Disaster Recovery – New Challenges and Opportunities for Business Process Management Research and Practice

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Abstract

Managing processes across community/NGOs, government and business agencies brings upon brand new challenges, yet to be explored by the Business Process Management (BPM) community. This 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 knowledge-intensive i.e. 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 management of DR processes. The literature was analysed through a theoretical lens combining two existing frameworks previously developed and used by the BPM community. Our research provides insights into the main characteristics of DR processes and the existing research gaps found across BPM and DR. These insights were used to identify relevant theories that could be used by information systems researchers to study different aspects of DR processes, in particular: (i) sharing and co-creation of process-related knowledge among very diverse process participants; (ii) management of data and information flows across different types of organizations (business, governmental and community/NGOs); (iii) flexible coordination mechanisms, and (iv) provision of more flexible IS support for these emerging knowledge-intensive processes.

Keywords: Disaster Recovery, Business process Management (BPM), Operational processes, Knowledge-intensive process, Literature review.

Introduction

Natural and other man-made disasters continue to have devastating impact on humans, communities, societies, environment as well as business, governmental and non-profit (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.

While disaster management efforts have been studied from many different perspectives, in this article we focus on the process perspective. The main objective is to better understand possible challenges related to management of complex processes in these highly agile environments and open up new opportunities for information systems (IS) research and practice.

Although unpredictable, disaster management situations involve management of many different types of multi-faceted processes, designed to bring the affected area back to a "new-normal" condition. They range from predefined and highly structured processes, as prescribed by emergency operating procedures and protocols (e.g. initiating an emergency warning procedure), to highly emergent, ad-hoc ones that need to be designed and managed as they evolve. Examples include rehabilitation, debris management and reconstruction (Moe & Pathranarakul 2006, Labadie 2008, Lettieri et al. 2009).

Even when they are pre-defined by operating procedures, implementation of these "routine" processes becomes highly situational and reliant on human knowledge and expertise, and as such, knowledge-intensive. Examples include emergency evacuation of people with special needs such as aged, frail or immobile citizens.

In spite of their unpredictability and uniqueness, processes in disaster management need to be coordinated and managed, but not by methods reliant on predictability and stability, as in typical Business Process Management (BPM). More importantly, disaster management not only requires management of different types of processes, it requires a very different approach to management - more mindful of, and accommodating to impossible-to-predict human (not customer) needs. Very recent episodes in our wider region provide very strong support for this argument. For example, during the Victorian bushfire disaster surviving families who lost everything were demanded to produce identification before their application for emergency relief would be processed. "Survivors unable to produce identification were told they needed at the very last a copy of a bank statement to prove who they were" (Robson, 2009).

Moreover, disaster management 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). This in turn creates quite unique challenges for their management, in terms of coordination, assumed and delegated roles and responsibilities, information sharing, technology support and so on. In addition to these cross-organisational challenges, there are additional intra-organisational challenges for each participating stakeholder, again related to their internal processes. For example, additional load as well as process efficiency requirements become challenging to handle, in addition to keeping everyday business running. For example, to help the victims of the January 2009 Queensland floods disaster, "between Nov 2010 and 17 June 2011, Centrelink paid out close to $464 million in disaster recovery payments, through almost 400,000 successful claims…At the peak of the flood recovery effort there were up to 2500 Centrelink staff nationwide working on the crisis – almost 10 per cent of the Centrelink workforce. This was on top of Centrelink's business-as-usual processing of tens of thousands of claims for payment such as Newstart, Age Pensions, Families and Carers" (Lahey, 2011). Given the nature of work of this government agency as well as the recipients of social welfare and other types of government support, their

"business-as-usual" claims could not be treated as less important.

Another equally important challenge for process management is created by fundamentally different types of participating organisations – government, business, communities – each with different governance mechanisms governing or at least influencing their responsibilities. For example, while process-related roles and responsibilities are defined by the normative contexts of government and business organisations, in the community-based organisations this may not be the case. Yet, they are often critical when it comes to influencing rather than regulating community behaviour. For example, in a recent example from Sydney, Australia, in spite of the alert systems working well, people simply ignored the issued Tsunami warning because of the perceived low probability of the event. To make the matters even worse, many rushed to the beach creating even more problems, through the unforeseen traffic congestion. Luckily, Tsunami did not occur (Smith and Robins, 2010).

The above-cited examples provided an initial motivation and impetus to study process management in disaster management. While acknowledging the importance of all phases of disaster management, in this research we focus on disaster recovery because it includes ad-hoc knowledge-intensive processes across different types of organisations. Looking from the process perspective, management of these knowledge-intensive processes remains an open research challenge in the BPM field. DR is the final of the four phases of disaster management (Lettieri, Masella and Radaelli,. 2009) that often continues long after the immediate recovery efforts cease to attract media attention and the immediate danger to communities is no longer there.

The main objective of our overall research is to contribute to a better understanding of DR processes and their management, leading to new opportunities for IS-related research and practical contributions, especially in relation to knowledge-intensive processes. The research reported in this paper is motivated by the necessary first step –the need to understand the existing process-related approaches and challenges as reported in the relevant literature in two different fields: BPM and DR.

Through a very comprehensive cross-disciplinary literature review this paper focuses on two key questions:

Q1: *What are the main characteristics of DR context?*

Q2: *What are the main characteristics of DR processes?*

Guided by the obtained insights, we then proceed to identify some relevant theories and discuss how they could be used by IS researchers to study different aspects of these processes, including sharing and co-creation of process-related knowledge across the boundaries of business, governmental and community organisations, complex information flows as well as agile and emergent coordination patterns that cannot be fully predefined.

Our research confirms a wide research gap found across BPM and DR. More precisely, the mainstream BPM literature does not consider the knowledge-intensive DR processes as attempted in this project. On the other side, the DR literature also confirms that management of DR processes has not been considered by the DR community from the process perspective, especially from the perspective of knowledge-intensive processes, as defined later in the paper. Future applications of the relevant theories identified in this research, are expected to contribute to closing of this research gap through an improved understanding of knowledge and information aspects of these processes as well as their support – all fundamental for their management and coordination.

The main contributions of this paper are envisaged to be relevant not only for the researchers interested in process management in disaster recovery and management, but also for those interested in management of more agile, emergent processes across busi-

ness, government and community sectors that remain an open research challenge for the IS community. Examples include cross-organisational processes found in complex systems of human-care such as aged care, healthcare or disability services.

