

Evaluation of organizational resilience: application in Quebec

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Abstract. Resilience is a new trend in the field of risk management, especially since the Hyogo Conference of 2005. In Quebec, an initiative was launched to increase the resilience of the essential systems. The four-step methodology developed by the *Centre risque & performance* is intended to be applied to the essential systems in Quebec. The first two steps have been partially realized and the results have been illustrated. From these results, a first representation of resilience is presented.

1 INTRODUCTION

Events such as the 1998 ice storm in Quebec and the August 2003 blackout that affected 50 million people in the Midwestern and Eastern USA and Ontario made governments aware that it has become essential to develop a culture of resilience within organizations in order to overcome disruptions of any kind and any size. The World Conference on Disaster Reduction held in Hyogo, in January 2005, was the base for new reforms for many governments. Indeed, the strategic goal of the Conference was “the development and strengthening of institutions, mechanism and capacities at all levels, in particular at the community level that can systematically contribute to building resilience to hazards” (United Nations, 2005, p. 9).

In this context, the Quebec government has the responsibility to ensure, at all times, the security of the entire population. One way for government authorities to assume this responsibility is to ensure, directly or indirectly, the constant supply of essential resources to the population. The unavailability of these resources, even temporary, could generate significant negative consequences on the health, the safety and the social and economic welfare of persons, or communities, and greatly impact the viability of enterprises and the effective functioning of governments and their institutions. These consequences could jeopardize the confidence of the public towards these institutions. From this perspective (where the public interest prevails), the Quebec government, through the Organization of Civil Protection of Quebec (OSCQ - *Organisation de Sécurité Civile du Québec*), has proposed to governmental, municipal, public and private institutions to undertake a comprehensive approach to reduce the vulnerability of essential systems in Quebec

and, thereby, to increase their resilience.

2 RESILIENCE: CONCEPTS AND EVALUATION

METHODOLOGY

Consistent with the literature, the theoretical concept of organizational resilience has been established from a consensus with all members of the Resilience Subcommittee of the OSCQ. The definition of organizational resilience that was retained is: « *a system's capacity to maintain or restore an acceptable level of functioning despite perturbations or failures.*» (MSP, 2009; Robert et al., 2010). This definition incorporates the concepts of systems approach, risks acceptability and adaptation to disturbances. The definitions found in the literature include some of the concepts found in this definition. Haines (2009) defines the resilience as the ability of a system to recover after an emergency. Madni and Jackson (2009), incorporate in their definition the notions of anticipation, resistance and adaptation. Similar notions are found in the works of Hollnagel et al. (2006) which give several definitions that incorporate the concept of capacity to regain (recover) a normal state of functioning after a disruption.

Overall, the majority of approaches that were investigated refer to an ability to operate in degraded mode or to regain a normal state of functioning after a disruption. The approach proposed by the CRP and the OSCQ stands out because it integrates all modes of organizational functioning expressed in terms of current management, specific management due to disturbances and emergency management. Organizational resilience corresponds to an organization's ability to manage all modes of organizational operation. Resilience must incorporate notions of retroactive evaluation, adjustments and validation of system.

The works done by the CRP in the last years have allowed the development of a methodological approach based on the assessment of risks related to critical infrastructures interdependencies (Robert and Morabito, 2008). This approach has led to the definition of a concept of resilience that integrates the concepts of system knowledge, of disturbances anticipation and management (Pinel, 2009; Pairet, 2009). Figure 1 below shows these different concepts.

The good knowledge of the system allows to define the various states in which the system can operate and the different levels of functioning (performance, dysfunction and failure). The state of a system is dynamic which means it evolves with time. The different states are represented by colors (green, yellow and red). To each system's state corresponds a management method (current management, specific management and emergency management). These management methods are represented by the springs and the cylinder. The springs symbolize an adaptive management while the cylinder symbolizes a more responsive management. An example of a more responsive management is the establishment of emergency procedures. The three key concepts of the resilience definition are the following:

- "system": the organization is viewed within a system approach;
- "despite perturbations or failures": it is necessary to characterize the system's perturbations, and even failures, and determine an acceptable level for them;
- "capacity to maintain or restore": when perturbations occur, the system adapts its management modes to be more resilient.

