1-1-2008

Information Technology, Improvisation and Crisis Response: Review of Literature and Proposal for Theory

Anouck Adrot
Georgia State University, adrot@free.fr

Daniel Robey
Georgia State University, drobey@gsu.edu

Information Technology, Improvisation and Crisis Response: Review of Literature and Proposal for Theory

Anouck Adrot

Paris-Dauphine University – Georgia State University

Anouck.adrot@free.fr

Daniel Robey

Georgia State University

drobey@gsu.edu

ABSTRACT

Crisis response is generally acknowledged as a crucial aspect of crisis management. Crisis response often requires a need to improvise because the circumstances demand spontaneous innovation that departs from established procedures. Although previous research has acknowledged improvisation as a valuable component of crisis response, it has not provided adequate conceptual understanding of improvisation. Moreover, studies on the role played by information technology (IT) in crisis are inconsistent regarding the ways that IT may support improvised responses. As a result, few recommendations could be formulated to guide practitioners in using IT to respond to crises, thereby wasting crucial resources. This paper proposes a definition of improvisation that emphasizes its relationship to dynamic capabilities and organizational routines. Using this definition, we analyze the literature on crisis management. The results show that IT enables the reuse of existing resources in novel and spontaneous ways but also supports collaboration and leadership expertise.

Keywords

Improvisation, crisis, information technology, dynamic capabilities.

INTRODUCTION

Crisis has increasingly become a subject of extensive research, and a major concern for managers. Industrial accidents are more likely to happen due to increasing organizational and technical complexity (Perrow, 1984), and organizations remain vulnerable to acts of terrorism and natural disasters. Much of the literature focuses on the prevention of crises, but many crises cannot be prevented or avoided. Therefore, an equally important aspect of crisis management is the response to crisis, especially managing the immediate aftermath to limit additional consequences. During crisis response, planning and anticipation are necessary (Shrivastava, 1993; Rerup, 2001). Resilience and improvisation are also important dimensions of crisis management because one must expect reality to be different from what was anticipated (Rerup, 2001; Waugh, Streib, 2006).

Responses to crises require organizations to engage in unfamiliar actions without the time to formulate detailed plans. Depending on the nature of a crisis, organizations may need to revise previous plans, as there are no recipes that can be followed blindly when the situation is unexpectedly new and complex. Every crisis is unique and planning for crisis response is limited by uncertainty inherent in the notion of crisis (Billings, Milburn, Schaalman, 1980). For these reasons, improvisation is considered as a core element of crisis response (Mendonça, 2007). The organizational ability to improvise in response to crisis is important, yet research on improvisation remains abstract and incomplete.

Information technology's (IT) role in crisis management has also been investigated (Comfort, 1993; Quarantelli, 1997). On the one hand IT is a crucial support for communication and coordination during disasters. In particular, mobile devices enable fast communication and prevention of additional damage. On the other hand, IT has been criticized for wasting time due to information overload (Hiltz, Turoff, 1985; Quarantelli, 1997), the lack of user-friendly tools (Mendonça, 2007), as well as integration issues (Dawes, Cresswell, Cahan, 2004). Thus, IT's reliability for supporting improvisation remains uncertain.

This paper seeks to fill two related needs: (1) defining improvisation and (2) investigating the role that IT plays in improvisation during crisis response. The first need exists because researchers have defined improvisation in many different ways, thus making it difficult to classify actions during crisis response as improvisation or something else. We begin by

analyzing previous definitions of organizational improvisation, followed by our proposed definition. We then address the second need by reviewing the literature on the contribution of IT to crisis improvisation.

ORGANIZATIONAL IMPROVISATION

Most definitions of improvisation draw upon the analogy between management action and artistic performance, usually in jazz or theatre (Cunha, Cunha, Kamoche, 1999; Vera, Crossan, 2005). From the jazz metaphor, extemporaneous improvisation is understood as intentional variations on melody, harmony or rhythm to produce music that is fresh and new. Extended interpretation of the jazz metaphor reveals insights into collective improvisation and the role that minimal structures play in the coordination among performers. For instance, minimal rules may guide the order of solos in a performance, and signals between performers can cue changes in the direction of the performance. These metaphors reflect the inherent complexity of improvisation, which can be compared to the complexity of managerial responses to crisis situations. They suggest that managers can become like creative artists by improvising instead of following prescribed plans.