The paper is organised as follows. Section 2 introduces the foundation concepts necessary for a better understanding of DR context. Section 3 describes the two theoretical frameworks used in this study. Section 4 provides details of our research method used to conduct literature analysis across two different domains: BPM and DR. Section 5 describes our research findings while Section 6 identifies the relevant theories that could be used by IS researchers for future studies of DR processes, in particular their information, coordination and knowledge-related aspects. Finally Section 7 outlines the main conclusions, study limitations and future work.

Foundation Concepts

In general, disaster management is considered to involve four equally critical, but very different phases named: Mitigation (Pre-disaster), Preparedness (Pre-disaster), Response (During disaster) and Recovery (Post-recovery) (Lettieri et al. 2009). Obviously each phase is equally important yet quite unique in terms of its known and more importantly unknown challenges, always exceeding our collective ability to predict, let alone address them. As previously explained, in this research we focus on the recovery - the final of the four phases of disaster management, as depicted by Figure 1. “Recent disasters around the world have raised thorny and difficult issues regarding recovery and reconstruction”. (Labadie 2008).

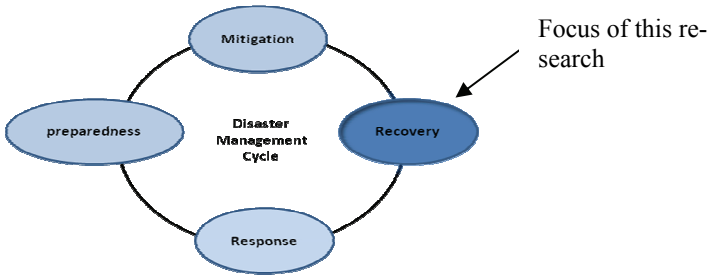

Figure 1. Disaster Management Cycle (Lettieri et al., 2009)

Although scholars believe that boundaries between relief, rehabilitation, reconstruction and re-development are blurred and overlapping (Harvey 1998, Green 2000), they generally distinguish between short-term and long-term challenges of DR. Thus, the main short-term challenge of the recovery phase, termed *rehabilitation*, is to restore the living conditions of the stricken community. This is followed by *reconstruction* - the long-term challenge to achieve sustainability and survivability of the community (Moe & Pathranarakul 2006, Labadie 2008, Lettieri et al. 2009). Disaster recovery efforts include many different activities such as 1) rebuilding houses, buildings, infrastructure, 2) creating communications infrastructure, 3) providing immediate and long term support such as medical and other human-services, loans, 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 set of operational processes that require effective coordination and cooperation of various agents, such as governmental agencies, NGO, volunteer groups, and private companies, as depicted

by Figure 2. Furthermore, 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 be done, how, when, by whom and with which resources. (Labadie 2008). The key ingredients of these processes become human knowledge, experience and creativity. These aspects cannot be easily understood let alone captured by process models and fully automated, as it is often the main objective of the traditional "organizationally-bound" business processes.

Even more, DR processes challenge our shared understanding of the key term "process", held and promoted for many decades by the mainstream BPM community. It is all too common for the organizations to interpret 'process' as 'flow diagram'. It specifies 'first you do this, and then you do that' (Davenport, 2010). "Sometimes the assumption is made that the concept of process and process management only apply to highly structured, transactional work, such as order fulfilment, procurement, customer service, and the like. Nothing could be further from the truth…Process should not be misinterpreted as a synonym for routinization or automation, reducing creative work to simplistic procedures" (Hammer, 2010, pp.11).

Acknowledging the importance of human-knowledge for their design and implementation processes, we see DR processes as knowledge-intensive. Compared to the well-established 'mainstream' research in Business Process Management (BPM), research on knowledge-intensive business processes (BPs) is still emerging. "While there appears to be an intuitive awareness of processes that are more knowledge intensive than others, the characteristics that constitute knowledge intensity have not been well documented in the research literature" (Kulkarni and Ipe, 2010, p. 33). It is also important to acknowledge that most jobs and work situations do require some degree of knowledge, even selling cinema tickets or driving (Davenport, 2010). However, this research adopts a much more complex view of knowledge work, as proposed by Davenport (2005). Thus, "knowledge work involves complex situational decision making, is inherently emergent, and rarely, if ever, standard to the point that it becomes routine" (Davenport, 2005, pp. 12). Therefore, BPs involving knowledge work of this nature, are considered to be knowledge-intensive.

Even though the research on knowledge-intensive processes is still emerging in the BPM field, it is possible to observe that so far researchers interested in these complex processes, just like those in the mainstream BPM, predominantly focus on those ones found within clearly defined organizational context i.e. "organizationally-bound processes". Examples include prior research by (Kulkarni and Ipe, 2010) and (El Sawy and Josefek, 2003). In other words, these processes are regulated by organizational norms and policies, with participants' process-related responsibilities defined by the formal organizational roles they assume. These observations apply to both the processes found in a single or across organizations.

In this paper we aim to extend the current boundaries of knowledge intensive business processes (KIBPs) by considering very complex DR processes that span the boundaries of business/commercial organizations (B), governmental agencies (G) and communities (C) including not-for-profit NFPs and NGOs, as depicted by Figure 2.

The above examples illustrate the complexity of DR processes and the need for their better understanding through research. We also posit that management of disaster recovery processes becomes an important contributor to the overall success of the recovery efforts.

Theoretical Foundations

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.

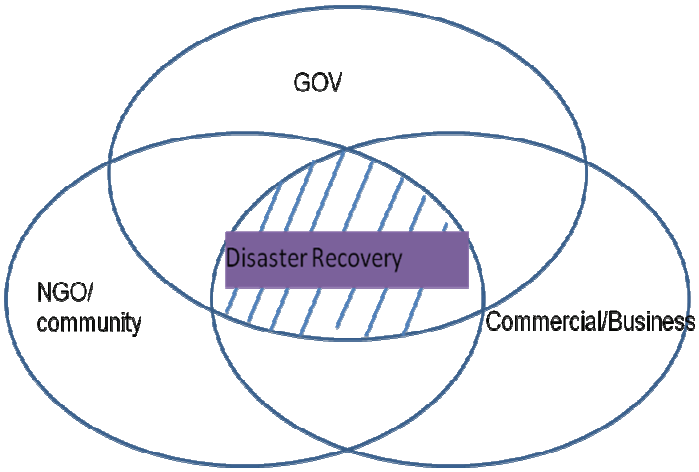

Figure 2. Context of DR processes

As any disaster recovery is a complex and multi-faceted endeavour, choosing a comprehensive basis to identify and categorize DR processes at different levels of abstraction and from different perspectives was the essential starting step.

