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Organizational learning through disasters: a multi-utility company's experience

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Abstract

Purpose – Analyzing how and what the local multi-utility AIMAG learned through the 2012 Northern Italy earthquakes, the purpose of this paper is to "normalize" the organizational learning (OL) triggered by disasters.

Design/methodology/approach – Seven managers who experienced the earthquakes were interviewed. The collected data are supplemented by archival materials. The analysis was conducted based on the 4I model (Crossan *et al.*, 1999), using the qualitative data analysis tool "NVivo."

Findings – The earthquakes audited AIMAG's knowledge repositories, revealing its weakness and strength. When the earthquakes struck, individuals intuited the situations based on their previous experience, interpreting the need to respond to the interruptions and begin recovery immediately. The collective interpretation formed the basis for joint actions, which integrated the group learning at the organizational level. The effective cognition and behavior were instituted to the organization, and the new knowledge was absorbed into the organization's knowledge repositories awaiting the next audit.

Originality/value – The concept of "learning through disasters" is advocated. By perceiving disasters as a series of interruptions that may have happened before and may re-occur, the learning is connected to organizations' past and future through knowledge repositories. In addition, by analyzing data based on the multi-level OL model, the learning triggered by disasters was observed to occur throughout the organization at individual, group and organizational levels, in which routines played a critical linking role.

Keywords Utilities, Organizational learning, Routines, Earthquake risk management, Knowledge repositories, Learning through disasters, Multi-level organizational learning

Paper type Research paper

1. Introduction

Organizational learning (OL) has commonly been used to explain the behavior of organizations when facing disasters. There is a growing consensus that disasters trigger OL, which enables organizations to handle the interruptions. Task performance experience is converted into knowledge that changes the organization's context and affects its future experience (Argote and Miron-Spektor, 2011). Many scholars believe that disasters are of both high impact and relevance, which tend to produce learning that transforms organizations (Lampel *et al.*, 2009; Desai, 2010; Madsen, 2009, Christianson *et al.*, 2009), and that not being able to learn from disasters is dangerous (Alexander, 2012). However, the literature in this field is still divided.

Disasters are relative concepts. They are hard to define and interpret. Situations that are disastrous for one organization may be less dramatic for another (Lampel *et al.*, 2009). Disasters are also highly context based, complex and infrequent (Van Laere, 2013). Drawing scientific inferences from disasters that occurred at different periods in different contexts is challenging. Analyzing the OL at individual, group and organizational levels, this study advocates that disasters trigger the learning, and thus normalizes the learning through disasters.

Disaster is the product of natural hazards and social and human vulnerability (Chmutina *et al.*, 2017). The vulnerability of organizations combined with the natural hazard causes damages that are part of disasters. Our case study makes a valuable contribution to exploring the connection between disasters and learning. The 2012 Northern Italy earthquakes are natural hazards, which triggered disasters to the environment, local residents and organizations. AIMAG, a local multi-utility company that provides electricity,

gas, water, public lighting and waste collection services to the earthquake-affected area faced major interruptions. Although it was unprepared, AIMAG resumed its services rapidly and recovered from the interruptions. It also established a schema to manage future disasters. Thus, the assumption that those involved in AIMAG learned from the disasters can be made.

To investigate in detail how learning was triggered by disasters and what AIMAG learned through the interruptions, this research collected data from seven interviews with managers and from archived materials. By analyzing the data based on the multi-level learning model, this research discovered that the earthquakes caused operational, financial and administrative interruptions, which audited AIMAG's knowledge repositories and triggered the learning process as outlined by Crossan *et al.* (1999).

Findings support the concept of "learning through disasters," which helps to "normalize" OL. By perceiving the earthquakes effects as a series of interruptions that may have happened in the past and may re-occur, the OL thus began long before the earthquakes struck. During the time of the disruption, knowledge was retrieved from the organization's knowledge repositories and new knowledge was generated across all levels throughout the organization. The knowledge that proved to be effective was instituted into the organization. Routines, as the primary form of organizational knowledge, served as links to multi-level learning and connected past knowledge to the future.

2. Theoretical framework

The concept of OL has been developed in recent years and used to study organizational change. One stream of research perceives OL as an improvement in the performance of organizations, whereas another considers OL as a change of organizational knowledge (Schilling and Kluge, 2009; Argote and Miron-spektor, 2011). These two concepts are not contradictory but complementary. In both, learning is viewed as contributing to the evolution of organizations. The former focuses more on the results, such as increasing productivity and improving efficiency, while the latter addresses the importance of processes. While improvements in performance take time to appear, changes in OL processes can be demonstrated more quickly. In this research, both the improvement of performance and changes in organizational knowledge are considered as OL.