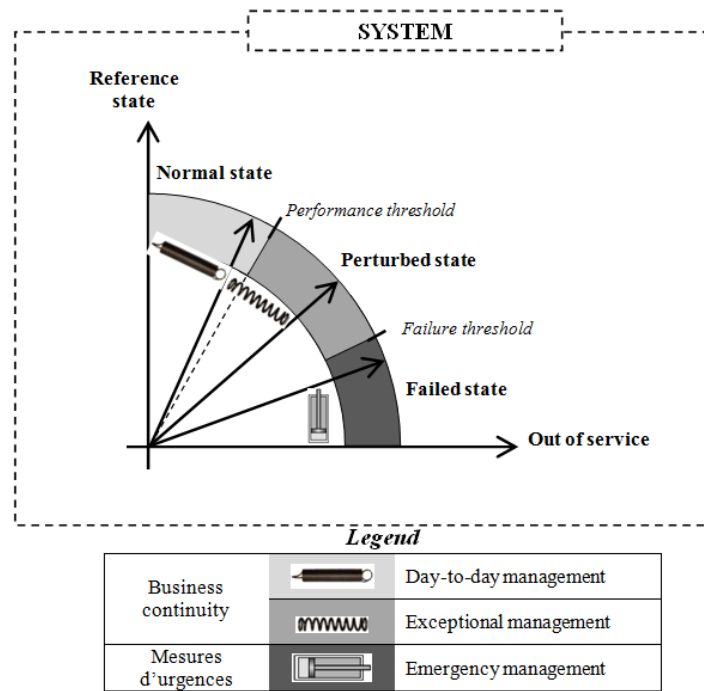


Figure 1: Concept of resilience (adapted from Robert et al.,2010)

This approach represents the first concept of resilience. It is advocated to represent an organization, which will henceforth be referred to as a “system.”

A system is a coordinated set of tangible or intangible actors and management and control elements organized within functional units based on common, established goals. A system uses resources that come from suppliers, called inputs, and provides other resources to users, called outputs.

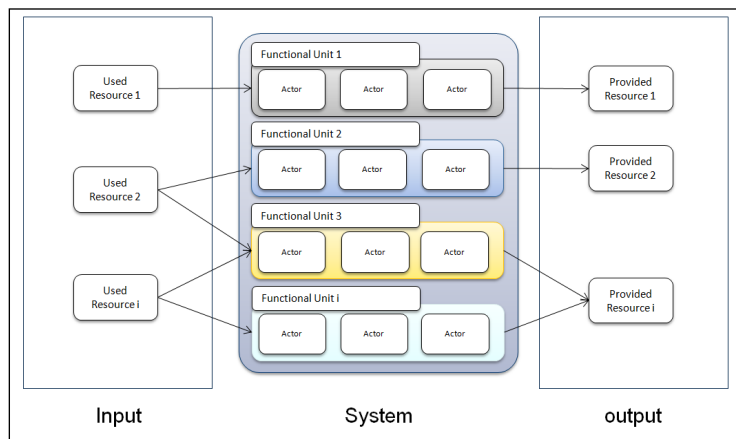


Figure 2: System approach

This approach is particularly interesting because it is multidisciplinary. The definitions selected allow numerous concepts to be incorporated and thus can be applied in many domains. As well, this approach makes it possible to decompose a

system fractally. In other words, a functional unit can itself be seen as a system and so on down to the smallest element. This vision enables users to better operationalize this approach within an organization.

The system approach therefore makes it possible to portray a system (inputs, functional units, outputs). We must now examine the environment in which a system operates and what kinds of perturbations and failures it must face.

The concept of resilience is perceived as being somewhat theoretical and complex. Knowing that the evaluation of resilience must become an important decision tool for organizations (BS, 2006; CSA, 2008, ISO, 2009), it is therefore crucial to integrate it into their culture, even though the transition from theory to practice is a difficult one.

The first way of acting concretely within an organization to operationalize all of these concepts and make it more resilient is to integrate the motto “Accept – Anticipate – Plan”, explain in the table 1.

Table 1: Concepts of resilience

Accept	<ul style="list-style-type: none"> • understand the environment in which the system is operating; • define a reference state for the system; • be aware of and accept system failures.
Anticipate	<ul style="list-style-type: none"> • be proactive in dealing with potential failures; • forecast turnaround times and provide for flexibility.
Plan	<ul style="list-style-type: none"> • organize preventive and corrective actions in advance thanks to the resilience management modes; • take the dependency of other resources into account when implementing actions.

The cement that binds these concepts and builds system resilience is the ongoing evaluation of the *coherence* among all of the system-internal elements related to knowledge, anticipatory mechanisms and planning rules, as well as its coherence with its environment. It is the knowledge of these three parameters which permits building the resilience portrait of a system.

The theoretical concepts presented above require an operational approach so they can be applied to systems. This implementation takes the form of a methodology designed to evaluate the resilience of systems (Pairet, 2009). The proposed methodology for evaluating system resilience is organized around four main steps as summarized in table 2.

Table 2: Recapitulation of the four step methodology

Identification of steps	Description of activities
Step 1: Portrait of the system	Definition of system
	Identification and breakdown of main outputs
	Identification of functional units
Step 2: Study of outputs and inputs	Characterization of outputs
	Characterization of inputs
	Evaluation of consequences and response times
Step 3:	Identification of critical elements

Management of failures	Characterization of management modes
	Characterization of alternative resources
Step 4: Evaluation of resilience	Knowledge of system
	Capacity to maintain its activities
	Capacity to restore its activities
	State of resilience of system

The first steps of this methodology, currently being implemented for all departments and agencies of the Organization of Civil Protection of Quebec (MSP, 2009) are of a crucial importance. Indeed, the component "Portrait of the system and study of outputs and inputs" that can be grouped under "Knowledge of the system" already allows a certain measure of the resilience of the system. Knowledge should always be the first step in a process for assessing organizational resilience and for eventually finding mechanisms for adaptation and anticipation that will remain in the organizational processes in order to ensure acceptable performance in most situations.

