Disaster Recovery – The Process Management Perspective

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DISASTER RECOVERY – THE PROCESS MANAGEMENT PERSPECTIVE

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Abstract

Process management is becoming increasingly important for managing commercial, governmental as well as non-profit (NGOs) organisations. Process management approaches depend on the process characteristics and requirements, typically determined by the organisational context, both internal and external. Managing processes crossing the NGOs, Government and business agencies brings upon brand new challenges. Our research focuses on disaster recovery, as a prime example of such a complex cross-organisational environment. Even though every disaster is unique, when considered from the process perspective, disaster recovery could be seen as a set of operational processes – some of which are highly structured and predefined, while the others are highly emergent, ad-hoc processes that need to be designed in-situ and managed as they evolve. Through an in-depth review of the relevant literature published by the Business Process Management (BPM) and disaster recovery (DR) research communities this paper reports on the existing research on the process management perspective of disaster recovery. The literature was analysed through a theoretical lens combining two existing frameworks previously developed for a formal organisational context. Our research provides insights into the main characteristics of the operational processes and suggests that their management should consider the so-called “Integration Model” and “Collaboration model” as the most suitable.

Keywords: Disaster Recovery, Business process Management (BPM), Operational processes, Knowledge-intensive process, Collaborative process.
1 INTRODUCTION

Natural and other man-made disasters continue to have devastating impact on humans, communities, societies, environment as well as business, governmental and nonprofit (NGOs) organisations worldwide. Unable to predict the next occurrence and its effects, countries all around the world are engaged in design and implementation of various methods for disaster management with the main objective to decrease possible impacts. A typical disaster management model, such as the one described by (Lettieri et al. 2009), consists of four canonical phases: mitigation (Pre-disaster), Preparedness (Pre-disaster), response (During disaster) and recovery (Post-disaster). Obviously each phase is quite unique in terms of its known and more importantly unknown challenges, always exceeding our collective ability to predict, let alone address them.

While acknowledging the critical importance of all phases of disaster management, in this research we focus on the recovery phase. “Recent disasters around the world have raised thorny and difficult issues regarding recovery and reconstruction.” (Labadie 2008).

Looking from the management perspective, disaster recovery could be seen as a set of complex and multi-faceted operational processes, which include both short term and long term activities to bring the disrupted area back to a “new normal” condition. Thus, typical processes (activities) include rehabilitation, debris management and reconstruction (Moe & Pathranarakul 2006, Labadie 2008, Lettieri et al. 2009). They are always contextual and very unique in each case, thus very hard to manage by any method that relies on predictability and stability.

While disaster recovery efforts could be studied from many different perspectives, in this article we focus on the process perspective with the main objective to better understand possible challenges related to process management in these highly agile unpredictable environments. We argue that disaster recovery requires management of many different types of processes, ranging from the pre-defined and highly structured ones as prescribed by emergency operating procedures, to highly emergent, ad-hoc processes that need to be designed and managed as they evolve. Moreover, these processes are by nature collaborative and often span the boundaries of different formal and informal organizations, including those of very different types (business, government and community/NGO). Even when pre-defined by operating procedures, when implemented these processes become highly situational and thus knowledge-intensive. The same observation applies even more to the ad-hoc, emergent processes that need to be designed and then managed, often under the extreme conditions.

Given the fact that all work could be seen as process work, as suggested by (Hammer 2010), we argue that management of disaster recovery processes become an important contributor to the overall success of the recovery efforts. However, there exists an important research gap found across two different research areas: Business Process Management (BPM) and Disaster Recovery (DR). More precisely, a very comprehensive literature review, reported later in the paper, confirms that the mainstream BPM literature does not deal with the disaster recovery processes as attempted in this project. But at the same time, the emerging BPM research direction towards knowledge-intensive processes and their management does provide a good foundation for studying disaster recovery processes, especially their knowledge aspect. On the other side, the disaster recovery literature, also reported later in the paper, reveals the same research gap, thus confirming that the process perspective, in particular management of disaster recovery processes has not been considered by the DR community.