The learning mechanisms have been the subject of debate, but most studies agree that experience is one of the main sources of learning. Different experiences can trigger different OL. Experiences from rare events have been the focus of attention, as they are critical for OL and can trigger transformative learning (Lampel *et al.*, 2009). Experience of disasters "brutally" audits organizations' knowledge repositories, uncovering their weaknesses and revealing their strengths, and can provide valuable opportunities for organizations to learn more about themselves (Christianson *et al.*, 2009; Van Laere, 2013). Thus, some scholars believe that OL triggered by disasters can enhance an organization's skill level and improve its knowledge (Weick and Roberts, 1993; Christianson *et al.*, 2009; Liu and Low, 2009). For example, airlines, mining companies and railway organizations have improved their performance by learning from previous accidents or near accidents (Le Coze, 2013; Madsen, 2009). Disasters also audit the risk awareness of organizations, which contributes to preventing and limiting future risks (Madsen and Desai, 2010; Madsen, 2009; Baum and Dahlin, 2007; Liu and Low, 2009; Blanco *et al.*, 1996). This can occur at group and individual levels in addition to the organizational level. For example, Madsen (2009) stated that: "organizational participants of the hazards inherent in their work and organizational participants respond by adjusting their individual mental safety models" (p. 872).

However, learning the appropriate lessons from disasters is challenging. Disasters are often considered as exceptions, disregarded as statistical outliers or treated as accidental manifestations of underlying organizational processes (Lampel *et al.*, 2009). Most studies

emphasize the specifics and thus diminish the generalizability of the learning triggered by disasters. This study suggests that learning from exceptions is not exceptional learning. Disasters should be regarded as a series of interruptions, which may reappear due to other reasons. Learning triggered by interruptions can also be considered a continuous process in a longer timeframe. Knowledge used during the response and recovery stage can be retrieved from organizations' knowledge repositories, and the new knowledge generated can then be stored in the repositories for future use (Christianson *et al.*, 2009). Even if disasters do not recur, lessons concerning skills and capabilities acquired during the events can still be valuable.

The concept "learning through disaster" has been put forward by some scholars. Lampel *et al.* (2009) suggested that learning through disasters consists of capturing lessons and then using them to improve skills and expand capabilities. Christianson *et al.* (2009) suggested that learning from disasters is not so much an issue of what can be learned "from rare events," as what can be learned "through the rare event," as the learning associated with a disaster does not occur separately "from the event or after the event." The learning occurs throughout the interruptions and those who generate the lessons are the same people who apply them. However, no research systematically explains how an organization can learn through disasters. In this study, the 4I model was used to observe how AIMAG learned when facing earthquakes and what it learned through the interruptions (Crossan *et al.*, 1999). OL is described in terms of four processes: intuiting, interpreting, integrating and institutionalizing, which link individual, group and organizational levels. These three learning levels define the structure through which OL takes place. The processes bind the structure together. This multi-level learning model demonstrates how individual learning can be integrated into groups and eventually the knowledge can be instituted to organizations (Crossan *et al.*, 1999; Lawrence *et al.*, 2005; Schilling and Kluge, 2009). This model is particularly suitable for investigating learning triggered by disasters. Disaster management requires the efforts of the whole organization. Individuals intuit and experience first-hand the severity of a situation based on their previous experience. They then interpret the situation and interact with others in the group to develop shared understanding, and to take coordinated action through mutual adjustment. This is an integrating process, connecting groups to the organization. Weick and Roberts (1993) conceptualized the collective mind as a pattern of heedful interrelations of actions in a social system. The valuable lessons acquired through learning will be incorporated into organizations and retained in their knowledge repositories.