Although the insights drawn from jazz and theatre metaphors are useful, they are limited by the differences between art and business contexts (Hatch, Weick, 1998). Although management is a purposeful activity, its objective is not creative expression. Moreover, the crises faced in the business world differ from the artistic risks taken by the jazz or theatre performer. Organizations are also more complex than even the largest jazz orchestra or Wagnerian opera, so improvisation in organizational contexts cannot simply mirror the principles derived from the study of performing arts. IT is also not typically used to assist improvisers on stage.

All too often, we believe, improvisation has been presented as a magic solution to the inability to plan during crisis. The exclusively positive view of improvisation ignores potentially harmful consequences in which safety and security may be threatened by abandoning standard procedures. Many treatments of improvisation overstate the importance of spontaneity at the expense of misunderstanding the relationship between spontaneous and planned action (Vera, Crossan, 2005). Improvisation is seen as an alternative when planning is impossible or irrelevant (Perry, 1991). But many examples of crisis indicate that operational routines are the only means to complete response when planned strategy cannot be followed. Naïve treatments of improvisation also convey a suspicious and mysterious image of managerial action rather than promoting a reliable process for crisis response. At their worst, they imply that effective management involves the abandonment of plans and structures because they inhibit creative responses. For some authors, improvisation is merely a negation of foresight and planning (Weick, 1998).

Table 1 summarizes six different ways in which organizational improvisation has been conceptualized. Although all definitions share a vague common concern with innovative responses, there is little commonality across definitions. However, the first three definitions capture the relationship between improvisation and planned activity. By describing improvisation as a situation in which the time between the conception of an action and its execution is reduced, Moorman and Miner (1998) characterize improvisation as "decision as action unfolds". This means that organizational members take decisions as they are already enacting them. The need to improvise is associated with unstable and high-velocity environments in which innovation is necessary (Eisenhardt, 1989; Crossan, Cunha, Vera, Cunha, 2005). Organizations may be compelled to improvise when there is "time pressure or emergency to respond to an unexpected problem" (Weick, 1993). Still, organizations do not always improvise in these circumstances, such as during crises (Roux-Dufort, Vidaillet, 2003).

Table 1 Definitions of Improvisation

Source	Definition
Suchman, 1987	" Action that fills the gap between routine organizational procedures and events in the course of daily work"
Preston, 1991, cited by Vera, Crossan, 2005	"To cope or ingeniously adapt to a set of circumstances".
Moorman, Miner, 1998	"Decision as action unfolds".
Meyer, 1998	"Devising resourceful solutions to intractable problems".
Cunha et al., 1999	"The conception of action as it unfolds by an organization and/or its members drawing on available material, cognitive, affective and social resources"
Rerup, 2001	"Improvisation is the ability to recombine chunks of past

	experience into new patterns of action"

The simultaneity of planning and acting forms an organizational paradox (Clegg, Cunha, Cunha, 2002; Joffre, Aurégan, Chedotet, Tellier, 2007). It leads us to notice that the paradox of acting and planning boils down to the simultaneity of ends and means which is logically and temporally contradictory. How can individuals coordinate for action as they develop coordination mechanisms? How can plans and actions occur simultaneously? These paradoxes illustrate the tensions inherent in improvisation while they also beg for more analytical thought about how such paradoxes can be resolved (Lewis, 2000).

The second three definitions in Table 1 all refer to resources. The idea that improvisation involves creative recombination of resources at hand, also known as "bricolage" (Cunha et al., 1999), is fundamental to these definitions. Particularly in crisis situations, organizations do not have the time or capacity to acquire new resources. Improvisation is unlike organizational invention that departs from what the organization accomplished and learned from the past. For Rerup (2001), improvisation is a form of resilience, which is achieved by recombining past experience and resources into new patterns of action. Cunha, Cunha and Kamoche (1999) refer to the wide range of material, cognitive, affective and social resources that may be recombined to generate improvised responses to crisis.