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 3. This separation is very important, as "projects or activities at different levels require different participants, different methodologies and different types of support", (Harmon, 2010, pg. xxvi). 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. At the process level, organizations are focusing on process improvement and new methods for process analysis and design. Finally, at the implementation level organizations are focusing on development of technological and human resources designed to support processes. They include process support systems and people – process participants in different formal roles. Thus, people are seen as supporters or "implementers" of a strategy-driven process.

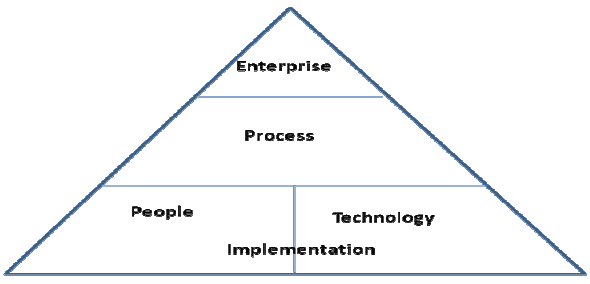

Figure 3. The BPM Pyramid (Harmon , 2010)

The previous two decades saw BPM practiced predominantly at the *Business Process level* and within the *Technology component* of the Implementation level. The main focus was on highly repetitive, transactional BPs and manufacturing organizations. These processes were improved through methodologies such as BP Reengineering, Six Sigma, Lean, Total Quality Management (TQM) – all highly suitable for highly repetitive processes that could be captured and represented by process models. At the implementation level these processes were supported by BP systems including workflows and Enterprise Resource Planning (ERP) systems. The main focus was on process standardization, elimination of "waste", and most importantly, on process efficiency achieved through automation. As the BPM systems entered the *mainstream* enterprise applications across industry sectors and organizations started to reach higher levels of BPM maturity, their BPM focus has gradually expanded to include all four areas of the pyramid.

We argue that DR processes also need to be studied at different levels of abstraction, however, Harmon's framework needs to be adapted to our chosen context. Thus the "Enterprise level" is extended to represent high-level process strategy, architecture & governance across three different types of organisations. As in the original framework, the remaining two levels focus on details of operational processes and their implementation by process participants and possible IT support.

The second framework was selected on the basis that DR processes are, by nature, knowledge-intensive BPs as explained in the previous section. 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 4). The matrix also considers the collaborative aspect, again highly applicable to the DR processes.

The above two frameworks were combined to provide a theoretical lens for our investigation of DR processes, guided by the above stated research questions.

Research Method

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 method 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.

Step1- 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.

Step2- 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".

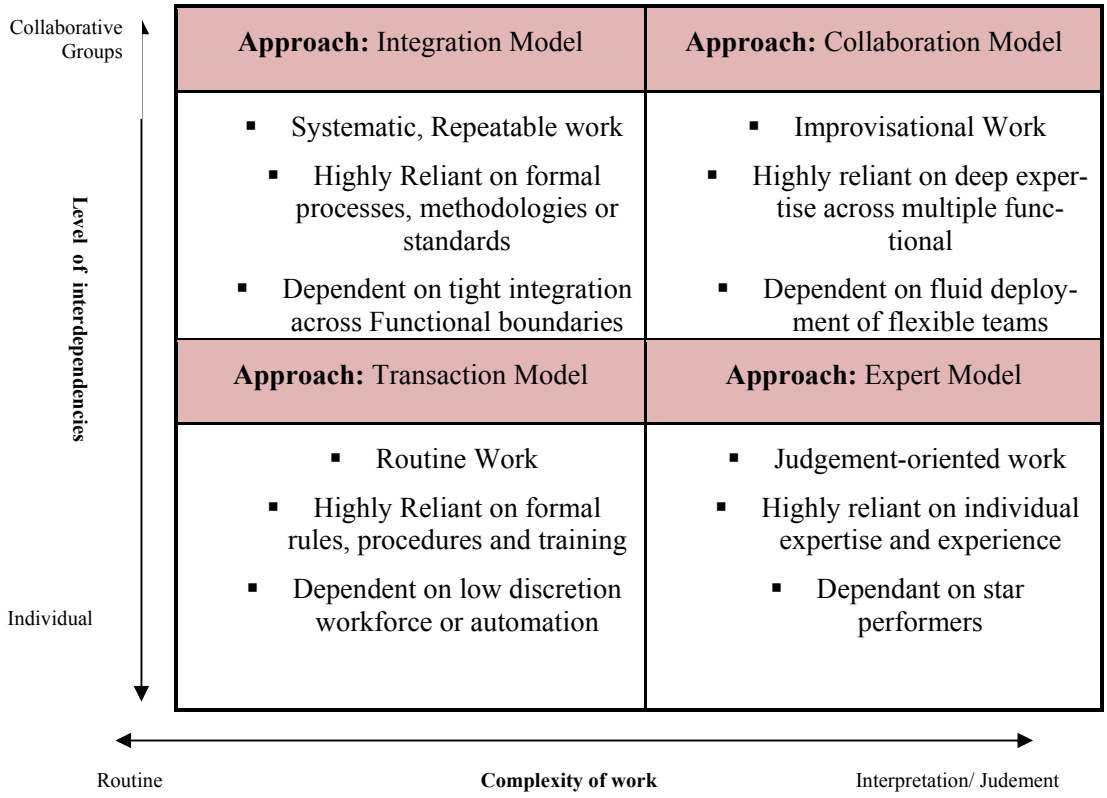

Figure 4. Four Approaches to knowledge work, (Davenport, 2010)

Step3- 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.

Additionally, we also conducted a search of all "conference proceedings", "Scholarly Journals", "Dissertations and theses" which contained "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.

From the DR literature we searched 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, the subject of the first journal is "medical science" whereas the 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, we considered a large set of real-life case studies published in (Pinkowski, 2008), because of their highly descriptive nature. After reviewing all 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, previously introduced in Section 3. They are described in the next section.

Step 5- Research Agenda: In this step we outline some interesting topics for future research in information systems and identify the relevant theories that could be used to gain a better understanding of the information, knowledge and coordination aspects of DR processes.

Literature Analysis and Synthesis

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 i) a different approach to disaster recovery during Alaskan Earthquake; 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 (Pinkowski, 2008).

Understanding DR Context through Concept Analysis (Research question 1)

In order to address the first research question, we performed the concept analysis of the identified literature. As a result, we described the DR context through two broad categories: i) situational characteristics of disaster recovery, ii) requirements for disaster recovery. We then grouped disaster recovery characteristics around four main concepts representing four different perspectives: Dynamic context, Process, Resource, and Information. Our findings confirmed that disaster recovery is a dynamic situation which has different aspects, dimensions and stakeholders with conflicting objectives, culture and priorities. Infrastructure failure and data/information loss and inaccessibility are the problems of this context reported in the literature. Table 1 shows the characteristics of disaster recovery situations.