Knowledge is an important indicator of OL, which can be either tacit or codified, and is manifested in both cognition and behavior (Argote and Miron-Spektor, 2011). It can be embedded in various repositories, including individuals, routines and transactive memory systems, and can undergo constant evolution (Schulz, 2002). Routines are the primary form of organizational knowledge, linking the learning at individual, group and organizational levels. They are perceived as "behavioural regularities and cognitive regularities" and can be tacit or explicit. Routines include rules, strategies, structures, technologies, cultural practices, capabilities, etc., and are the products of institutionalization, created to retain acquired knowledge (Schulz, 2002). If learning triggered by disasters is not encoded in organizational routines, it may get lost. Individuals may again change their mental models and behavior in response to periods free of accidents (Madsen and Desai, 2010). Routines exist independently of any individual so the knowledge will not be lost when those who experienced disasters leave an organization (Crossan *et al.*, 1999). Though repetitiveness is one of the causes for skill-based errors (Reason, 1990), routines maximize efficiency and legitimacy and minimize or suppress conflicts, and are useful in a crisis situation (Feldman and Pentland, 2003). Routines also connect an organization's past with its future. Disasters lead organizations to re-assess, revise and record these routines. When the next interruption occurs, the routines will again be audited.

Based on these theoretical premises, it is suggested in this study that the earthquakes triggered a series of interruptions that may be similar to those AIMAG encountered in the past and will face in the future. Unlike the disasters themselves, learning through disasters is thus not unique or idiosyncratic (Christianson *et al.*, 2009). The response to the earthquakes and the recovery from them can be perceived as a process that the organization had learned through capturing the learning occurring at individual, group and organizational levels, in which routines are critical as knowledge repositories and as links between these levels.

3. AIMAG and the 2012 earthquakes

AIMAG is a multi-utility company based in the province of Modena in Northern Italy providing services to 24 municipalities. It supplies 15 million m^3 of water to about 110,000 customers, it treats 95,588 tons of waste for more than 70,000 customers and it distributes 274,963,713 m^3 gas to about 130,000 customers. It was founded in 1964 as the public water and gas provider for the municipality of Mirandola. From the 1970s, it grew to become an inter-municipality consortium providing more public services to the neighboring municipalities. In 2001, AIMAG became a joint-stock company with 21 municipalities holding 65 percent of its shares; 25 percent is owned by Hera, a large multi-utility in the North Italy, and the rest of the shares are owned by two local foundations. The company has about 450 employees. Its revenue comes stably from its local customers (citizens and businesses) through utility bills.

The first seismic event occurred on May 20, 2012. An earthquake of 6.1 magnitude struck the region of Emilia Romagna This earthquake was followed by several aftershocks, which caused 7 deaths and 50 injuries. The first series of earthquakes damaged the historical centers of many municipalities. However, they did not cause any severe damage to AIMAG. Another earthquake of 5.8 in magnitude and several aftershocks struck the same area nine days later, causing additional 20 deaths, 350 injuries and widespread damage, particularly to buildings already weakened by the first earthquake.

The area affected by the earthquake was around 967 km^2, and 227,000 people were affected. This second series of earthquakes started at 9:00 which led to the four deaths and many injuries at many work places. The earthquake area has a cluster of biomedical industry of more than 100 companies and many of them were affected. AIMAG's services were interrupted. The main damage included the main office buildings in Mirandola and Carpi, and the water towers in San Felice, Cavezzo, Concordia and San Possidonio. The earthquakes also led to problems in waste collection. AIMAG had to maintain regular waste collection, and take into consideration that people in the affected area had been moved into tents. In addition, the area's largest fermentation plant for organic waste was damaged, and the earthquakes generated a new kind of waste (debris), which AIMAG had never dealt with before. Financial damage was also incurred. The situation of local families made the top managers decide to stop billing. This decision, though appreciated by citizens and public authorities, created financial tension in AIMAG and uncertainty regarding its revenue.

The operational interruption mainly affected communication, gas services and waste collection. In the immediate aftermath of the earthquakes, telecommunication was interrupted and walkie-talkies were the only form of communication. The manager for legal affairs, human resources and procurement commented: "The important aspects in the immediate aftermath were: removing debris and minimizing the risks from switching off the gas pipes. Although the earthquake is a 'new' context for us, switching off the gas pipes was not a new activity. We knew how to do it. As for the earthquake debris, we had never collected this kind of waste […]. The employees performed excellently during the emergency. They were highly motivated and willing to take on new (non-routine) activities explaining that they were doing it for their territory, for their community." The response to

the interruption was timely. A few minutes after the earthquake on May 29 the gas service restarted. Waste collection resumed six hours later, and three days later the information and communications technology (ICT) system of the fermentation plant was restarted. The administrative interruption was caused by the damage to the office buildings. Tents were purchased and set up in the safe open space on the second day, so that staff could resume the service. One of AIMAG's shareholders, Hera, offered to host AIMAG employees in its offices in Modena. Within a week, the transfer of the administrative department had been completed. The financial interruption took the form of the suspension of customer billing, while the company continued to pay its suppliers on time. However, by the end of the year, 90 percent of AIMAG customers began to pay their utility bills regularly again, which was interpreted very positively by AIMAG's management. The CEO confirmed: "One extraordinary result was that 90% of the customers had paid the utility bills at the end of December. This result is interpreted as the appreciation of our services by citizens."