From this review of previous definitions of organizational improvisation, we identify three needs. First, a more satisfactory definition should reconcile the paradox that implicates planning and action as simultaneous activities. In other words, a definition should articulate the relationship between plans and actions more carefully. Second, the manner in which available resources are combined should be addressed specifically. In addition, IT should be included as a resource so that its potential contribution to crisis response is not ignored. Third, since organizational improvisation is a collective response, the coordination among different actors in organizations needs greater emphasis. These requirements promise a more practical understanding of organizational improvisation, one from which actionable responses may be derived. In the following section, we articulate a more comprehensive definition of organizational improvisation.

A NEW DEFINITION OF ORGANIZATIONAL IMPROVISATION

We propose to analyze improvisation not as an isolated event but rather as a component of a wider process of organizational adaptation. This analysis implies that improvisation is a crucial factor for long-term stability. We therefore propose the following definition:

Organizational improvisation is a collective process that involves spontaneous deviation from established uses of resources and that requires coordination among actors who command resources.

Each of the key elements of this definition is discussed below.

Collective Process

Organizational improvisation is necessarily collective because it involves a coordinated response rather than an individual response. Although individual actors contribute improvised responses following crisis, such efforts (no matter how heroic or creative) can easily dissipate without the efforts of others. Considering improvisation to be collective does not imply that an organization acts as a unified entity; rather, organizational action involves the coordinated efforts of many individuals representing different interests within the organization. A unified response by an organization is rare under normal conditions and highly unlikely during crisis.

We also conceive of improvisation as a process, which occurs over a short period of time. Thus, the study of organizational improvisation should document the sequences of events during the aftermath of a crisis. Methodologically, this can be achieved more practically by reconstructing events from interviews and documented sources. In the longer term, successful improvisations might be retained as part of an organization's repertoire, from which it might draw from in future crises. Hatch and Weick (1998), for example, regard improvised actions as part of the organizational memory afterwards. However, improvised actions in the short term may not necessarily be retained for future situations requiring improvisation. Indeed, the new repertoire may not be useful unless there is a very similar kind of crisis in the future. Given the nature of crisis, we are skeptical of the claim that improvised responses to one crisis would always be useful for a subsequent crisis.

Spontaneity

Many definitions emphasize the role of personality traits in spontaneous action (Webster, 1992). But a group's ability to formulate "an immediate development on a topic" is also important (Dewey, 1913, cited by Webster, 1992; George, Jones, 1997). For example, the ability to find new ideas depends on how reflection on work practices is managed (Zollo, Winter, 2002). George and Jones (1997) identify forms of spontaneity in organizations among which helping coworkers, protecting the organization, and making constructive suggestions are crucial activities in organizations that improvise during crises (Larson, Metzger, Cahn, 2006).

Deviation from Established Uses of Resources

The largely unresolved paradox discussed earlier deals with the requirement that improvisation include simultaneous performance of plans and actions. Rather than regarding plans as irrelevant to improvisation, we regard established use of resources to be a necessary part of the definition. We support this claim with recent research on routines and earlier work on scripts, both of which involve resources.

Pentland and Rueters (1995) define routine as a "set of possible patterns enabled and constrained by a variety of organization, social, physical and cognitive structures from which organizational members enact particular performance". For some authors, routines serve to constrain organizational members to believe that activities that made the organization successful in the past remain the legitimate course for the future. However, this narrow view of routines obstructs fresh thinking and inhibits creative deviations from past practices (Milburn et al., 1983; Crossan, Sorrenti, 1997; Moorman, Miner, 1998). Routine is inherently improvisational for Feldman and Pentland (2003), who view routines not as restricted cognitive frames but rather as generative systems that enable adaptation and organizational change. In other words, familiar routines are renewed whenever they are performed (Feldman, 2000). This view challenges the position that distinguishes between improvisation and routine (Moorman, Miner, 1998).

Routines are formed around the use of organizational resources. The rationale for describing routines as a part of improvisation is that they are not a single repetitive pattern of actions (Cohen, Bacdayan, 1994; Pentland, Rueters, 1995), but rather a set of interdependent sequences of actions. Routines are not restricted to groups or subunits, but confront different units of work, cultures and communities of practice. Routines support intra-organizational cohesion, even in crisis, providing a reference point from which adjustments or radical changes can be made. By comparing improvisations with established routines, actors can gauge the degree to which their deviations depart from established uses of resources. In this sense, improvisation literally fills the gap between repetition of a routine and a completely original performance (Suchman, 1987). Without knowledge of routines, actors would be unprepared to execute spontaneous actions that differed from established ways to use resources.

