

**The Relationship of Business Continuity Management, Supply Chain Risk
Management and ICT within the Supply Network**

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The candidate confirms that the work submitted is his/her own and that appropriate credit has been given where reference has been made to the work of others.

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Abstract

Literature has shown that Business Continuity Management (BCM) has been of particular interest to the researcher since the establishment of BS 25999 in 2006, although the underlying concept was first introduced in the mid 1980s. Previous studies of BCM have tended to focus on individual organisations and do not deal adequately with supply chains which are also at risk. For supply chains, risk management is usually discussed within the Supply Chain Risk Management (SCRM) topic. BCM and SCRM are therefore related but also differ. Both can be conceptualised as a management innovation which is an emerging topic within innovation research and as such factors affecting the adoption of this type of innovation are under-researched.

Information and Communication Technology (ICT) had been argued as a potential source of disruption to business and at the same time ICT might be advantageous in supporting BCM and SCRM. This argument seems relevant to relating BCM, SCRM and ICT in terms of their adoption within the supply chain.

Data from a questionnaire survey of 110 organisations across various sectors in the United Kingdom (UK) are used to answer the research question: “what are the key determinants to the adoption and the stages of adoption of BCM, SCRM, and ICT in an organisation within its supply network?” The data collected were analysed quantitatively, from simple analyses such as mean scores, and Spearman correlation coefficients, to more sophisticated analysis such as factor analysis, ANOVA, logistic regression and multiple regression.

Adoption level, and a second dependent variable (stages of adoption), are predicted by a model with four categories of independent variables including (i) the characteristics of the innovation (BCM, SCRM, and ICT; including, the relative advantage, complexity, compatibility, and observability), (ii) the internal and external factors of innovation characteristics (managers’ support, strategy integration, and stakeholders pressure on the innovation), (iii) the characteristics of the organisation (size, position in supply chain, decentralised organisational structure and organisational performance), and (iv) the external environment (stakeholders pressure, system openness, environmental uncertainties and supply chain complexity).

The main findings revealed that the adoption behaviour in organisations within the supply chain can be understood from the model developed in this study. The most significant predictors of the adoption level and stages of adoption of BCM, SCRM, and ICT are system openness and decentralised organisational factors.

This study contributes both to knowledge of the adoption of management innovations (BCM and SCRM) and to implications for practice by assisting managers in understanding more about what factors are important when adopting management innovations in general and the two innovations in particular.

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Chapter 1

Introduction

The introductory chapter provides a brief overview of the research topic and the need for the study. Specifically, the chapter aims are to explain the importance of conducting a study on Business Continuity Management (BCM), Supply Chain Risk Management (SCRM), and Information and Communication Technology (ICT), when viewed as related innovations adopted by organisations within the general context of a Supply Network. This introductory chapter presents an outline of the study which will be discussed in depth through the next chapters. Section 1.1 after this introductory paragraph; highlights the setting of the agenda followed by the scope of the study in section 1.2. Section 1.3 provides the research question followed by the objectives of the study. The rationale of the study is discussed in section 1.4, followed by the structure of the study in section 1.5; and a summary will conclude this chapter in section 1.6.

1.1. Setting the Agenda

Many disasters have been reported around the world in recent years. Disasters such as 9/11, or Severe Acute Respiratory Syndrome (SARS), have had a great impact on business systems overall. In some Asian countries, extreme natural disasters have occurred such as: earthquakes (Japan), volcanic eruptions (Philippines), tsunami (Papua New Guinea, Indonesia, and Sri Lanka), floods (China), and smoke hazards from burning forests (Malaysia, Indonesia and Singapore). In a business context, such disasters may lead to major business interruptions and threaten the whole business functionality of supply chains.