The earthquake response stage ended after three weeks. In September, the earthquake debris was removed. By November, normality gradually returned. Office buildings were renovated and the staff were back in their offices by the end of the year. This study interpreted this disastrous event as operational, administrative and financial interruptions that AIMAG may have faced in the past and could experience again in the future. This helps to "normalize" disasters and gain more scientific inferences. How these interruptions triggered the learning mechanism and what AIMAG learned through the earthquake events are explored in the following sections.

4. Methodology

An inductive qualitative case analysis method was used to obtain in-depth observations of the complexity of learning through disasters (Christianson *et al.*, 2009). Bobrow and Norman (1975) proposed two methods of comparing theory with data: by examining a small part of the conceptual structure in comparison with many examples; and by comparing a complete conceptual framework with structured data. The second approach is defined as a case analysis objective. The multi-level OL model was used to capture the learning at individual, group and organizational level, to gain novel insights (Crossan *et al.*, 1999). Disaster is a relative concept and is highly context based, and case analysis is particularly suitable for studying such events.

Primary data were collected through face-to-face interviews with the CEO, the water services manager, the environmental service manager, the legal affairs, human resources and procurement manager, the information system, internal organization, quality and safety manager, the certification and safety manager and the communications and external relations manager. Interviewing top managers allows us to observe the OL at individual, group and organizational level. They all vividly remembered their experiences of the earthquakes when asked. They played important roles in leading the teams to respond to and recover from the interruptions, and contributed to institute the knowledge obtained into AIMAG. A semi-structured interview protocol drawing on the literature of OL was applied (Appendix). The interviews ranged from 90 to 120 minutes. The interviews were conducted in the native language of the interviewees and were recorded. Secondary data were collected to supplement and validate the interview data. Data on AIMAG and on the 2012 earthquakes in Emilia Romagna from the internet (mainly online magazines and local newspapers dated from 2012 to 2017) were gathered. Archived materials related to earthquakes from AIMAG were collected during the site visits.

The data were coded and analyzed using the NVivo software. The interviews were translated from Italian to English by the authors who are native Italian speakers with careful selection of terms and the transcription was checked by the other author who is proficient in both languages. Secondary data were imported for the data analysis.

Blanco *et al.* (1996) suggested that an analysis of interruptions should begin by reconstructing the event to analyze the physical situation, the social situation, people-people and people-object relationships. A node called "Timeline" was first created to line up all the important events. Data were organized under six nodes: organization, group, individuals, before the earthquakes, during the earthquakes and after the earthquakes. Given that organizational knowledge can be manifested in cognition and in behavior, the response and recovery phases were split into two sections. The first records the "cognition" of individuals, groups and AIMAG. The second records the behavior occurring due to cognitive changes in the individuals, the groups and in the organization. Four nodes (intuiting, interpreting, integrating and instituting) were also created to capture the learning processes. This enabled us to: measure the improvement in performance and the changes in the organization's knowledge in different phases, which were due to experiencing the disasters; and trace the learning process at different levels and explore the interaction among these levels. Then, we iterated between data and theory, developing codes for recurrent patterns until "theoretical saturation" was reached (Christianson *et al.*, 2009). Our key criteria for coding were relevance (as an explanatory factor) and frequency.

5. Findings
From analyzing the coded data, this study found that the disasters triggered an audit of AIMAG's knowledge repositories. Individuals intuited the crisis situations based on their previous knowledge, interpreted the situations to form collective sensemaking and integrated the knowledge into joint actions to cope with the interruptions. Knowledge about how to respond to interruptions and recover from them was retrieved, applied, revised and then restored in the knowledge repositories via a process of instituting.