To cope with a 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, innovation are required in DR as well as safe, timely, cost effective prediction and quick, integrated planning and decision making.

Table 1- Characteristics of disaster recovery situations

Characteristics	Sources
Dynamic Context : dramatic, critical, dynamic& breathtaking	Alexander et al. 2006; Barakat & Strand 1995; Gupta & Sharma 2006; Ink 2008; Kemp 2008; Labadie 2008; Wiek et al. 2010
Process : multi-facet, multi-dimensional, multi-stakeholders, multi-agent, complex, costly, time consuming, problematic, comprehensive Long-term process which takes place overtime against backdrop of social & organizational characteristics and demands with different, partly conflicting objectives, priorities, perspectives, cultures, perceptions of different stakeholders	Alexander et al. 2006; Arya et al. 2006; Barakat & Strand 1995; Cuny & Tanner 1995; Green 1995; Gupta & Sharma 2006; Iyer & Bandyopadhyay 2000; Kemp 2008; Labadie 2008; Leslie 1995; Minamoto 2010; Moe 2010; Osei 2007; Pardasani 2006; Rajib 2006; Ravindra & Pande 2007; Regnier et al. 2008; Sugimoto et al.2011; Wiek et al. 2010
Resource: IT and non-IT infrastructure failure and destruction	Ekici et al. 2009; Gupta & Sharma 2006; Labadie 2008; Leslie 1995; Moe 2010; Pardasani 2006; Ravindra & Pande 2007
Information: inability to access information source; Data lost and unreliable	Petrantonakis et al.2005; Vom Brocke et al. 2011

Table 2- Disaster Recovery Requirements

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

Analysis of DR Operational Processes (Research question 2)

In the next step, we derived characteristics of operational processes as shown by Table 3. We then analysed these characteristics through the theoretical lenses described in the previous section of this paper, as shown by Table 4. Our mapping confirms some interesting observations with regards to different process levels as well as the nature of knowledge work involved.

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 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 the 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. Table 5 shows the analysis of these activities through the lens of Davenport's knowledge work matrix. It confirms that DR processes involve a whole range of processes, routine to knowledge-intensive, as originally posited.

The following section discusses these findings and justifies their importance for future research and practical challenges of process management in DR.

Table 3- The main characteristics of DR processes

Code	Process characteristics	Sources
C1	"Intergovernmental , goal-oriented" instead of "procedure-oriented" approach	Beggan 2011; Diego 2008; Gannapati 2008; 2010; Ghafory-Ashtiany 1999; Ink 2008; Kemp 2008;Leslie 1995;Moe; Pardasani 2006
C2	"Scenario-based" & "Proactive "approach and structure	Aziz et al. 2009; Diego 2008; Dommun 2009; Gannapati 2008; Iyer & Bandyopadhyay 2000; Niranjan et al. 2007
C3	"Community-based" approach	Alexander et al. 2006; Diego 2008; Gannapati 2008; Green 1995; Ink 2008; Labadie 2008; Leslie 1995; Pardasani 2006; Rajib 2006
C4	"Operational approach" to built disaster lessons and experiences sys.	Diego 2008; Ekici et al. 2009; Ghafory- Ashtiany 1999; Gupta & Sharma 2006; Leslie 1995; Moe 2010; Rajib 2006; Sugimoto et al.2010
C5	Simple organization structure with not many levels, outsourcing, temporary team, instituting coordination team & appointing liaison role	Beggan 2011; Choudhuri et al. 2009; Dommun 2009; Ekici et al. 2009; Ink 2008; Iyer & Bandyopadhyay 2000; Jayatilaka et al 2003; Niranjan et al. 2007; Pai and Basu 2007; ; Ramirez 2010; Sarker et al. 2009; Weerakkody et al. 2003
C6	Providing IT Disaster recovery plan, Disaster recovery central plan, Strategy, policy, booklet, guideline, uniform conditions before disaster happens	Alexander et al. 2006; Barakat & Strand 1995; Beggan 2011; Bharadwaj et al. 2009; Cuny & Tanner 1995; Diego 2008; Dong et al. 2009; Ekici et al. 2009; Gannapati 2008; Ghafory- Ashtiany 1999; Green 1995; Gupta & Sharma 2006; Ink 2008; Kemp 2008; Labadie 2008; Moe 2010; Nelson 2000; Petrantonakis et al.2005; Rajendram & Senevirtne 2009; Ravindra & Pande 2007
C7	Required process in disaster recovery are monitoring, tracking, evaluation, documentation, coordination, training, knowledge management, decision making, planning, expediting, networking, logistic and reporting	Alexander et al. 2006; Aziz et al. 2009; Barakat & Strand 1995; Beggan 2011; Diego 2008; Ekici et al. 2009; Gannapati 2008; Ghafory- Ashtiany 1999; Green 1995; Gupta & Sharma 2006; Ink 2008; Iyer & Bandyopadhyay 2000; Kemp 2008; Labadie 2008; Minamoto 2010; Moe 2010; Osei 2007; Pardasani 2006; Patin 1997; Petrantonakis et al.2005; Rajendram & Senevirtne 2009;Rajib 2006;