The main objective of this research is to identify and analyze the existing approaches to, and associated challenges of managing disaster recovery processes, as reported in the current literature, including research articles as well as published case studies. To achieve this objective, we focus on different types of knowledge-intensive as well as highly structured processes, found both in the BPM and DR literature; aiming to understand their main characteristics, in order to identify possible
requirements for their management. Therefore, this research focuses on the following key research question: *What are the existing approaches to management of disaster recovery processes?*

In order to answer this question, three sub-questions were designed, Q1: *What are the main characteristics of a disaster recovery situation?* Q2: *What are the main requirements for disaster recovery?* Q3: *What are the main characteristics of operational processes in disaster recovery?*

As any disaster recovery is a complex and multi-faceted endeavour, choosing a comprehensive basis to identify and categorize disaster recovery processes at different organizational levels was an essential starting step. In order to achieve this goal we adopted “the BP Trends pyramid” by (Harmon 2010). This widely used framework offers a comprehensive approach to understanding process management at three levels of abstraction: the enterprise, process and implementation levels. Furthermore, in order to analyze the identified processes in terms of their interdependence and knowledge complexity, we adopted the “Knowledge work matrix” by (Davenport, 2010).

These two research frameworks were combined and used as a theoretical lens for a very comprehensive literature review of related work in BPM and DR. Our results show that 1) Existing successful approaches to process management in disaster recovery correspond to the “Collaboration model” and “Integration model” as defined by the Davenport matrix and 2) More research needs to be done at process and implementation level.

2 DISASTER RECOVERY: FOUNDATION CONCEPTS

As already stated, our research focuses on the recovery phase. According to Lettieri et al (2009), “Recovery consists of those actions that aim to bring the disrupted area back to an often improved normal condition”. It includes short-term and long-term activities called rehabilitation and reconstruction (Moe & Pathranarakul, 2006).

The main challenge of the recovery phase is to restore or improve the pre-disaster living conditions of the stricken community in short term, and in the long term achieve sustainability and survivability of the community (Moe & Pathranarakul 2006, Labadie 2008, Lettieri et al. 2009). Although scholars believe that boundaries between relief, rehabilitation and development are blurred and overlapping (Harvey 1998, Green 2000), generally short term activities to bring the disrupted area back to the normal condition is called rehabilitation.

Disaster recovery efforts include many different activities such as 1) rebuilding houses, buildings, infrastructure, 2) creating communications infrastructure, 3) providing loan, credits, technical assistance 4) strengthening disaster mitigation efforts and 5) debris management (Labadies 2008, Ekici et al. 2009).
When analysed from the process perspective, DR could be seen as a high-level process that is also operationalized (implemented) in each phase by a set of very complex multi-facet (Labadie 2008), multi-actor processes (Lettieri et al. 2009) at the operational level. These operational processes (activities) require effective coordination and cooperation of various agents, such as governmental agencies, NGO, volunteer groups, and private companies. Furthermore, prior to their implementation, many of these operational processes need to be designed in-situ. This in turn involves very complex situational decision-making, dealing with difficult issues such as what needs to done, how, when, by whom and with which resources (Labadie 2008). All of these issues create a need for a better understanding of the process perspective of DR. At the same time, these very complex process-related issues are not encountered by traditional BPM that tends to focus on formal organisations, governed by very different kind of organisational rules and policies. The same observation applies to collaborative BPM, where cross-organisational BPs are considered in business-to-business (B2B) context, and as such, regulated by contracts.

3 THEORETICAL BASIS FOR THE STUDY

This section aims to introduce the two key frameworks used to set a theoretical basis for this research study. In combination, these frameworks created a theoretical lens that was then used to analyse the results of a comprehensive literature review, as described later in the text.

The starting point for this research involved a selection of the most appropriate basis to identify and categorize disaster recovery’s operational processes at different organizational levels. For this purpose, we adopted a widely used BPM framework by Harmon (2010) also known as “the BP Trends pyramid”. This framework offers a comprehensive approach to understanding process management at different levels: enterprise, process, implementation via human resources and IT, as depicted by Figure 2. The Enterprise level offers a high-level view of enterprise-wide BPs and focuses on strategy, process architecture, process governance, process measurement systems, managing culture change and organizational transformation. The process level focuses on process analysis and (re) design, including methodologies and tools. The implementation level focuses on BP implementation including information technologies (i.e. BPM systems) and human resources (i.e. process participants).