5.1 The interruptions audited AIMAG's knowledge repositories
The earthquakes triggered a brutal audit of AIMAG's response repositories. The interruptions caused by the earthquakes revealed the weaknesses of AIMAG, including a low awareness of risks, inadequate preparations for disasters and a highly localized business. Their strengths (strong leadership, encouragement of middle managers and rootedness in the local area) were also revealed.

Exceptional events such as natural hazards often lead to the "black swans" effect, in which organizations can be misled when attempting to recognize the risks (Masys, 2012). As the certification and safety manager stated: "We rated the area where we operate as 'of a low seismic risk'. Therefore, we were not very prepared for the earthquake response. Of course, we had done evacuation training and an earthquake scenario had been previously considered. However, after the training, we used to return to work without thinking that something like this could ever happen. We've never had any scenario analysis of how the crisis situations would evolve." AIMAG was unprepared for the telecommunications network disruption. Luckily, most of the top management had walkie-talkies, which enabled them to communicate and coordinate in the immediate aftermath of the earthquakes.

The local geographical distribution of those involved in the disaster response was also an important factor. The employees, customers and most of the suppliers were local. Any negative event occurring in this geographical area will therefore have a multi-faceted impact on AIMAG. The earthquakes created problems for some of the employees' families and distracted them from work. AIMAG suspended to bill its customers after the earthquakes, which created financial tension for the company. Although the suppliers managed to service AIMAG during the emergency, there were potential risks in mainly relying on local supplies.

The audit triggered by the earthquakes, however, highlighted the strengths that enabled AIMAG to respond to the interruptions and recover rapidly. To address the administrative interruption, tents were purchased and were set up in the safe open area within three days.

The fact that the chairman and the CEO were working in the tents encouraged employees to continue their work. Leadership has been identified as fundamental when organizations face emergencies (Bhandari *et al.*, 2014). Indeed, as the certification and safety manager stated: "During the emergency, it was important for the Chairman and CEO to be in the field, and for them to be visible to everyone. Having their desks under the tents and working with other employees gave a clear and strong message that we were all 'going through a hard time together'." This kind of leadership boosted morale, and working in the open space under the same tents created a more direct and informal relationship among employees. In addition, middle managers were instrumental in creating an understanding between top managers and workers. They were good at transforming the strategies into actions (Beck and Plowman, 2009), and could encourage the workers as they had direct contact with them and understood their concerns. For example, the female administrative staff were unwilling to transfer to Hera's offices in Modena (32 km from Mirandola) due to family and safety concerns. With the right encouragement from middle managers, within a week the administration department was operating from Modena.

The morale of employees who had not experienced any major damage at home was high, and they continued to work to resume services as soon as possible. All the interviewees mentioned that the working morale under the crisis situation was very high. The manager of the environmental services confirmed that: "immediately after the earthquake, employees demonstrated a sense of belonging and rootedness in the area, as well as a positive attitude to what needed to be done." Though unprepared for the earthquakes, as a utility provider AIMAG has its own emergency management team for daily operations and had gained knowledge from handling emergencies, which enabled it to quickly respond to and recover from the earthquakes. As stated by the CEO: "our emergency service played an important role in earthquake response and recovery. Having an emergency team was our strength. Our organization is able to be split into different parts, and each part knows what to do in different areas of our local area." As the employees were local and all experienced the same disastrous event, a shared mental model resulted (Rerup, 2009; Wang and Ahmed, 2003), which enabled members to contribute and make sense of the situation, to facilitate better collaboration.

5.2 Multi-level learning through disasters

Scholars of multi-level learning have suggested that OL occurs at individual, group and organizational levels through four processes: intuiting, interpreting, integrating and instituting (Crossan *et al.*, 1999; Lawrence *et al.*, 2005; Schilling and Kluge, 2009). Macrae (2009) stated that: "Identifying risk was largely an interpretive rather than a statistical process" (p. 106). Intuiting is essential to interpreting and making sense of crises. It is a rapid process in which individuals heuristically connect the current situation with experience, which prepares them for interpreting the situation (Crossan *et al.*, 1999). Intuiting is an individual process and can only affect others when they attempt to interact with the individual (Crossan *et al.*, 1999). As the communications and external relations manager recalled: "I was hiding under my desk on May 29 in, Carpi and I heard the screams of fleeing colleagues. After we went out, I started to think about what we needed to do. Shortly after, the CEO arrived, and we started to drive toward Mirandola. Driving through the municipalities that were affected by the earthquakes, we began to understand how severe the damage was and what we needed to recover the services. When we arrived in Mirandola, we immediately started to act."