		Ravindra & Pande 2007; Regnier et al. 2008; Sugimoto et al.2010; Wiek et al. 2010
C8	Processes design strategy: streamlining , open, accountable, accessible and transparent Processes need intra-organizational and inter-organizational relationships	Beggan 2011; Diego 2008;Ink 2008
C9	trust, commitment and collective responsibilities shall be made between all stakeholders	Alexander et al. 2006; Ink 2008; Wiek et al. 2010
C10	Manage resource collection and allocation specially funding Between different levels & from range of organization	Alexander et al. 2006; Cullen et al. 2005; Cuny & 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; Wiek et al. 2010
C11	Participation of NGO & donor group participation & aligning NGO plan to overall plan	Barakat & Strand 1995; Cuny & Tanner 1995; Ekici et al. 2009; Gupta & Sharma 2006; Labadie 2008; Minamoto 2010; Pardasani 2006; Regnier et al. 2008; Sugimoto et al.2010
C12	Avoiding of making disaster political events	Cuny & Tanner 1995; Minamoto 2010; Osei 2007; Rajendram & Senevirtne 2009
C13	Use media to make everything as much clear and transparent as possible to publics	Alexander et al. 2006; Dechano & Butler 2001; Diego 2008; Gupta & Sharma 2006; Ink 2008; Moe 2010
C14	Processes need engagement of all stakeholders	Diego 2008; Gannapati 2008; Ink 2008; Kemp 2008
C15	Processes shall be designed in contingent, on-going emergent manner	Dommun 2009; Iyer & Bandyopadhyay 2000; Nelson 2000; Niranjan et al. 2007
C16	Clear, direct reporting to upper levels is required	Beggan 2011; Gannapati 2008; Ink 2008; Kemp 2008
C17	Networking through mutual understanding, shared values & behaviours & avoiding conflict	Alexander et al. 2006; Aziz et al. 2009; Barakat & Strand 1995; Cuny & Tanner 1995; Dechano & Butler 2001; Ink 2008; Leslie 1995; Minamoto 2010; Pardasani 2006; Ravindra & Pande 2007; Regnier et al. 2008
C18	plan and address unique needs, policies and processes independently with some unique conditions by each part . establishing central office for taking charge of recovery process	Gannapati 2008; Ink 2008; Kemp 2008; Minamoto 2010; Osei 2007; Regnier et al. 2008
C19	Designing Incentive and reward Mechanisms for actors of disaster recovery	Alexander et al. 2006; Cuny & Tanner 1995; Diego 2008;Ink 2008
C20	Developing IT disaster recovery plan to not loose data and keep security	Ardagna & Francalanci 2005; Baptisa 2009; Benlian 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
C21	Implement tracking and Knowledge management system & using IT tools	Aziz et al. 2009; Baptisa 2009; Diego 2008; Fischer 1998; Petrantonakis et al.2005; Rajendram & Senevirtne 2009
C22	Database s and Data Back-up	Choudhuri et al. 2009; Diego 2008; Petrantonakis et al.2005
C23	Deploy experts in employees and management levels	Barakat & Strand 1995; Beggan 2011; Gupta & Sharma 2006; Ink 2008; Pardasani 2006; Minamoto 2010; Rajendram & Senevirtne 2009; Rajib 2006
C24	Deploy well-Functioning and decisive leader	Ink 2008; Luftman and Zadeh 2011; Rajib 2006; Ramirez 2010
C25	Pre-agreement between stakeholders specially insurance	Beggan 2011; Dechano & Butler 2001; Diego 2008; Gannapati 2008; Ink 2008; Kemp 2008; Ravindra & Pande 2007

Table 4- Mapping the literature based on the theoretical lens

Code	Harmon			Davenport	Code	Harmon			Davenport	Code	Harmon			Davenport
	E	P	I	K.W.A		E	P	I	K.W.A		E	P	I	K.W.A
C1	×			JE- C	C9	×			NA	C17		×		C
C2	×			JE	C10	×			NA	C18		×		JE-R- C
C3	×			C	C11	×			NA	C19		×		NA
C4	×			C	C12	×			NA	C20		×		R
C5	×			JE- C	C13			×	NA	C21			×	NA
C6	×			R	C14		×		C	C22			×	NA
C7	×			C	C15		×		JE	C23			×	JE
C8	×			JE- C	C16		×		NA	C24			×	JE
C25			×	R										

***E:** Enterprise Level **P:** Process Level **I:**Implementation Level **KWA:** Knowledge-Work approach **R:** Routine **JE:** Judgment/ Expertise **IN:** Individual **C:**Collaborative **NA:** Not Applicable*

Table 5- Analysis of different types of knowledge work in DR processes based on Davenport Matrix

Individual	Routine	Collaborative	Judgment/ Interpretation
-	C6;C18; C20;C25	C1; C3;C4;C5; C7; C8; C14; C17;C18	C1;C2;C5;C8;C15;C18;C23;C24

Summary of the key findings

Our findings confirm that the existing research does consider DR processes, however, only at the higher level of abstraction. Therefore, there is a need to examine these processes at the lower levels of abstraction (i.e. the ways they are operationalised) but without an attempt to capture their precise models, as it is done in "traditional" BPM.

We also confirm the existence and importance of *knowledge-intensive processes in* DR. This opens another interesting domain for researchers and practitioners interested in human-centric processes, especially the challenges of their ongoing improvement and flexible IS support.

The existence of highly prominent collaborative model of knowledge work is not surprising, given the complexity and inter-organisational nature of these processes. Effective collaboration among very diverse participants is reliant on the effective data and knowledge sharing across different types of organisations: government, business and community.

Data sharing opens very interesting questions related to data quality, ownership and integration – all in the context of cross-organisational BPs. These specific challenges are not currently studied by the mainstream BPM research where processes are "organisationally-bound" thus normatively-regulated as in B2B (Business-to-business scenarios).

Even more challenging is sharing of process-related knowledge across different contexts, organisational and professional boundaries. As knowledge-intensive processes need to be designed in-situ, dynamic knowledge co-creation becomes an equally important knowledge process, not currently investigated by the mainstream "organisationally-bound" knowledge management research.

Furthermore, the previously identified characteristics of DR situations and DR requirements, shown by Tables 1 & 2, confirm the need for more flexible coordinating mechanisms that cannot be pre-planned and captured by process models, as in traditional BPM. This also creates the need for a more flexible technology support where coordina-

tion mechanisms are used to guide technology integration, rather than the other way around.

Based on the previous discussion, we identify the following key aspects of DR process management:

- sharing and co-creation of process-related knowledge among very diverse group of process participants
- collaboration across different types of organisations
- flexible coordination mechanisms
- flexible IS support
- data sharing and management of information flows across organisational boundaries.

The following section identifies and describes the relevant theories that could be used by IS researchers to gain a better understanding of these key process-related issues.

Research Agenda

In spite of the existing research gap related to DR process management confirmed in this research, the existing IS research does provide relevant theories that could provide further guidance to IS researchers interested in this important topic.

The main objective of this section is to offer a brief summary of a sample of relevant theories that could be used to gain a better understanding of the key aspects of DR process management, as listed in the previous section. It is envisaged that better understanding of these aspects could possibly lead to their better management in the future.

Table 6 provides a list of the selected theories relevant for IS research and outlines their applicability to the above listed key aspects of DR process management.