The impact of these threats become more severe as they affect a wide scale of operations connected to the supply network (Comfort et al., 1999; Nakamura, Uchida, Asahi, Takahata, Hashimoto, & Shibata, 2003). As a consequence, the importance of Business Continuity (BC) within organisations has become substantial (Cerullo & Cerullo, 2004; Herbane, Elliott, & Swartz, 2004; Michael Pitt

& Goyal, 2004; Rose & Lim, 2002). An example includes how a communication company, Ericsson, after a fire at their sub-supplier impacted severely on its operations and implemented risk management (Andreas & Ulf, 2004). However, most research on business continuity deals with Information Technology (IT) related issues. The reason for this is that most companies now depend on IT, and are becoming more linked and open to external networks (Cerullo & Cerullo, 2004; Lam, 2002). Most researchers see the threat in IT from such as cyber-terrorism. According to Cerullo and Cerullo (2004), “the threat includes unauthorized access to a system, disruption or denial of service, unauthorized use of a system, or unauthorized changes to system hardware or software”. However, in BC, threats not only come from IT but also come from natural disasters. This assertion is based on the paper by Cerullo and Cerullo (2004) titled “Ernst & Young Global Information Security Survey 2002”. The survey revealed that an unexpected threat often occurred to at least 75% of organisations around the world and the number of threats seem to be increasing annually (Cerullo & Cerullo, 2004).

The threats represented above, have long been seen as risks in business, and the idea of managing them is not new. For example, work on high reliability organisation (Roberts, 1990) and high reliability management (Roe & Schulman, 2008) has been carried out in the past. However, approaching the management of these, and similar risks, from a supply chain viewpoint is more novel. A study of Supply Chain Risk Management (SCRM), although not particularly focussed on the above threats, appears important in systematically identifying, analysing, and responding to risks to ensure smooth operations for an organisation within its supply chain. The importance of Business Continuity Management (BCM) in organisations has been increasingly recognised, e.g. by the establishment of BS 25999 in December 2006 by the British Standards Institute, as the code of practice for Business Continuity Management (British Standard Institute, 2006). However, in general, studies of BCM tend to focus on single organisations (or individual businesses) rather than supply chains, and focus on the processes connected to information technology (IT) and information systems (IS) (Elliott & Swartz, 1999). Compared to BCM, SCRM studies concern issues covering supply network topics and are associated with risk management aspects such as resilience and recovery. As BC (or some describe it as Disaster Recovery) refers to an organisation’s ability

to recover from a disaster or any unexpected event that occurs, and the resumption of operations (Bryson, Millar, Joseph, & Mobolurin, 2002), finding the connection between BCM and SCRM is relevant to organisations within a supply network. It is not sufficient for a company to only give attention to components of its own systems, but an organisation's managers also have to consider risks to their supply network (Souter, 2000), and must be able to share risks and rewards amongst them (Lambert & Cooper, 2000; Mentzer et al., 2001). Therefore BCM and SCRM need to be related as they are in this thesis; and similarly, given the links between BCM and ICT outlined above, and between BCM and ICT that occur in practice, then studying all three would be beneficial.

All three can be seen from the perspective of innovations that are adopted by organisations. However, BCM and SCRM can be seen as management innovations (Birkinshaw, Hamel, & Mol, 2008) while ICT is better seen as a technical innovation and a generator of a cluster of innovations. The definition of innovation given by Damanpour & Evan (1984) used in this thesis is one employed by many social scientists. Damanpour & Evan (1984) defined innovation as “the adoption of an idea or behaviour – whether product, device, system, process, policy, program or service – that is new to the adopting organisation”. Innovation concerns an idea, behaviour, product, service, practice, process, system, or programme which is new to the adopter (Damanpour & Schneider, 2006; Rogers, 1983, 1995, 2003). The main criterion here is the novelty of the object to the adopter/user. As long as the idea is perceived as new by the adopter, it is an innovation (Rogers, 1995, 2003). In the light of this definition, the present study conceptualises BCM, SCRM and ICT as innovations, and particularly recognises the first two as management innovations. The study then develops a conceptual model that describes their adoption by organisations. The model integrates and builds on the work of Rogers to propose factors which influence the adoption and the stages of adoption, of the individual innovations. Further, the relationships between the three innovations are investigated.