In the ambiguity and uncertainty created by the earthquakes, the interviewee intuited the situation – as a crisis, from feeling the quakes and hearing the screams of fleeing colleagues – which facilitated a prompt interpretation: "we need to recover the service." The interpretation set the tone of the response and guided actions. All the interviewees reported that their immediate interpretation of the interruptions generated by the

earthquakes was to resume the services, which was followed by the actions of organizing an emergency meeting to map the damage and organize the response. The manager of environmental services said: "the office here (in Carpi) was in the garden. We started to organize a help desk so that people could refer to us for questions. We set up a $100\,m^2$ tent in the garden and we began again to provide our services. The idea at that moment was to satisfy the requests from citizens."

The AIMAG employees responded promptly to the interruptions and took responsibility for their actions. The certification and safety manager explained: "in the immediate aftermath of the earthquakes, when the emergencies were presented, employees demonstrated an unexpected capacity to respond to these situations. They demonstrated authoritativeness together with management and decision-making skills, which had never been revealed before and would have been subsequently maintained. Many of them were responsible for making decisions and operating on the basis of their experience and competence, without seeking confirmation from supervisors." The employees also demonstrated a high level of team spirit during the response and recovery phases. As the water service manager confirmed: "when facing difficulties, we are more united. It was exactly what happened when we were faced with the earthquakes […]. I've never seen my team so united before." AIMAG employees understood how they could contribute from their interpretation of the interruptions. They collaborated to achieve collective outcomes and subordinated their own needs to those of the organization. They did whatever was needed to resume the services. Working with other members, the interpreting process naturally blended into the integrating process. Integrating is a process that connects group learning to the organizational level, and requires the development of a shared understanding and the coordination of actions. Actions that are perceived to be effective will be repeated (Crossan *et al.*, 1999). In the case of AIMAG, the company built up more resilient routines in the post-earthquake situation, "repeating" effective actions taken during the response and recovery stages.

Christianson *et al.* (2009) stated that: "re-structuring refers to a general capacity to rebuild structures and routines that prove to be inadequate" (p. 854). This involves instituting the learning acquired by individuals and groups into the organization and making sure that routines re-occur (Weick and Roberts, 1993). The data collected three years after the earthquakes enabled us to observe how AIMAG's routines had been restructured. In AIMAG, the re-structuring of routines was mainly demonstrated by the increased awareness of disaster risk reduction strategies and the implementation of a risk management schema. The manager of environmental services explained: "a more structured work on emergency planning has been shown as necessary and useful. Experience had played a fundamental role during the event, but also limits had been evident. We needed to assume different scenarios and develop responses. We needed to transform from 'responding based on the competence and experience' to a new structure, which focuses on prevention, relying on a systematic risk evaluation." After the earthquakes, AIMAG routinized some actions that proved to be effective during the response.

6. Discussion

From the systematic observations of how AIMAG learned through the interruptions, this study examines what they learned. The unexpected audit triggered by the earthquakes made individuals focus more on working safety, and increased the awareness of risks and the effects produced. This increased knowledge was also manifested in the employees' behavior. Explicit examples were: increased numbers of workers wore helmets at work, or showed increasing interest and involvement in training initiatives related to preparedness and response to emergencies. In addition, managing the emergencies enabled AIMAG members to learn more about the functions of other departments and increased the

interaction between them. Most interviewees stated that they had learned during the emergencies, and had understood their colleagues better. The manager of legal affairs, human resources and procurement said: "some employees who had been considered before the event as very 'cold', demonstrated strong empathy toward the others colleagues during and after the event […]." Employees established more direct relationships with colleagues who showed a willingness to help during the crisis. However, the few members of staff who did not show up during the crisis, particularly the managers, had problems being re-integrated into the team and in re-establishing their leadership.

