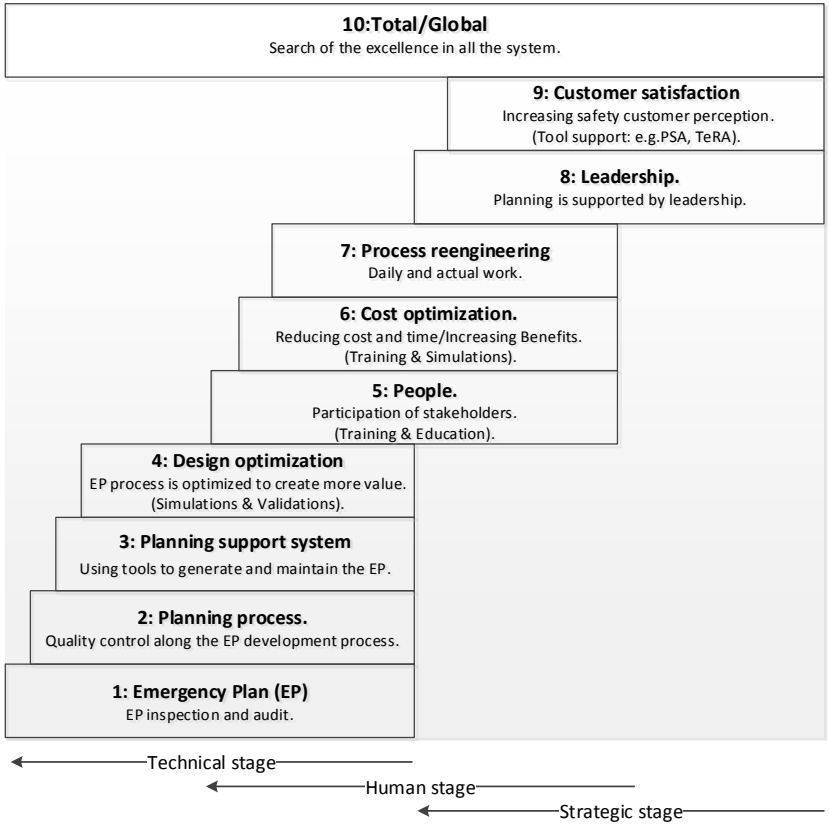

Figure 1. QuEP Framework.

The QuEP framework defines ten maturity levels designated by the numbers 1 (the lowest) to 10 (the highest). Figure 1 shows a representation of the framework, which is based on the one proposed by Camisón (Camisón 1998, 2007). At the maturity level 1, the organization is able to generate an emergency plan document according to regulations and laws, but without any structured plan generation process. The quality of the emergency plan depends on the expertise and knowledge of the planners. At this level, the emergency plan as a document may be manually inspected and audited. At level 2, the organization has incorporated a specific and repeatable planning process, which influences the quality of the emergency plan since the process is accompanied by a quality control process to ensure the quality of the emergency plan. At level 3, the organization uses a planning support system which implements the planning process defined at level 2 to generate and maintain the emergency plan. In addition, the planning support system provides reusable resources related to risk assessment, response procedures, evacuation plans, and other emergency plan components. Level 4 organizations, in turn, are able to improve the planning processes by designing new activities to create more value in the emergency plan, like simulations of response procedures or information availability checking. Levels 1 to 4 form what Camisón calls the technical stage of the TQM approach, which is oriented to increase the quality of the product (i.e., the emergency plan).

The three following levels in the hierarchy relate to the human participation in the planning process. Level 5 evaluates the participation of the people involved in the emergency plans generation and enactment (the response). The planners, the workers, the response teams and the citizens must change the way of thinking and increase their participation in the planning process. The organization must increase the investment in emergency education, training and drills. At maturity level 6, the organization focuses on optimizing costs and achievement profits. Adding the human dimension means, to some extent, improving the emergency plans by detecting important losses and inefficiencies. The organization must study costs and find the balance between investment and profits. A better planning of education courses, training and drills to reduce costs are examples of actions to

be undertaken at this level. The main benefit is the increase in the safety of people, thus enhancing the organization's reputation for safety. At level 7, organization adds to level 6 a continuous observation of daily and actual emergency planning activities, using process re-engineering techniques to improve the emergency planning process.