Routines bear similarity to the concept of scripts. Gioia and Poole (1984) consider scripts to be "stored knowledge that is called into play whenever the situational cues evoke an expectation for certain events to occur." Although scripts are defined differently from routines, they represent a structured set of cognitive elements that help the understanding of new situations. Scripts provide not only an unconscious reference but also means for adaptation and improvisation. Crises are typically the kind of situation in which scripts can assist improvisation. According to Gioia and Poole, "Other situations (than stereotypical) entail some variation on the protoscript and require some means of distinguishing knowledge of these variations in memory." Scripts may be either individual or collective in nature.

By tying the definition of improvisation to the deviation from established use of resources, we invite further comparison with the discourse on dynamic capabilities. Dynamic capabilities correspond to an organization's ability to satisfy environmental requirements by recombining resources to develop capabilities that previously existed only potentially. As a response the limitations of the resource-based-view of the firm (Barney, 1991; Grant, 1996), dynamic capabilities theory focuses on the outcome of organizational and cognitive processes that integrate novel applications of existing capabilities (Teece, Pisano, Shuen, 1997). Although no clear consensus exists on the definition of dynamic capabilities, the emphasis of most definitions is upon the ability of organizations to reconfigure and redeploy resources is different ways (Eisenhardt, Martin, 2000; Zollo, Winter, 2002). This capability to use existing resources in novel ways corresponds to the notion of bricolage from the improvisation literature. Zollo and Winter's (2002) definition of dynamic capability as "a learned and stable pattern of collective activities through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness" closely reflects the spirit of the improvisational nature of resource usage.

Coordination among Actors

The final concept within our definition is the need for coordinated action in improvised response to crisis. As in most coordinated efforts, information transmission is crucial to integrate a new idea or an initiative in collective functioning. Without information transmission, subunits may have different perception of the situation, and improvisation may not be coordinated (Roux-Dufort, Vidaillet, 2003). Subunits need to remain informed and they need feedback about what is new and how it affects their own work. By analogy, performers in a jazz band must listen to band mates to detect unexpected changes introduced by another member. Normally, coordination in jazz is accomplished with familiar signals, such as a glance, nod or a quick breath. Organizational communication also needs to be frequent and accurate during improvisation.

Three main mechanisms appear to regulate information flow during organizational improvisation. First, *boundary spanning* helps information translation from one community of users to another, as defined by Wenger (1999). Different communities or subsystems may have divergent rules or codes for action which, in addition to political tensions, can have a negative

impact on the organizational ability to react during crisis (Beamish, 2002). Boundary spanning enables a translation of information from one group to another to assure consistent action. Second, *expertise* helps to identify which interpretation of reality is legitimate. For example, in high reliability organizations that have to organize instantaneously, new issues for collective action are first addressed to experts (Weick, Sutcliffe, 2001). Especially in crisis situations, dialogue and feedback between experts helps to guide the ongoing improvisation (Faraj, Xiao, 2006). Third, *minimal structures*, such as rules or coordination patterns, facilitate information sharing (Pinnington, Morris, Pinnington, 2003). Minimal structures include rules and codes that assure coordination and information feedback. They are particularly important during jazz performance (Kamoche, Cunha, 2001), but they are also apparent in organizational contexts. Our reading of dynamic capabilities theory suggests that all three mechanisms participate in the organizational adjustments that are crucial during improvisation (Zollo, Winter, 2002).

The primary purpose of systematically articulating a new definition of improvisation is to guide our review of the literature on IT's role in crisis response. In the following section we briefly describe the method for reviewing and classifying this literature.

METHOD

We searched for articles that dealt with crisis response through web databases, including EBSCOhost, Web of Science, and ABI Inform. The scope of selection using keywords went well beyond the IS literature, yielding 150 articles including conceptual papers, essays, and case studies. Initial screening of these papers resulted in many not being retained either because they did not match our definition of improvisation or because they did not deal with IT's contribution to crisis response. Ten of the remaining papers are used in this paper as the basis for investigating the relationship between IT features and characteristics of improvisation.