Table 6- Relevant theories and their applicability to future research on DR process management

Relevant Theories	Key aspects of DR process management
Boundary spanning	collaboration among process participants, knowledge sharing and co-creation
Boundary objects	data and knowledge sharing, information flows
Actor-network theory	Flexible IS support, management of information flows, collaboration
Theory of co-ordinating	flexible coordination mechanism, flexible IS support

The selected theories are briefly described as follows, along with their applications to the key aspects of DR process management:

- Boundary Spanning The ability of members in different communities to interact with each other is referred to as boundary spanning. Individuals who can link separated groups of people and facilitate information sharing are called boundary spanners. Levina and Vaast (2005) call this "a practice-based perspective to knowledge management in organizations". If organizations can successfully engage their members in boundary spanning activities they can create knowledge based competencies when boundary spanners facilitate sharing of knowledge and experiences between different groups. Levina and Vaast differentiate between nominated boundary spanners and boundary spanners in practice since not all nominated boundary spanners become boundary spanners in practice: we still need a better understanding how boundary spanning is enacted in practice. (Levina and Vaast, 2005)

In the case of DR, boundary spanning is even more challenging since the interaction takes place between very different business, community and government groups. Boundary spanning theory could help researchers to better understand how the interaction between different groups emerges and takes place. It could also potentially be used to design and test boundary spanning mechanisms between groups, leading to possible ways of improving KIBPs *through improved collaboration, knowledge sharing and co-creation.*

- Boundary Objects Boundary objects facilitate developing coherence across intersecting social worlds. They are "objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" (Star and Griesemer, 1989). However, not all nominated boundary objects become boundary objects in use (Levina and Vaast, 2005). To become boundary objects in use they need to be locally useful and they must have common identity, i.e. they must be common enough to be recognized by different social worlds (Levina and Vaast, 2005).

Research on knowledge-intensive processes in DR can benefit from the boundary object theory in many ways. Researchers can test the usefulness of existing boundary objects and whether and how they have become boundary objects in use. By understanding the needs of various community, government and business groups, researchers could analyze what is needed from boundary objects to become useful for all these different groups taking part in DR. *This is envisaged to facilitate better transfer and co-creation of process-related knowledge, sharing of data and improved information flows.*

- Actor-Network theory Actor-Network theory (ANT) explores heterogeneous networks of both human and non-human actors. The relations between the actors are central in ANT. Since the different actors are heterogeneous, researchers have studied how boundary objects could be used to mediate different actor worlds (Briers and Chua, 2001). A central concept in ANT is "translation" which "refers to the process of creating a temporary social order, or the movement from one order to another, through changes in the alignment of interests in the network" (Sarker et al., 2006, p. 54).

The ANT lens could be used in disaster recovery research to study the interaction and collaboration in the networks of community, government and business actors. Another interesting avenue would be to combine ANT with the concept of boundary objects and study how boundary objects might mediate the different actor worlds. Finally, ANT would be a very useful lens to study how actor networks respond to unpredictable disaster situations, helping us to understand, for example, the appropriate IS support for knowledge-intensive DR processes.

- Theory of Coordinating (different from coordination theories) Organizational and inter-organizational work is coordinated through coordination mechanisms, such as standards, rules or contracts. Jarzabkowski et al. (2012)

take a practice perspective and argue that "coordinating mechanisms are dynamic social practices that are under continuous construction" (Jarzabkowski et al., 2012, p. 907). They stress the dynamic nature of coordination mechanisms and call them coordinating mechanisms. Coordinating mechanisms "emerge through their use in ongoing interactions" (Jarzabkowski et al., 2012, p. 909) through "performative-ostensive cycles that iteratively construct coordinating mechanisms" (Jarzabkowski et al., 2012, p. 918). Jarzabkowski et al. present a model of five performative-ostensive cycles for creating coordinating mechanisms: 1) enacting disruption 2) orienting to absence 3) creating elements 4) forming new pattern, and 5) stabilizing patterns. (Jarzabkowski et al., 2012)

The theory of coordinating is suitable for investigating situations with change and emergent patterns. That is why it provides a very useful theoretical lens for disaster recovery research. Using this lens researchers could study how different actors use existing coordinating mechanisms and how new coordinating mechanisms emerge. Understanding coordinating mechanisms as dynamic and evolving social practices provides a solid theoretical foundation for researching emerging coordinating mechanisms in knowledge-intensive processes in DR situations.

Conclusion

Recent disasters around the world have raised thorny and difficult issues regarding recovery and reconstruction. Learning about the existing approaches to process management becomes a very important source of information for the future disaster recovery situations, in spite of their unpredictability.

In this paper, we offered a comprehensive literature review of the related work in BPM and DR research. The relevant literature was analysed through a combined theoretical lens of two theoretical frameworks used by BPM researchers and practitioners: Harmon's (2010) BPM pyramid and Davenport's (2010) knowledge work matrix. Our analysis clearly shows the research gap found across the existing DR and BPM literature thus creating the need for future process-related research in DR as well as information systems. We envisage the proposed theories to provide solid theoretical foundations for the future studies of information, knowledge and coordination perspectives of DR processes.

Our literature review is based on a representative sample of journal articles published by the basket of eight IS journals as well as DR literature consisting of a DR handbook of real-life case studies and disciplinary journals. However, our 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. Our current work includes further investigation of knowledge-intensive processes in DR, especially their coordination (and coordinating) aspects, and opportunities for more flexible IS support for management and execution of these processes.

We also envisage that the theoretical contribution of our work is relevant not only for the researchers interested in the process perspective of disaster management, but also for those interested in management of more agile, emergent processes across business, government and community sectors that for now remain unexplored by the IS research community.

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References

Alexander, B., Chan-Halbrendt, C. and Salim, W. (2006). "Sustainable Livelihood considerations for disaster risk management," *Disaster Prevention and Management*, 15 (1), pp.31-50.

Arya, A., Mandal, G. and Muley, E. (2006). "Some Aspects of tsunami impact and recovery in India," *Disaster Prevention and Management*, 15 (1), pp.51-66.

Ardagna, D., Francalanci, C. (2005). "A cost-oriented approach for the design of IT architectures," *Journal of Information Technology*, 20 (1), pp.32-51.

Aziz, Z., Pena-Mora, F., Chen, A. and Lantz, T.(2009). "Supporting urban emergency response and recovery using RFID-based building assessment," *Disaster Prevention and Mgm*. 18 (1), pp.35-48.

Barakat, S. and Strand, A.(1995). "Rehabilitation and reconstruction of Afghanistan: a challenge for Afghans, NGOs and the UN," *Disaster Prevention and Management*, 4 (1), pp.21-26.

Beggan, D. (2011). "Disaster recovery considerations for academic institutions," *Disaster Prevention and Management*, 20 (4), pp.413-422.