As already stated, design of disaster recovery processes involves knowledge work and situational decision making, due to their highly unpredictable nature. Therefore, they could be seen as knowledge-intensive, to some or larger extent, as the actual implementation of these processes may involve knowledge work but could be also very routine. Therefore there is a need to better understand disaster recovery processes’ design and implementation from the knowledge perspective, in order to draw some conclusions about their management. In order to achieve this objective, we adopted the so-called “knowledge work matrix” by Davenport (2005). According to this matrix there are 4 approaches to knowledge work, based on “degree of expertise” and “level of coordination” (Figure 3). The matrix also considers the collaborative aspect, again highly applicable to the DR processes.

4 RESEARCH METHODOLOGY

This study is designed as an in-depth analytical literature review of the relevant research papers and case studies published by the BPM and DR communities, dealing with different aspects of process management in disaster recovery. We adopted the research methodology designed by (Vom Bocke et al. 2009) and (Webster & Watson 2002). More precisely, our literature review followed the framework proposed by (Vom Bocke et al, 2009), and consisted of the following five steps: 1) definition of review scope 2) conceptualization of topic 3) literature search 4) literature analysis and synthesis and 5) consideration of possible research agenda.
Step 1- Definition of review scope: We focused on two different areas of research: IS and DR. In the IS field, we focused on the literature on disaster recovery and within it, papers related to the process aspects of DR. We then focused on the DR publications with an objective to understand the process perspective.

Step 2- Conceptualization of topic: This step involved selection of the most appropriate keywords to guide our selection of relevant papers. These keywords were derived from two very recent resources that could be used as representative of the current BPM and DR work. These were the “Handbook of disaster management” by (Pinkowski, 2008) and “Handbook on business process management” by (Rosemann & Brock, 2010)”. The outcome of this were two main categories: 1) “Research Context” where keywords included “Disaster Recovery”, “Debris Management”, “Disaster Reconstruction” and “Disaster Rehabilitation”, 2) “Process management” with the keywords of “process improvement” and “process management”.

Step 3- Literature search: We followed Webster and Watson structured approach (2002) to determine the most relevant sources. In order to identify high quality articles in the IS literature; we chose the basket of 8 leading journals as determined by the Association for information systems (AIS). We also reviewed the Business process management journal (BPMJ) as the most representative specialised journal in BPM field. For the purposes of this paper, we focused only on the journal papers as the most representative of the IS research and thus did not include the papers published by the IS conferences. In addition, we also conducted a search of all “conference proceedings”, “Scholarly Journals”, “Dissertations and theses” which contains “disaster” and “process improvement/process management” in their title between 2000-2011 in the following databases: Proquest, Business Source Premier;
Emerald ScienceDirect, JSTOR. The main objective was to identify any additional and potential sources. This search did not reveal any relevant work.

From the DR literature we selected the most representative specialised journals in this area. We also included a large set of real-life case studies published in (Pinkowski, 2008), because of their highly descriptive nature. We then looked for the journals with title containing “disaster” and “management” words. Through this process we identified the academic, fully refereed journals titled “Disaster Management and Response” and “Disaster Prevention and Management”. According to Ulrichweb, Subject of the first journal is “medical science” whereas subject of the second journal is “public health and safety”. The second journal, Disaster Prevention and Management, was selected because its subject is more general and thus closer to our research aim. Journal articles with at least one of the “Context research” keywords in their title were selected without any time limitation. Furthermore, after reviewing all published cases by (Pinkowski, 2008), we selected four as the most related to our work.

**Step 4 - Literature analysis and synthesis:** This step was conducted in three phases. (1) Scope analysis (Brocke et al. 2009) (2) Concept analysis (Webster & Watson 2002) and (3)Analysis and Synthesis through the theoretical lens we previously designed. They are described in the next section.

**Step 5 - Research Agenda:** In this step we offer some conclusions and outline some interesting topics for future research. The outcomes of this step are incorporated in the concluding section of this paper.