1.2. Scope of the Study

The growing importance of BCM in the United Kingdom (UK), as evidenced by the establishment of BS25999 in 2006, cannot be ignored. Recognition of BCM in the UK really started when the government introduced PAS 56 in 2003 (PAS 56, 2003). According to “Publicly Available Specification 56” (PAS 56), BCM is a “holistic management process that identifies potential impacts that threaten an organization, and provides a framework for building resilience and the capability for an effective response that safeguards the interests of key stakeholders, reputation, brand and value-creating activities” (PAS 56, 2003). It shows that BCM involves many disciplines including risk management and supply chain management. The document outlined the importance of supply chain, however, no further explanation was provided regarding the connection that supply chain might have with BCM or risk management. Earlier in 1999, Elliott & Swartz (1999) focused on the UK finance sector and discussed disruptions faced by organisations across all sectors around the UK such as the City of London bombings in 1992 and 1993 and the Manchester bombing in June 1996. Elliott & Swartz (1999) reported that the Business Continuity Institute (BCI) estimated only 60% of organisations in the UK have a disaster recovery plan, with only 25% of them renewing their plan every year. IBM UK, a globally-integrated enterprise, and the world’s largest IT and consulting services company (IBM, 2010) reported in 1996 that only 57% of companies surveyed in the UK had a contingency plan in hand (Elliott & Swartz, 1999). Elliott & Swartz (1999) suggested that the key lesson for BCM to be adopted in an organisation is to ensure that BCM covers business-wide in a sense that it should not focus solely on IT issues or be limited within a single organisation.

In 2003, following the establishment of PAS 56, scholars such as Jüttner et al. (2003) discussed “supply chain vulnerability”, in which they discussed how organisations in the UK have overlooked critical exposures to their supply chain, when they focus only on their own organisation. Exposures to any entity within the supply chain may affect the organisation’s ability to continue operations hence stop provision of finished goods and services to customers. Following such “supply chain vulnerability” studies, “Supply chain Resilience” was then discussed in 2004 by scholars such as Christopher & Peck (2004). The term resilience has been used

commonly in the UK to describe the “ability of the system to return to its original (or desired) state after being disturbed” (Christopher & Peck, 2004).

Given the above, the UK government has introduced the Civil Contingencies Act Enhancement Programme in 2004 which includes a revised chapter of emergency preparedness and Business Continuity Management (Cabinet Office, 2011). The concentration on these elements and the importance of the practical area of supply chain management is understandable, since researchers are seeking to establish guidelines on the implementation of BCM and SCRM, as a matter of relative importance to the country across all sectors. However, there is a lack of research regarding the influence of specific contextual factors on the adoption of BCM and SCRM in the UK. With ICT being argued as a potential disruption, whilst at the same time being of possible assistance to successful BCM and SCRM, it seems relevant to relate the adoption of BCM, SCRM and ICT in which these three are conceptualised as innovations. The present study seeks to contribute towards filling this gap in the research.

Having determined that the study was to be conducted in the UK (a developed country), the significance of the adoption of BCM, SCRM and ICT in the context of developed countries in general, and in UK in particular, is considered. Since SCRM is part of the study, then looking at organisations within the context of their supply chain is important but is also necessary given the current emphasis on outsourcing and on the importance of SCM. E.g. literature has discussed the influences of members within the supply network on the success of supply chain management (Lambert & Cooper, 2000) Hence this study covers organisations within their supply network in which every member in the supply chain plays their role in influencing the other members to adopt the innovation.

1.3. Objectives of the study

The purpose of this study is to focus specifically on adoption level and stages of adoption of three (3) innovations (BCM, SCRM and ICT) in an organisation within their supply chain. This requires disaggregating the generally-employed stage model of Rogers (Rogers, 1995: pg 163) to distinguish between adoption decision and stages of adoption (see Figure 3.1, Chapter 3).

The research attempts to answer the question “what are the key determinants of the adoption, and the stages of adoption of BCM, SCRM, and ICT in an organisation within their supply network?” This question will be addressed by addressing the following sub-questions:

1. Do the characteristics of BCM (or SCRM or ICT), affect the organisation’s adoption, and their stages of adoption, of these innovations?
2. Do the internal and external factors of BCM (or SCRM or ICT) characteristics; significantly influence the organisation’s adoption, and their stages of adoption, of these innovations?
3. Do the characteristics of the external environment significantly influence the organisation’s adoption, and their stages of adoption, of BCM (or SCRM or ICT)?
4. What features of a company influence the organisation’s adoption, and their stages of adoption, of BCM (or SCRM or ICT)?
5. To what extent are the results of this study consistent with those of research conducted in a different context?