Benlian, A. (2011). "Is traditional, open-source, or on-demand first choice? Developing an AHP-based framework for the comparison of different software models in office suites selection," *European Journal of Information Systems*, 20 (5), pp.542-559.

Baptisa, J. (2009). "Institutionalisation as a process of interplay between technology and its organisational context of use," *Journal of information Technology*, 24 (4), pp.305-319.

Bharadwaj, A., keil, M. and Mahring, M. (2009). "Effects of information technology failures on the market value of firms," *Journal of Strategic IS*., 18 (2), pp.66-79.

Braha, D. and Bar-Yam, Y. (2004). "Information flow structure in large-scale product development organizational networks," *Journal of Information Technology*, 19 (4), pp.244-253.

Briers, M. and Chua, W.F. (2001) "The role of actor-networks and boundary objects in management accounting change: a field study of an implementation of activity-based costing", *Accounting, Organizations and Society* 26(3), pp. 237–269.

Chen, Y. and Bharadwaj, A. (2009). "An Empirical Analysis of Contract Structures in IT Outsourcing," *Information Systems Research*, 20 (4), pp.484-506.

Choudhuri, B., Maguire, S. and Ojiako, U. (2009). "Revisiting learning outcomes from market led ICT outsourcing," *Business Process Management Journal*, 15 (4), pp.569-587.

Cullen, S., Seddon, P. and Willcocks, L. (2005). "IT outsourcing configuration: Research into defining and designing outsourcing arrangements," *Journal of Strategic IS*, 14 (4), pp.357-387.

Cuny, F. and Tanner, V. (1995). "Working with communities to reduce levels of conflicts: "spot reconstruction"," *Disaster Prevention and Management*, 4 (1), pp.12-20.

Davenport, T. (2010). 'Process Management for Knowledge Work' in Rosemann, M.and Brock, J. Handbook on Business process management I. Springer, Heidelberg New York. pp.17-35.

Davenport, T. (2005) "Thinking for a Living", Harvard Business School Press.

Davis, G., Ein-Dor, Ph., King, W. and Torkzadeh, R. (2006). "IT Offshoring: History, Prospects and Challenges," *Journal of the Association for Information Systems*, 7 (11), pp,770-795.

Dechano, L. and Butler, D. (2001). Analysis of public perception of debris flow

hazard. Disaster Prevention and Management, 10 (4), pp.261-269.

Diego, S. (2008). 'Debris disposal and recycling for the cedar and paradise wildfire in San Diego' in Pinkowski, J., Disaster management handbook. CRC/ Taylor & Francis, Portland United States. pp.185-244.

Dong, L., Neufeld, D. and Higgins, C. (2009). "Top Management support of Enterprise Systems implementations," *Journal of Information Technology*, 24 (1), pp.55-80.

Doomun, M. (2008). "Multi-level information system security in outsourcing domain," *Business Process Management Journal*, 14 (6), pp.849-857.

Ekici, S., McEntire, D. and Afedzie, R. (2009). Transforming debris management: considering new essentials. *Disaster prevention and Management*, 18 (5), pp.511-522.

El Sawy, O.A. and Josefek, R.A., (2003) "Business Process as Nexus of Knowledge" in Holsapple, C., (Ed), Handbook on Knowledge Management 1, Knowledge Matters, Springer.

Fischer, H. (1998). The role of the new information technologies in emergency mitigation, planning, response and recovery. *Disaster prevention and Management*, 7 (1), pp.28-37.

Gannapati, N. (2008). 'Disaster management structure in Turkey: Away from a reactive and paternalistic approach' in Pinkowski, J. Disaster management handbook. CRC/ Taylor & Francis, Portland United States. pp. 281-320.

Ghafory-Ashtiany, M. (1999). Rescue operation and reconstruction of recent earthquakes in Iran. *Disaster prevention and Management*, 8 (1), pp.5-20.

Goldstein, J., Chernobai, A. and Benaroch, M. (2011). An Event Study of the Economic Impact of IT Operational Risk and its subcategories. *Journal of the Association for IS*., 12 (9), pp.606-631.

Green, R. (1995). Widening horizons in post-war reconstruction. *Disaster Prevention and Management*, 4 (1), 38-44.

Green, R. (2000). Rehabilitation: Strategic, Proactive, Flexible, Risky?. Disasters, 24 (4), pp.343-362.

Gupta, M. and Sharma, A. (2006). Compounded loss: the post tsunami recovery experience of Indian Island communities. *Disaster Prevention and Management*, 15 (1), pp.67-78.

Hammer, M. (2010). 'What is Business Process Management?' in Rosemann, M.and Brock, J. Handbook on Business process management I. Springer, Heidelberg New York. pp. 3-16.

Harmon, P. (2010). 'The Scope and evolution of Business Process Management' in Rosemann, M.and Brock, J. Handbook on Business process management I. Springer, Heidelberg New York. pp.37-82.

Harvey, P. (1998). Rehabilitation in Complex Political Emergencies: Is Rebuilding Civil Society the Answer?. Disasters, 22 (3), pp.200-217.

Hendela, A. and Mendonca, D. (2004). Innovation in Demolition: A Case Study from the Cleanup of Ground Zero. In Proceedings of American Conference on Information Systems (AMCIS), P. 255, USA, New York.

Ink, D. (2008). 'A different approach to disaster recovery: Alaskan Earthquake disaster recovery' in Pinkowski, J. Disaster management handbook. CRC/ Taylor & Francis, Portland United States. pp.101-114.

Iyer, R. and Bandyopadhyay, K. (2000). Managing technology risks in the healthcare sector: disaster recovery and business continuity planning. Disaster Prevention and Management, 9 (4), pp.257-270.

Jayatilaka, B., Schwarz, A. and Hirschheim, R. (2003). Determinants of ASP choice: an integrated perspective. European Journal of Information Systems, 12 (3), pp.210-224.

Jarzabkowski, P.A., Le, J.K. and Feldman, M.S. (2012) "Toward a Theory of Coordinating: Creating Coordinating Mechanisms in Practice", Organization Science 23(4), pp. 907-927

Kulkarni U. and Ipe, M (2010), "Knowledge-intensive Business Processes: A process-technology Fit Perspective", Proc. Of the ICISTM 2010 Conference, Springer-Verland Berlin Heidelberg, pp.32-43.

Kemp, D. (2008). 'Disaster in the United States and Canada: the Case of the Red River' in Pinkowski, J. Disaster management handbook. CRC/ Taylor & Francis, Portland United States. pp. 245-266.