Each article's content was extracted and entered into a summary table. We considered each characteristic of improvisation (from our definition) and analyzed how they were supported by information technology. For example, Table 2 shows the entry for the article "Learning from Crisis" (Dawes et al., 2004), which reports on organizational uses of technology to cope with the loss of information resources following the 9/11 attacks on the World Trade Center. These tables are useful in supporting a narrative review of each article. Due to space constraints, additional summaries and narratives are not included in this paper.

Table 2. Article Extraction Entry Example

Improvisation Characteristic	Spontaneous action	Deviation from established use of resources	Boundary Spanning	Minimal Structures	Expertise
Description	Immediate creation of a data analysis centre (DAC). Spontaneous disposal of military devices.	Adaptive use of applications initially designed for weather forecasting to spread information about availability of housing and other resources. Reuse of DNA software by police to identify victims. Use of existing investments with other sources to build an ad hoc GIS.	Using GIS, different groups could follow the evolution of information needs and transfer missing information to the units in need.	Data coordination and integration failed. There was no unique principle to govern data collection and quality control. Resulted in GIS data problems.	Emergency management applications managed by experienced volunteers from other states, vendor experts, and IT experts from police. The management of the deployment was shared according to skills.
Analysis: IT	The DAC was	Use of	GIS centralised data	IT helped to	Many-to-many

contribution	consistent because all resources were immediately available or recovered. Internet network was the only reliable infrastructure during the disaster.	standardized and modular applications facilitated their integration and innovative use. Existing investment could be used thanks to immediate share of existing resources.	for different groups and enabled information sharing. Graphical representation provided one unique geographical reference and facilitated information sharing.	gather data and transmit it to everyone but did not provide any regulation of the information format.	communications supported coordination from different sources of expertise.

So far, we have completed manual analysis because the number of articles we have classified has been reduced to 10. From the entire set of articles, we identified six IT characteristics that contribute to crisis response: (1) *graphical representation*, such as conceptual and geographical mapping; (2) *modularity*, which allow applications to be quickly combined and reused; (3) *calculation* that supports data selection, scenario simulation and complex treatment; (4) *many-to-many communication* that enables reciprocal information sharing among more than two users; (5) *centralization*, which affects the ability to access different data through one interface; and (6) *virtuality*, referring to the non-material characteristic of data and facilitates recovery, replication, and exchange. These characteristics were then cross-tabulated against the five components of our definition of improvisation. We recognized other characteristics during analysis, such as data integration. But these appeared much less frequently and were not presented by authors as potential contributions but rather obstacles. So we excluded them from the cross-tabulation**.**

RESULTS

The result of cross tabulation is shown in Table 3. We draw four main ideas from our analysis. First, graphical representation of data during crisis response creates a unique reference that places shared information into a uniform format (Comfort, 1993). Graphs have the ability to represent complex data in a way that can be comprehended with a single glance. This feature enables fast interpretation and response, thereby assisting crisis response.

Table 3. Cross-tabulation Results

Mechanisms supported by IT	Graphical Representation	Modularity	Calculation	Many to many Communication	Centralization	Virtuality
Spontaneous action		Comfort, 1993. Dawes et al., 2004.	Comfort, 1993.			Yuan, Detlor, 2005. Palen, Liu, Hiltz, 2007. Carver, Turoff, 2007.
Deviation from established use of resources	Palen et al., 2007. Mendonça et al., 2007.	Dawes et al., 2004. Dantas, Seville, 2006. Mendonça et al., 2007.	Yuan, Detlor, 2005. Mendonça et al., 2007. Comfort, 1993. Comfort et al., 2001.	Comfort, 1993. Yuan, Detlor, 2005. Comfort et al., 2001.	Mendonça et al., 2007. Comfort et al., 2001.	Comfort, 1993. Calloway, Keen, 1996. Dawes et al., 2004. Yuan, Detlor, 2005. Dantas, Seville, 2006. Mendonça et al., 2007.