## 5 LITERATURE ANALYSIS AND SYNTHESIS

### 5.1 Relevant literature applying process perspective (Scope analysis)

Our literature analysis in the IS field confirmed a significant research gap related to the prior and current research on disaster recovery from the process management perspective. Only 24 articles out of 125 were found to be partially relevant. These articles did not focus on disaster recovery per se, but only referred to disaster recovery very briefly. Most of them focused on developing effective IT recovery plans as an important factor in IT system development/security/maintenance in the context of corporate IS/IT strategies. Development of the effective IT recovery plans need to consider: i) Outsourcing; ii) building temporary teams during disaster recovery; iii) contingency planning, and scenario-based planning; iv) distributing resources effectively; v) using intranet during disaster recovery; and vi) importance of leadership and management support. Moreover, Braha & Bar-Yam (2004) highlighted the importance of supply chain in disaster recovery. The study by Hendela & Mendonça (2004) showed that information systems which intended to support large-scale debris removal should be: i) extensible, so that they can be used within and among unpredictable organizational structures; ii) flexible, so that they support real-time generation of new procedures; and iii) integrated, so that they are capable of communicating with a variety of other systems.

A total of 28 journal articles were found in “Disaster Prevention and Management” journal which were related to disaster recovery. 24 out of 28 articles were case studies. Four additional cases related to disaster recovery were found in the Disaster management handbook, describing (a) different approach to disaster recovery during Alaskan Earthquake disaster recovery; ii) Debris disposal and recycling for the Cedar and Paradise Wildfires in San Diego; iii) Disaster in the United states and Canada: The Case of the Red River; iv) Disaster Management structure in Turkey (Pinakowski, 2008).

### 5.2 Characteristics and requirements of disaster recovery (Concept analysis)

Next, we conducted the concept analysis of the identified literature. As a result, we identified two broad categories: i) situational characteristics of disaster recovery, ii) requirements for disaster recovery. We then looked at disaster recovery characteristics from four different perspectives: Context, Process, Resource, and Information. Our main finding is that disaster recovery is a dynamic situation which has different aspects, dimensions and stakeholders with conflicting objectives, culture
and priorities. Infrastructure failure, lost data/information and inaccessibility are problems related to the context of DR. Table 1 shows the characteristics of disaster recovery situations.

To cope with disaster recovery situation, it is necessary to better understand the requirements of disaster recovery. Key findings are shown in Table 2. These findings show that main aims of DR are building long term resilience, more sustainable and survivable community. Improvisation, flexibility and innovation are required in DR as well as safe, timely, cost effective prediction and quick, integrated planning and decision making.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context : dramatic, critical, dynamic &amp; breathtaking</td>
<td>Alexander et al. 2006; Barakat &amp; Strand 1995; Gupta &amp; Sharma 2006; Ink 2008; Kemp 2008; Labadie 2008; Wiek et al. 2010</td>
</tr>
<tr>
<td>Information: unavailability to access to information source; Data lost &amp; treat</td>
<td>Petrantonakis et al. 2005; Vom Brocke et al. 2011</td>
</tr>
</tbody>
</table>

Table 1. Characteristics of disaster recovery situations

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR needs quick, adaptive, integrated &amp; comprehensive, expedited actions especially in planning &amp; decision making</td>
<td>Cuny &amp; Tanner 1995; Green 1995; Ink 2008; Moe 2010; Pardasani 2006; Rajib 2006; Ravindra &amp; Pande 2007</td>
</tr>
<tr>
<td>DR needs high flexibility, innovation &amp; improvisation</td>
<td>Cuny &amp; Tanner 1995; Ghafor- Ashtiany 1999; Ink 2008; Rajib 2006</td>
</tr>
<tr>
<td>DR shall be safe, timely &amp; cost effective with accurate prediction and keeping equity.</td>
<td>Arya et al. 2006; Cuny &amp; Tanner 1995; Diego 2008; Ghafor- Ashtiany 1999; Gupta &amp; Sharma 2006; Moe 2010; Pardasani 2006; Ravindra &amp; Pande 2007</td>
</tr>
<tr>
<td>Long term resilience &amp; more sustainable and survivable community are the main aims of DR</td>
<td>Alexander et al. 2006; Barakat &amp; Strand 1995; Green 1995; Gupta &amp; Sharma 2006; Labadie 2008; Moe 2010; Osei 2007; Pardasani 2006; Rajib 2006; Regnier et al. 2008; Sugimoto et al. 2010; Wiek et al. 2010</td>
</tr>
</tbody>
</table>