Labadie, J. (2008). Auditing of post-disaster recovery and reconstruction activities. *Disaster Prevention and Management*, 17 (5), pp.575-586.

Lahey, K. (2011). "A day in the Life of the Emergency Sector", The Australian Journal of Emergency Management, Vol. 26, No. 4, Nov 2011.

Leslie, J. (1995). Towards rehabilitation: building trust in Afghanistan. Disaster Prevention and Management, 4 (1), 27-31.

Levina, N. and Vaast, E. (2005) "The Emergence of Boundary Spanning Competence in Practice: Implications for Implementation and Use of Information Systems", MIS Quarterly (29:2), pp. 335-363.

Lettieri, E., Masella, C. and Radaelli, G. (2009). Disaster management: findings from a systematic review. Disaster Prevention and Management, 18 (2), pp.117-136.

Lewis, B. and Byrd, T. (2003). Development of a measure for the information technology infrastructure construct. European Journal of Information Systems, 12 (2), pp.93-109.

Luftman, J. and Zadeh, H. (2011). Key Information technology and management issues 2010-2011: an international study. Journal of Information Technology, 26 (3), pp.193-204.

Niranjan, T., Saxena, K. and Bharadwaj, S. (2007). Process-oriented taxonomy of BPOs: an exploratory study. Business Process Management Journal, 13 (4), pp.588-606.

Minamoto, Y. (2010). Social capital and livelihood recovery: post-tsunami Sri Lanka as a case. Disaster Prevention and Management, 19 (5), pp.548-564.

Moe, T. (2010). Cleanup after Katrina: an analysis on policy, process, priorities, problems, and politics. Disaster Prevention and Management, 19 (3), pp.314-332.

Moe, T. and Pathranarakul, P. (2006). "An integrated approach to natural disaster management: public project management and its critical success factors," *Disaster Prevention and Management*, 15 (3), pp.396-413.

Niehaves, B. and Plattfaut, R. (2011). "Collaborative business process management: status quo and quo vadis," *Business Process Management Journal*, 17 (3), pp.384-402.

Niranjan, T. Saxena, K. And Bharadwaj, S. (2007). "Process-oriented taxonomy of BPOs: an exploratory study," *Business Process Management Journal*, 13 (4), pp.588-606.

Osei, P. (2007). "Policy responses, institutional networks management and post-Hurricane Ivan reconstruction in Jamaica," *Disaster Prevention and Management*, 16 (2), pp.217-234.

Pai, A. and Basu, S. (2007). "Offshore technology outsourcing: overview of management and legal issues," *Business Process Management Journal*, 13 (1), pp.21-46.

Pardasani, M. (2006). "Tsunami reconstruction and redevelopment in the Maldives: A case study of community participation and social action," *Disaster Prevention and Management*, 15 (1), pp.79-91.

Petrantonakis, P. and Panayiotopoulos, J. (2005). "Using assignment model as an automated recovery system," *Disaster Prevention and Management*, 14 (1), pp.89-96.

Pinkowski, J. (2008). Disaster Management Handbook. CRC/ Taylor & Francis, Portland United States.

Rajendram, T. and Seneviratne, L. (2009). "The role of knowledge management in post-disaster housing reconstruction," *Disaster Prevention and Management*, 18 (1), pp.66-77.

Rajib, S. (2006). "Indian Ocean tsunami and aftermath: Need for environment-disaster synergy in the reconstruction process," *Disaster Prevention and Management*, 15 (1), pp.5-20.

Ramirez, D. (2010). "ERP Crisis Management Through Leadership Communication," *International Journal of Management & Information Systems*, 14 (1), pp.15-18.

Ravindra, K. and Pande, R. (2007). "Resettlement and rehabilitation issues in Uttaranchal (India) with reference to natural disasters," *Disaster Prevention and Management*, 16 (3), pp.361-369.

Regnier, P., Neri, B., Scuteri, S. and Miniati, S. (2008). "From emergency relief to livelihood recovery: lessons learned from post-tsunami experiences in Indonesia and India," *Disaster Prevention and Management*, 17 (3), pp.410-429.

Robinson, G. (2009), "'Cut the red tape' plea", Sydney Morning Herald, 11 February 2009.

Roseman, M. & Brock, J. (2010). Handbook on Business Process management I. Springer, Heidelberg New York

Sarker, S., Munson, C., Sarker, S. and Chakraborty, S. (2009). Assessing the relative contribution of the facets of agility to disturbed systems development success: an Analytic Hierarchy Process approach. *European Journal of Information Systems*, 18(4), pp.285-299.

Sarker, S., Sarker, S. And Sidorova, A. (2006) "Understanding Business Process Change Failure: An Actor-Network Perspective", *Journal of Management Information Systems,* 23(1), pp. 51 – 86.

Scott, S. and Barrett, M. (2005). Strategic risk positioning as sense making in crisis: the adoption of electronic trading at the London international financial futures and options exchange. *Journal of Strategic Information systems*, 14 (1), pp.45-68.

Smith, D. and Robins, B. (2010), "Tsunami warning falls on deaf ears at Bondi Beach", The Sydney Morning Herald, published on the 1st of March, 2010.

Star, S. L. and Griesemer, J. R. (1989) "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology 1907-39", Social Studies of Science (19). pp. 387-420

Sugimoto, M., Iemura, H. AND Shaw, R. (2010). Tsunami height poles and disaster awareness: Memory, education and awareness of disaster on the reconstruction for resilient city in Banda Aceh, Indonesia. *Disaster Prevention and Management*, 19 (5), pp.527-540.

Webster, J. and Watson, R. (2002). Analyzing the past to prepare for the future: writ-

ing a Literature Review. *MIS Quarterly*, 26 (2), xiii-xxiii.

Weerakkody, V., Currie, W. and Ekanayake, Y. (2003). Re-engineering business processes through application service providers: challenges, issues and complexities. *Business Process Management Journal*, 9 (6), pp.776-794.

Wiek, A., Ries, R., Thabrew, L., Brundier, K. and Wickramasingha, A. (2010). Challenges of sustainable recovery processes in tsunami affected communities. *Disaster Prevention and Management*, 19 (4), pp.423-437.

Vom Brocke, J., Simons, A., Herbst, A., Derungs, R. and Novotny, S. (2011). Information flow structure in large-scale product development organizational networks. Business Process Management Journal, 17 (6), pp.965-985.

Vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R. and Cleven, A. (2009) Reconstructing the Gient: On the Importance of Rigour in Documenting the Literature search process. In Proceedings of European Conference on Information Systems (ECIS), P.161, Italy, Verona.

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