3 CURENT RESERCH

Since 2008, the first step of the methodology proposed here-above and the study of its outputs was conducted in 10 key sectors in Quebec, with the participation of 15 different ministries and agencies. Indeed, the 10 sector's portraits were realized and the majority of these portraits have been validated by a representative of each ministry and agency present in the Resilience Subcommittee of the OSCQ. All the essential resources of Quebec have been identified. The study of the outputs was conducted by focusing on the consequences of the unavailability of a resource on the health, the safety and welfare of the population and the social and economic activities and on the governance. The Figure 3 below shows the progress made in the study of the outputs.

This figure is divided into three parts each representing a different stage in the advancement of knowledge. Initially, the consequences have been established theoretically for all essential resources in Quebec (93 resources). Then, the study of the consequences has been submitted to the Resilience Subcommittee of the OSCQ for validation. As can be seen in the figure, only some of the consequences have been validated. Hence, this second objective was not fully achieved. Finally, the next step will be to submit the study to the entire community of essential resources providers to ensure the consistency of the study.

The notion of "objective" has been integrated into the process in order to show the progress made over a long period of time and to ensure a constant mobilization of all partners. As shown in Figure 3, the role of these partners is to identify the organizations that must be involved in the process and to validate and accept the outputs of the methodology.

The circular shapes represent the consequences on the population caused by the unavailability of critical resources in Quebec: the more colors there are, the greater are the consequences on the population. This graphical representation allows a clear viewing of the resources that directly impact the population. It should be noted that

the representation has evolved between the first and second stage, when the study was submitted for validation to the experts of each organization member of the Resilience Subcommittee.

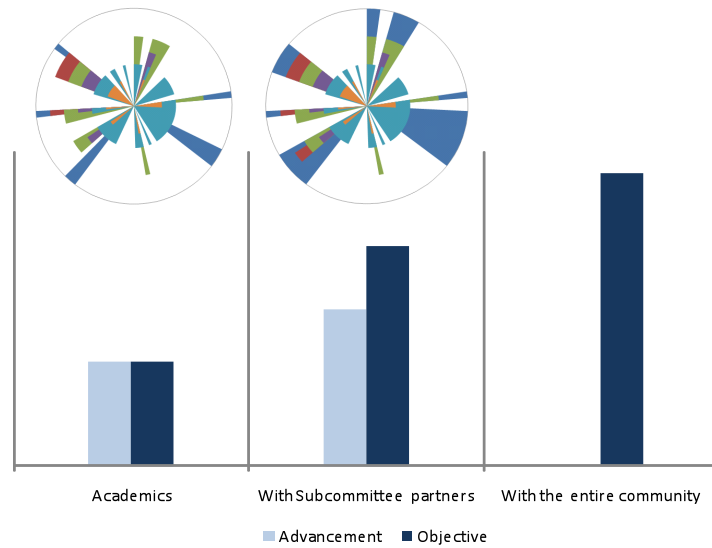


Figure3: Current research

Several parameters have been developed to initiate the construction of an overall portrait of the resilience of Quebec's critical systems. These parameters assess the level of expertise of the people/organizations involved in the process, the acceptance of the consequences by the essential resources providers, the coherence of knowledge, the acceptable length of resources outages (disruptions) for the population, the economic activities and the governance. These parameters concern mainly the notion of acceptance and, to a certain extent, the anticipation of disruptions and the planning of effective mitigation measures. Figure 4 shows schematically the initial construction of resilience.

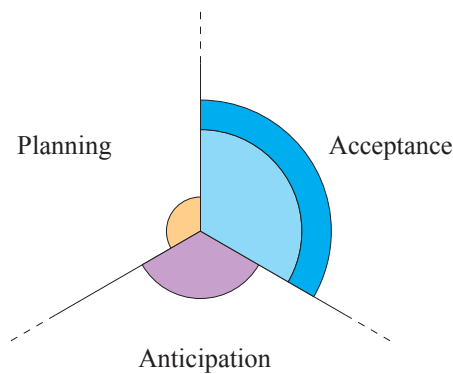


Figure 4: Illustration of resilience

4 CONCLUSION

The work done jointly with the 15 ministries and agencies in Quebec has allowed underpinning a fundamental point which was not included in the initial approach: the need to evaluate the resilience from the beginning of the process. This helped to highlight the concept of knowledge which must be integrated directly into the three parameters Acceptance - Anticipation - Planning. This point is crucial, because knowledge is the keystone of resilience but it cannot be evaluated as a single parameter.

In the proposed approach for building resilience, a time parameter must be included to clearly show the evolution of resilience. Indeed, the resilience of a system is continually evolving in terms of improvement and deterioration.

The proposed process for evaluating the resilience is currently at a development stage in a real organizational framework. Hence, it must be adapted to the constraints and realities of all of these organizations.

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