The earthquakes made it clear to AIMAG that there were both internal and external risks, which drastically increased its awareness of risk reduction. For example, having experienced the interrupted communication in the immediate aftermath of the earthquakes, AIMAG assigned walkie-talkie radios to the managers of the various sites to ensure a smooth flow of communication in further disastrous situations. More importantly, AIMAG started to think beyond the risks generated by daily operations and to consider natural hazards such as floods, earthquakes and tornados. All the interviewees expressed the need and the willingness to codify and standardize the knowledge acquired after successfully handling the interruptions generated by the earthquakes. A company-wide risk management schema was implemented, which codified the location of key assets, analyzed different scenarios and built up response and recovery plans accordingly. AIMAG also reconstructed the ICT system to back up and restore data in case of disasters. In addition, AIMAG learned specific knowledge on how to treat earthquake debris, particularly asbestos. When the tornado occurred in May 2013, AIMAG successfully handled the risks related to asbestos emissions. The manager of environmental services commented: "The biggest lesson that we learned from the earthquake experience is the need for better approaches and attitudes toward risks. We need to be more ready for different scenarios and the aftermath of the scenarios. I want my people to be able to manage complex situations, not just one specific complex situation."

The lessons learned at the individual and the group levels were easier to be comprehended and implemented. Individuals increased their awareness of risks and changed their behaviors accordingly. Groups coordinated better as team members got to know each other better. Nevertheless, it requires efforts and resources to institute the learning into AIMAG. Though all the interviewees expressed the need of codification and standardization of the knowledge for disaster prevention, few actions were taken. The company-wised risk management schema focused more on disaster response and recover. The protection is limited to intangible assets such as data and digital archive. The protection of buildings and equipments was not included in the risk management schema.

7. Conclusion
By demonstrating the changes in an organization's knowledge and the improvement of performance at individual, group and organizational levels, this study suggests that learning triggered by disaster is not exceptional learning. The interruptions generated by the earthquakes audited the knowledge repositories of the organization, revealing its weaknesses and strengths. Knowledge learned through previous emergencies can thus be exploited and used to explore new solutions (Crossan *et al.*, 1999). Routines connect all three levels of learning. Individuals seek knowledge from routines, groups coordinate according to routines and newly acquired knowledge is embedded in the organization's internal routines. Christianson *et al.* (2009) pointed out that: "learning through rare events refers to discovering and strengthening a set of organizing routines that facilitate the resumption of activity as the interruption winds down rather than simply learning about the content of the rare events" (p. 850). Therefore one way to "normalize" OL through disasters is to consider the learning in relation to future planning and responses (Richardson and Ardagh, 2013).

The knowledge in AIMAG's repositories will be again audited during subsequent interruptions and again be updated and recorded. However, this study also points out that OL should be instituted and incorporated into AIMAG at a deeper level. The risk management should not be limited to disaster response and recovery. A complete and effective business continuity plan needs to be established to ensure the financial, operational and productive performance. Future research could investigate how public service organizations, such as utilities, learn through disasters and how can they effectively implement the lessons acquired. The features of AIMAG's services, its ownership structure and its history with local authorities facilitated the coordination and the communication with the local municipalities in the aftermath of the earthquakes. Natural hazards are localized to geographical regions, which require the collaboration with the stakeholders at multiple levels of government. Future research could focus on the interaction between an organization and its key stakeholders to further the understanding of community resilience. Though this is a single case study, it provides rich and in-depth findings on how and what a multi-utility learned through the interruptions triggered by the earthquakes. They contribute to "normalizing" the OL triggered by disasters. The timeframe of learning is extended, by considering how the learning that occurred through the disasters relates to an organization's past and future. Our study also suggests that the learning happens at all levels inside an organization and routines play a critical linking role. Case studies are great teaching tools and yield out fruitful managerial implications. This study reveals the importance of growing the capability that allows organizations to learn through interruptions and the necessity of building up resilient routines that contribute to form learning capabilities.

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Appendix. Semi-structured interview questions to internal stakeholders

Pre-earthquakes
- When did you join AIMAG and why did you choose to join the company?

- Please describe to us some challenging situations in your career. How did you manage and what did you learn from the experience?

- How do you think about your job and how do you position yourself in the team and in the organization?

- Please describe to us your team, the daily work of your team and how decisions are made and executed in your team.

During the earthquakes
- Please briefly describe the 2012 earthquakes and AIMAG's response and recovery.

- What was your first reaction and impression after the earthquakes?

- What was the damage in your area?

- What decisions were taken in the immediate aftermath? Why did AIMAG take those decisions?

- What was your role in the response and recovery stage?

- Were your team able to handle the interruptions? What were the main challenges and how did you and your team solve them?

After the earthquakes
- What were the lessons learned and how did AIMAG institute the knowledge acquired?

- What kinds of changes have subsequently been brought about by the earthquakes?

- How did the relationships among employees change after experiencing the earthquakes?

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