						Carver, Turoff, 2007. Majchrzak, Jarvenpaa, Hollingshead, 2007.
Boundary Spanning	Comfort, 1993. Dawes et al., 2004. Mendonça et al., 2007.		Carver, Turoff, 2007. Majchrzak et al., 2007		Comfort, 1993. Palen et al., 2007.	Dantas, Seville, 2006. Mendonça et al., 2007. Carver, Turoff, 2007. Majchrzak et al., 2007
Minimal structures					Palen et al., 2007.	Yuan, Detlor, 2005.
Expertise			Yuan, Detlor, 2005.	Calloway, Keen, 1996. Dawes et al., 2004.	Dantas, Seville, 2006.	Yuan, Detlor, 2005. Mendonça et al., 2007

Second, the combination of calculation, virtuality, and many-to-many communication supports deviations from established uses of resources. Intelligent systems select and contact experts who are the most competent for different kind of skills (Yuan, Detlor, 2005). Multiple virtual discussions between experts enable appropriate responses (Dantas, Seville, 2006) that come from combination of different resources (Dawes et al., 2004).

Third, centralization of data enables actors to find information concerning others' past actions. Actors can build a common narrative that operates as a translator between groups and frames rules for action (Majchrzak et al., 2007).

Fourth, coordination relies on virtuality. Boundary spanning practices between distant groups cannot exist without immediate and free information replication and exchange (Comfort, 1993, Quarantelli, 1997). Virtuality also helps to keep shared information consistent in time, thanks to information feedback. Therefore, minimal structures of knowledge can be initiated and managed by experts (Yuan, Detlor, 2005). This helps to avoid potentially disastrous misunderstandings (Larson et al., 2006).

CONCLUSION

Our definition of organizational improvisation aims at a more realistic view of crisis response, enriched by the dynamic capability approach and a clearer view of IT contribution. Our results show that IT is a potential support for organizational improvisation during crisis. Our work is limited by our selective and incomplete use of prior literature. First, we are aware of the incompleteness of the suggested definition of organizational improvisation. For example, it does not cover collaboration, which is a crucial need during crisis (Mishra, 1996). Meanwhile, we restricted our reflection to coordination because our objective in this paper was to propose a resolution of the inner paradoxes of organizational improvisation that mainly include the question of coordination. As a result we did not consider organizational needs or constraints that are also important during crisis improvisation. Definitely, this should be examined in future research. Second, our literature review on IT contribution to crisis response is still incomplete. Further investigation may reveal additional IT characteristics. Moreover, a more exhaustive review may strengthen our results, or it may contradict them. Our hope is that our analysis will help guide more thorough and conceptually sound investigations of IT's role in improvised organizational responses to crises.

REFERENCES

1. Beamish, T. D. (2002) The Silent Spill: the Organization of an Industrial Crisis, MIT Press (Eds).
2. Barney, J. (1991) Firm Resources and Sustained Competitive Advantage, *Journal of Management*, 17, 1, 99-120.
3. Billings, R. S., Milburn, T. W., Schaalman, M. L. (1980) A Model of Crisis Perception: A Theoretical and Empirical Analysis, *Administrative Science Quarterly*, 25, 2, 300-316.