Table 2. Disaster Recovery Requirements

5.3 Analysis of operational processes (Analysis and synthesis through the theoretical lens)

In the next step, we derived characteristics of operational processes. Table 3 offers a synthesis of the general characteristics of DR’s operational processes as found in the literature. We then analysed these characteristics through the theoretical lenses described in the previous section of this paper, as shown by Table 4. This table shows the identified process characteristics at three different levels, as defined by Harmon’s framework, to the levels of Harmon framework. The same table also shows the Knowledge Work Approach, derived from the Davenport’s framework.

According to Harmon (2010), it is important to manage processes on all three levels: including the enterprise, process and implementation levels. However, our analysis of the existing literature shows that processes are considered only at the very high level of abstraction (that could be interpreted as
Table 3. Process Characteristic in disaster recovery

<table>
<thead>
<tr>
<th>Code</th>
<th>Process characteristics</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>“Intergovernmental, Bottom-up, goal-oriented” instead of “procedure-oriented” approach</td>
<td>Beggan 2011; Diego 2008; Gannapati 2008; 2010; Ghafoor-Ashtiany 1999; Ink 2008; Kemp 2008; Leslie 1995; Moe; Pardasani 2006</td>
</tr>
<tr>
<td>C3</td>
<td>“Community-based” approach</td>
<td>Alexander et al. 2006; Diego 2008; Gannapati 2008; Green 1995; Ink 2008; Labadie 2008; Leslie 1995; Pardasani 2006; Rajib 2006</td>
</tr>
<tr>
<td>C4</td>
<td>“Operational approach” to build disaster lessons and experiences sys.</td>
<td>Diego 2008; Ekici et al. 2009; Ghafoor-Ashtiany 1999; Gupta &amp; Sharma 2006; Leslie 1995; Moe; Rajib 2006; Sugimoto et al. 2010</td>
</tr>
<tr>
<td>C7</td>
<td>Required process in disaster recovery are monitoring, tracking, evaluation, documentation, coordination, training, knowledge management, decision making, planning, expediting, networking, logistic and reporting</td>
<td>Alexander et al. 2006; Aziz et al. 2009; Barakat &amp; Strand 1995; Beggan 2011; Diego 2008; Ekici et al. 2009; Gannapati 2008; Ghafoor-Ashtiany 1999; Green 1995; Gupta &amp; Sharma 2006; Ink 2008; Iyer &amp; Bandyopadhyay 2000; Kemp 2008; Labadie 2008; Moe 2010; Osei 2007; Pardasani 2006; Patin 1997; Petrantonakis et al. 2005; Rajendram &amp; Senevirute 2009; Rajib 2006; Ravindra &amp; Pande 2007; Regnier et al. 2008; Sugimoto et al. 2010; Wick et al. 2010</td>
</tr>
<tr>
<td>C8</td>
<td>Processes design strategy: streamlining, open, accountable, accessible and transparent processes need intra-organizational and inter-organizational relationships</td>
<td>Beggan 2011; Diego 2008; Ink 2008</td>
</tr>
<tr>
<td>C9</td>
<td>Trust, commitment and collective responsibilities shall be made between all stakeholders</td>
<td>Alexander et al. 2006; Ink 2008; Wick et al. 2010</td>
</tr>
<tr>
<td>C10</td>
<td>Manage resource collection and allocation specially funding Between different levels &amp; from range of organization</td>
<td>Alexander et al. 2006; Cullen et al. 2005; Cuny &amp; Tanner 1995; Diego 2008; Gannapati 2008; Ink 2008; Kemp 2008; Labadie 2008; Luftman and Zadeh 2011; Osei 2007; Pardasani 2006; Rajib 2006; Regnier et al. 2008; Wick et al. 2010</td>