The maturity levels 8 and 9 represent the strategic stage of the Camisón's classification. The main idea behind this stage is that increasing the quality of the emergency plans must be a strategic decision of the organization. Level 8 covers cultural aspects like leadership and clear direction style, both realized jointly with all the stakeholders (planners, citizens, responders and authority). Level 9 focuses on customer satisfaction that, in the case of emergency planning, may be understood as e.g. increased safety perception. Sometimes, IT-based tools like PSA and TeRA (Ruiz-Zafra et al., 2014) can play a key role in this regard.

At the top of the hierarchy, the level 10 aims for excellence throughout the QuEP framework, via a TQM approach to plan management. Such an approach can be reached in terms of a number of principles and practices that we outline below.

EMERGENCY PLANS MANAGEMENT PRINCIPLES AND PRACTICES

TQM approaches are based on the definition of a number of principles that must be satisfied via a set of practices undertaken by all the stakeholders. Table 1 summarizes who are the stakeholders participating in the emergency plan management processes, along with their responsibilities as stated in good practices guides and laws such as (NBA, 2007) and (CPG, 2010).

From the analysis of existing guides, we have derived the following set of principles:

- *Leadership and Policies*: Risk and emergency management are very important axes within an organization and, as such, an emergency plan must include policies to handle their key aspects.
- *Risk driven*: The emergency plan is based on the analysis and study of the risks associated to a given organization.

Stakeholders	Responsibilities
Public Administration	* Approve regulations and laws * Receive plans proposals * Approve plans
Civil Defense	* Coordination & Collaboration (local, regional, national). * Validation. * Drill schedule.
Organization	* Access to emergency management legislation. * Plan registration. * Validation * Education
Planners	* Plan generation. * Notification of planning activities to the organization. * Use of planning support tools
Workers	* Participation on the planning activities. * Education & Training
Citizens	* Access to plans. * To follow the instructions of responders.
Responders	* Access to formal knowledge.* Education &Training. * Response.

Table 1. Summary of stakeholders and responsibilities.

- *People*: The emergency plan elaboration must take cultural aspects into account.
- *Participation*: The emergency plan should be developed with participation of all the stakeholders.
- *IT and innovation*: Information technology significantly improves plan development.
- *Implementation*: The emergency plan must clearly define how it should be implemented.
- *Cooperation*: Inter-organizational coordination is key in emergency management, resulting sometimes in joint plans.
- *Results*: Goals must be clearly stated and work must be oriented to their fulfillment.
- *Monitoring and Continuous Improvement*: The emergency plan must continuously be evaluated and revised.

We are working on the definition of the set of practices that can lead organizations to fulfill the different principles. We have summarized our initial list of practices in Table 2. We do not provide more details due to space limitations.

Maturity Level	EP. Practice	EP. Principle
1: Emergency plan (EP)	Deliverable plan Standards and formats	Policies
	Consider aspects of risk	Risk driven
2: Planning process	Control in the development	Implementation
	Stakeholders involved	Participation
3: Planning support system	Analyze organizational resources	Implementation
	Analyze customer requirements	People
4: Design optimization	Optimizing requirements of risks.	Risk driven
	Simulation software Resource improvement and maintenance	Monitoring
5: People	Personal Training Public engagement.	Participation
	System responsibilities	Policies
6: Cost Optimization	Cost of training and Timeline.	Implementation
	Emergency drills	Monitoring
	Hazard analysis	Risk driven
7: Reengineering	Process improvement Analyzing daily activities	Monitoring
8: Leadership	Teamwork and Roles	Participation
	Leadership style	Policies
	Inter-organizational coordination	Cooperation
9: Service	Tools support	IT
	Customer perception	People
	Diffusion by authorities	Policies
	Customer satisfaction Goals and Vision (Objectives)	Results
10: Total	Search of the excellence in all system practices	