4. Calloway, L. J., Keen, G. W. K. (1996) Organizing for Crisis Response, *Journal of Information Technology*, 11, 1, 13-26.
5. Carver, L., Turoff, M. (2007) Human-computer Interaction: The Human and Computer as a Team in Emergency Management Information Systems, *Communications of the ACM*, 50, 3, 33-38.
6. Clegg, S.R., Vieira de Cunha, J.V., Cunha, M. P. (2002) Management Paradoxes: A Relational View", *Human Relations*, 55, 5, 483-503.
7. Comfort, L. K. (1993) Integrating Information Technology into International Crisis Management and Policy, *Journal of Contingencies and Crisis Management*, 1, 1, 15-26.
8. Comfort, L. K., Sungu, Y., Johnson, D., Dunn, M. (2001) Complex Systems in Crisis: Anticipation and Resilience in Dynamic Environments, *Journal of Contingencies & Crisis Management*, 9, 3, 144-158.
9. Cohen, M. D., Bacdayan, P. (1994) Organizational Routine Are Stored as Procedural Memory: Evidence from a Laboratory Study, *Organization Science*, 5, 4, 554-568.
10. Crossan, M., Cunha, M.P., Vera, D., Cunha, J. (2005) Time and Organizational Improvisation, *Academy of Management Review*, 30, 1, 129-145.
11. Crossan, M., Sorrenti, M. (1997) Making Sense of Improvisation, *Advances in Strategic Management*. 14, 155-180.
12. Cunha, M.P., Cunha, J.V., Kamoche, K. (1999). Organization Improvisation, What, When, How, Why, *International Journal of Management Reviews*, 1, 3, 299-341.
13. Dantas, A., Seville, E. (2006) Organizational Issues in Implementing an Information Sharing Framework: Lessons from the Matata Flooding Events in New Zealand, *Journal of Contingencies and Crisis Management*, 14, 1, 38-52.
14. Dawes, S. S., Cresswell, A. M., Cahan, B. B. (2004) Learning From Crisis: Lessons in Human and Information Infrastructure From the World Trade Center Response, *Social Science Computer Review*, 22, 1, 52-66.
15. Eisenhardt, K. M. (1989) Making Fast Strategic Decisions in High-Velocity Environments, *Academy of Management Journal*, 32, 3, 543-576.
16. Eisenhardt, K. M., Martin, J. A. (2000) Dynamic Capabilities : What Are They ?, *Strategic Management Journal*, 21, 10, 1105-1121.
17. Faraj, S., Xiao, Y. (2006) Coordination in Fast-Response Organizations, *Management Science*, 52, 8, 1155-1169.
18. Feldman, M. S. (2000) Organizational Routines as a Source of Continuous Change, *Organization Science*, 11, 6, 611-629.
19. Feldman, M. S., Pentland, B. T. (2003) Reconceptualizing Routines as a Source of Flexibility and Change, *Administrative Science Quarterly*, 48, 1, 98-113.
20. Gioia, D. A., Poole, P. P. (1984) Scripts in Organizational Behavior, *Academy of Management Review*, 9, 3, 449-459.
21. George, J. R., Jones, G. R. (1997) Organizational Spontaneity in Context, *Human Performance*, 10, 2, 153-171.
22. Grant, R. M. (1996) Towards a Knowledge-Based Theory of the Firm, *Strategic Management Journal*, 17, 109-122.
23. Hatch, M. J., Weick, K. E. (1998) Critic's Corner: Critical resistance to the jazz metaphor, *Organization Science*, 9, 5, 600-604.
24. Hiltz, S. R., Turoff, M. (1985) Structuring Computer-mediated Communication Systems to Avoid Information Overload, *Communications of the ACM*, 28, 7, 680-689.
25. Joffre, P., Aurégan, P., Chedotel, F., Tellier, A. (2007) Le management stratégique par le projet, Economica (Eds), Paris.
26. Kamoche, K., Cunha, M. P. (2001) Minimal Structures: From Jazz Improvisation to Product Innovation, *Organization Studies*, 22, 5, 733-764.
27. Kamoche, K., Pina e Cunha, M., Campos e Cunha, R. (2003) Improvisation in Organizations, *International Studies of Management & Organization*, 33, 1, 34-57.
28. Kamoche, K., Cunha, M. P., Cunha, J. V. (2003) Towards a Theory of Organizational Improvisation: Looking Beyond the Jazz Metaphor, *Journal of Management Studies*, 40, 8, 2023-2051.
29. Lewis, M. W. (2000), Exploring the Paradox: Toward a More Comprehensive Guide, *The Academy of Management Review*, 25, 4, 760-766.