</tr>
<tr>
<td>C11</td>
<td>Participation of NGO &amp; donor group participation &amp; aligning NGO plan to overall plan</td>
<td>Barakat &amp; Strand 1995; Cuny &amp; Tanner 1995; Ekici et al. 2009; Gannapati 2008; Gupta &amp; Sharma 2006; Labadie 2008; Minamoto 2010; Pardasani 2006; Regnier et al. 2008; Sugimoto et al. 2010</td>
</tr>
<tr>
<td>C12</td>
<td>Avoiding of making disaster political events</td>
<td>Cuny &amp; Tanner 1995; Minamoto 2010; Osei 2007; Rajendram &amp; Senevirute 2009</td>
</tr>
<tr>
<td>C13</td>
<td>Use media to make everything as much clear and transparent as possible to publics</td>
<td>Alexander et al. 2006; Dechano &amp; Butler 2001; Diego 2008; Gupta &amp; Sharma 2006; Ink 2008; Moe 2010</td>
</tr>
<tr>
<td>C14</td>
<td>Processes need engagement of all stakeholders</td>
<td>Diego 2008; Gannapati 2008; Ink 2008; Kemp 2008</td>
</tr>
<tr>
<td>C15</td>
<td>Processes shall be designed in contingent, on-going emergent manner</td>
<td>Dominum 2009; Iyer &amp; Bandyopadhyay 2000; Nelson 2000; Niranjan et al. 2007</td>
</tr>
<tr>
<td>C16</td>
<td>Clear, direct reporting to upper levels is required</td>
<td>Beggan 2011; Gannapati 2008; Ink 2008; Kemp 2008</td>
</tr>
<tr>
<td>C18</td>
<td>Plan and address unique needs, policies and processes independently with some unique conditions by each partner, establishing central office for taking charge of recovery process</td>
<td>Gannapati 2008; Ink 2008; Kemp 2008; Minamoto 2010; Osei 2007; Regnier et al. 2008</td>
</tr>
<tr>
<td>C19</td>
<td>Designing incentive and reward Mechanisms for actors of disaster recovery</td>
<td>Alexander et al. 2006; Cuny &amp; Tanner 1995; Diego 2008; Ink 2008</td>
</tr>
<tr>
<td>C20</td>
<td>Developing IT disaster recovery plan to not lose data and keep security</td>
<td>Ardagna &amp; Francalanci 2005; Baptisa 2009; Benlam 2011; Bharadwaj et al. 2009; Chen and Bharadwaj 2009; Davis et al. 2006; Jayatilaka et al. 2003; Luftman and Zadeh 2011; Pai and Basu 2007; Ramirez 2010</td>
</tr>
<tr>
<td>C21</td>
<td>Implement tracking and Knowledge management system &amp; using IT tools</td>
<td>Aziz et al. 2009; Baptisa 2009; Diego 2008; Fischer 1998; Petrantonakis et al. 2005; Rajendram &amp; Senevirute 2009</td>
</tr>
<tr>
<td>C22</td>
<td>Database s and Data Back-up</td>
<td>Choudhuri et al. 2009; Diego 2008; Petrantonakis et al. 2005</td>
</tr>
<tr>
<td>C23</td>
<td>Deploy experts in employees and management levels</td>
<td>Barakat &amp; Strand 1995; Beggan 2011; Gupta &amp; Sharma 2006; Ink 2008; Pardasani 2006; Minamoto 2010; Rajendram &amp; Senevirute 2009; Rajib 2006</td>
</tr>
<tr>
<td>C24</td>
<td>Deploy well-functioning and decisive leader</td>
<td>Ink 2008; Luftman and Zadeh 2011; Rajib 2006; Ramirez 2010</td>
</tr>
<tr>
<td>C25</td>
<td>Pre-agreement between stakeholders specially insurance</td>
<td>Beggan 2011; Dechano &amp; Butler 2001; Diego 2008; Gannapati 2008; Ink 2008; Kemp 2008; Ravindra &amp; Pande 2007</td>
</tr>
</tbody>
</table>
Enterprise level). Therefore, it is essential for the future research to focus more on the process and implementation levels. Furthermore, there is a need for more in-depth research in process level, especially with regards to coordination aspect.