Table 2. Relationships between QuEP maturity levels, Principles and Practices

THE QUEP MODEL

The total quality model proposed covers the 9 principles identified and their respective practices. Figure 2 shows the relationships between them. The core principles are *risk driven*, *people* and *cooperation* because the emergency planning is based on the analysis and study of the risks, the response defined and the coordination intra/inter organizational, respectively. The management of emergency plans may be improved with the *participation* of all the stakeholders in the planning process. Another dimension related to the quality is how the emergency plans management is *implemented* and the use of *IT* to support it, which facilitates the participation. Moreover, the organization *policies* related to emergency management must be clearly stated and supported by the managers of the organization; this enforces the core principles and the *results* obtained. Finally, the *continuous monitoring and improvement* is applied all the principles, i.e., the entire emergency plans management.

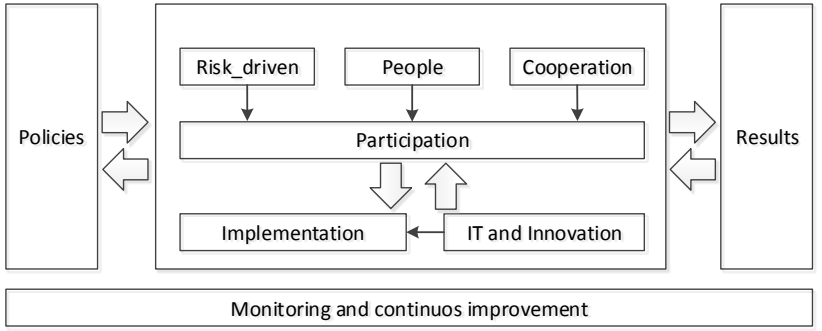

Figure 2. Total Quality Model to Emergency Plans Management

INTEGRATION WITH A EMERGENCY MANAGEMENT SYSTEM

The aim is the QuEP model could be integrated into any emergency management system. We have explored the integration with SAGA (Canós et al., 2013), a

framework to support the emergency plans lifecycle. It provides planners with a set of tools to elaborate, enact and share emergency plans. We plan to develop tools supporting the QuEP model to be integrated as a companion of the Plan Analysis Module within the SAGA architecture. Such a module is conceived to support the analysis of both emergency plans and their enactment (from the data collected during the execution of the responses). As shown in Figure 3, the QuEP framework will be added to SAGA as a new high-level component mostly interacting with the Plan Analysis Module.

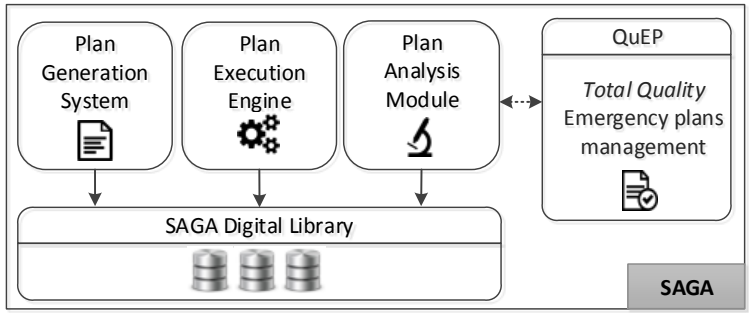

Figure 3. Integration with SAGA

CONCLUSIONS

We have introduced our first steps towards the definition of a Total Quality Management framework for emergency planning. The QuEP framework defines a number of principles for the emergency plan quality improvement that are supported by a number of practices still under study. A hierarchy of maturity levels allows to assess the capabilities of organizations with respect to the management of plans along their whole lifecycle, as well as to define improvement paths via a number of actions that can lead organizations up in the hierarchy.

Though in its first version the framework is essentially qualitative, we plan to transform it into more quantitative by assigning weights to the different dimensions to be analyzed. Such criteria and their weights will be the result of further research that will include interviews with all the stakeholders and reviews of additional literature on planning and quality management.

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