30. Larson, R. C., Metzger, M. D., Cahn, M. F. (2006) Responding to Emergencies : Lessons Learned and the Need for Analysis, *Interfaces*, 36, 6, 486-501.
31. Majchrzak, A., Jarvenpaa, S. L, Hollingshead., A. (2007) Coordinating Expertise Among Emergent Groups Responding to Disasters, *Organization Science*, 18, 1, 147-161.
32. Mendonça, D. J. (2007) Decision Support for Improvisation in Response to Extreme Events: Learning from the Response to the 2001 World Trade Center Attack, *Decision Support Systems*, 43, 3, 952-967.
33. Mendonça, D., Jefferson, T., Harrald, J. (2007) Collaborative Adhocracies and Mix-and-Match Technologies in Emergency Management, *Communications of the ACM*, 50, 3, 45-49.
34. Meyer, A. (1998) Organizing for improvisation: The backstage story of the Vancouver jazz concert, *Organization Science*, 9, 5, 569-576.
35. Milburn, T. W., Schuler, R. S., Watman, K. H. (1983) Organizational Crisis. Part II: Strategies and Responses, *Human Relations*, 36, 12, 1161-1179.
36. Mishra, A. K. (1996) Organizational Response to Crisis: The Centrality of Trust, in Kramer, R. M., Tyler, T, Trust In Organizations. Newbury Park, CA, Sage (Eds), 261-287.
37. Moorman, C., Miner, A. S. (1998) The convergence between planning and execution: Improvisation in new product development, *Journal of Marketing*, 62, 1-20.
38. Moorman, C., Miner, A. S. (1998) Organizational Improvisation and Organizational Memory, *Academy of Management Review*, 23, 4, 698-723.
39. Palen, L., Hiltz, S. R., Liu, S. B. (2007) Online Forums Supporting Grassroot Participation in Emergency Prepared and Response, *Communications of the ACM*, 50, 3, 54-58.
40. Pentland, B. T., Rueter, H. H. (1994) Organizational Routines as Grammars of Action, *Administrative Science Quarterly*, 39, 3, 484-510.
41. Perrow, C. (1984) Normal Accidents: Living With High-Risk Technologies. Rothstein Associates Inc.
42. Perry, L. T. (1991) Strategic improvising: How to formulate and implement competitive strategies in concert, *Organizational Dynamics*, 19, 4, 51-64.
43. Pinnington, A., Morris, T., Pinnington, C. (2003) The Relational Structure of Improvisation, *International Studies of Management & Organization*, 33, 1, 10-33.
44. Quarantelli, E. L. (1997) Problematic Aspects of the Information/Communication Revolution for Disaster Planning and Research: ten non-technical issues and questions, *Disaster Prevention and Management*, 6, 2, 94-106.
45. Rerup, C. (2001) Houston, we have a problem: Anticipation and Improvisation as sources of organizational resilience. *Comportamento Organizacional e Gestao*. 7, 1, 27-44.
46. Roux-dufort, C., Vidaillet, B. (2003) Why Organizational Improvisation does not necessarily Occur during Crises, *International Studies of Management & Organizations*, 33, 1, 86-115.
47. Shrivastava, P. (1993) Crisis Theory/Practice: Towards a Sustainable Future, *Organization & Environment*, 7, 1, 23-42.
48. Suchman, L. A. (1987) Plans and Situated Actions, Cambridge University Press.
49. Teece, D. J., Pisano, G., Shuen, A. (1997) Dynamic Capabilities and Strategic Management, *Strategic Management Journal*, 18, 7, 509-533.
50. Vera, D., Crossan, M. (2005) Improvisation and Innovative Performance in Teams, *Organization Science*, 16, 3, 203-224.
51. Waugh, W. L. Jr., Streib, G. (2006) Collaboration and Leadership for Effective Emergency Management, *Public Administration Review*, 66, 1, 131-140.
52. Webster, J. (1992) Group Spontaneity, *Special Interest Group on Computer Personnel Research Annual Conference. Proceedings of the 1992 ACM SIGCPR conference on Computer personnel research*, April 05-07, Cincinnati, Ohio, USA, 259-267.
53. Weick. K. E., Sutcliffe, K.M. (2001) Managing the unexpected: assuring high performance in the age of complexity, University of Michigan Business School Management Series, Jossey-Bass Editions.
54. Weick, K. E. (1993) Organizational redesign as improvisation, In G. P. Huber, & W.H. Glick, Organizational change and redesign, New York: Oxford University Press.

55. Weick, K. E. (1998) Introductory essay: Improvisation as a mindset for organizational analysis, *Organization Science*, 9, 5, 543-555.
56. Wenger, E. (1999) Communities of Practice: Learning, Meaning, and Identity, Cambridge University Press.
57. Winter, S. G. (2003) Understanding Dynamic Capabilities, *Strategic Management Journal*, 24, 10, 991-995.
58. Yuan, Y., Detlor, B. (2005) Intelligent Mobile Crisis Response Systems, *Communications of The ACM*, 48, 2, 95-98.
59. Zollo, M., Winter, S. G. (2002) Deliberate Learning and the Evolution of Dynamic Capabilities, *Organization Science*, 13, 3, 339-351.