When analysed from the “level of interdependencies” perspective (Davenport, 2005) process characteristics demonstrate the need for different types of actors to collaborate with each other in order to achieve shared goals of disaster recovery. Therefore, a high level of coordination is needed in disaster recovery. From “complexity of work” point of view, activities fall into two different categories. Availability of pre-defined plans, guidelines, booklets, policy, strategy, confirms that actors do follow some routines. On the other hand, the characteristics such as simple organizing, streamlining process, goal-oriented approach, open process, authority delegation, indicate that more interpretation and judgment are required to conduct activities. By looking at all of these results together we can conclude that managing disaster recovery’s operational processes needs high level of coordination and interpretation/judgment and as such they are knowledge-intensive. Simultaneously actors (process participants) in these operational processes do follow some routines defined by a central plan, strategy, policy, conditions, booklets and guidelines. When all of these activities were analyzed through the Davenport matrix, it is possible to confirm that the existing models for disaster recovery process management were Collaboration” and “Integration” models. Summary of this analysis and synthesis is shown in Table 5.

<table>
<thead>
<tr>
<th>Code</th>
<th>Harmon</th>
<th>Davenport</th>
<th>Code</th>
<th>Harmon</th>
<th>Davenport</th>
<th>Code</th>
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<td>NA</td>
<td>C17</td>
<td>×</td>
<td>C</td>
</tr>
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<td>×</td>
<td>JE</td>
<td>C10</td>
<td>×</td>
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<td>C18</td>
<td>×</td>
<td>JE-R-C</td>
</tr>
<tr>
<td>C3</td>
<td>×</td>
<td>C</td>
<td>C11</td>
<td>×</td>
<td>NA</td>
<td>C19</td>
<td>×</td>
<td>NA</td>
</tr>
<tr>
<td>C4</td>
<td>×</td>
<td>C</td>
<td>C12</td>
<td>×</td>
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<td>×</td>
<td>C</td>
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<td>×</td>
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<td>C23</td>
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<td>JE-C</td>
<td>C16</td>
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<td>JE</td>
</tr>
<tr>
<td>C25</td>
<td>×</td>
<td>R</td>
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</tr>
</tbody>
</table>


**Table 4. BPM Pyramid in disaster recovery/ Basic Comprehensive BPM guideline**

<table>
<thead>
<tr>
<th>Individual</th>
<th>Routine</th>
<th>Collaborative</th>
<th>Judgment/ Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C6;C18; C20;C25</td>
<td>C1; C3;C4;C5; C7; C8; C14; C17;C18</td>
<td>C1;C2;C5;C8;C15;C18;C23;C24</td>
<td></td>
</tr>
</tbody>
</table>

**Table 5. Analysis of Disaster recovery’s activities based on Davenport Matrix**
CONCLUSION AND RESEARCH AGENDA

Recent disasters around the world have raised thorny and difficult issues regarding recovery and reconstruction. At the same time, recovery and reconstruction efforts can help to mitigate possible future disaster effects by making the community more sustainable and more survivable (Labadie 2008). As there are different kinds of approaches for process management, learning about the existing successful models and approaches becomes a very important source of information for the future disaster recovery situations, even though they are always unpredictable. In this paper, we offered a comprehensive literature review of the related work in BPM and DR research. We considered various disaster recovery conditions and requirements aiming to derive possible process-related characteristics. They were then analyzed through a theoretical lens that combines two existing BPM frameworks by Harmon (2010) and Davenport (2005). Our results show that “Collaboration model” and “Integration model” are relevant for disaster recovery process management. This research contribution means that more efforts need to be placed on the coordination of different parties in disaster recovery. Our literature review as reported in this paper considered 8 top IS journals, one disaster management handbook and one disaster management journal as representative of IS and DR fields. However, our literature review did not include the IS conferences and this is the main limitation of our work. Acknowledging this important source of possible new ideas and research on the process perspective of DR, we intend to consider it in our future research.

References