The research objectives below are the major topics of investigation of this study following the above research questions:

1. To explore key determinants of the adoption and stages of adoption of BCM, SCRM, and ICT, in an organisation within its supply network.
2. To empirically examine the proposed framework, and assess the influence of various factors in this framework, which will affect the adoption level and stages of adoption of BCM, SCRM, and ICT in an organisation within its supply network.
3. To identify differences (if any) between the various types of innovations
4. To identify contributions to research on innovation, and to explore practical implications and guidelines for managers, in order to help them enhance their understanding of the adoption of BCM, SCRM, and ICT, in their organisation, and in a supply chain context.

To pursue the research summarised above, a generalised model is developed, that includes factors that are expected to influence the adoption, and its stages of adoption, of the innovation in organisations within the supply network in the context of developed countries.

1.4. Rationale of the Study

Diffusion of innovation in general (Damanpour, 1988, 1991), and BCM (Cerullo & Cerullo, 2004), SCRM (Jüttner, 2005), and ICT (FACET, 2010) in particular, are prominent research arenas which have attracted diverse researchers. Although a great body of literature can be traced in these research areas, it is believed that further research is justified. On the one hand, innovation studies have reported contradictory findings on specific innovations in different contexts. In addition, more research on different types of innovations in different contexts is needed to develop a good base for comparing the results and enriching the theory of innovation diffusion.

The main objective of business continuity management in an organisation is to ensure the resumption of its activities, rebuild business infrastructure, and continue customer service at an acceptable level. In supply chain management, business continuity is applied to ensure that the flow of materials, information, and financial resources are not disturbed by any type of disruption of the chain (Waters, 2007: pg 221). Whenever disruptions in supply occur, BCM is expected to return the business back to operational status and maintain an acceptable level at the earliest possible opportunity. For this reason, organisations in the supply chain should be able to access all the resources needed in BCM (Waters, 2007 : pg 221), such as:

1. adequate staff with skills to start the BCM process
2. staff to ensure the availability of key functions
3. various facilities and resources essential in allowing business processes to remain functioning
4. good IT infrastructure and secure systems
5. capability to manage flow of materials and procurement
6. staff capable of effective communication, both internally or externally
7. records for future use

The interest of this research is to explore an organisation's business continuity in a supply network. There are various studies in Supply Chain Risk Management (SCRM), that range from identifying risk, analysing risks, and how organisations in supply networks deal and respond to the risk identified. However, there are also needs to consider plans to continuously operate the business, and ensure the flow of materials in the supply chain whenever the risks occur, and while the normal supply chain elements aren't available. This style of planning is often accentuated with the impact of severe risks of increasing magnitude as they affect a wider scale of operations connected to the supply network (Comfort et al., 1999; Nakamura et al., 2003). This approach to planning has been given various names, such as, emergency management, disaster recovery, crisis management, civil protection and Business Continuity Management (BCM). The importance of BCM in organisations has been increasingly recognised by the establishment of BS 25999 in December 2006 by British Standard Institute, as the code of practice for Business Continuity Management (British Standard Institute, 2006). Apart from the different terms used for BCM and SCRM, many arguments articulate that BCM is a part of SCRM in a broader view, while some see SCRM as part of BCM. This study will provide insight into understanding both topics within this context of wider perspectives of business at risk, with the increasing use of outsourcing, and concerns within a supply network encompassing BC.

Table 1.1 below shows several examples of literature that discussed the topics of supply chain risk management and business continuity. A search was made through the web of science, provided by the University of Leeds, using keywords ("business continuity" or "crisis management" or "emergency planning" or "emergency management" or "disaster recovery" or "civil protection") AND ("supply chain" or "supply chain risk management") in July 2008 and updated in January 2010.

Table 1.1: Papers Discussing Supply Chain Risk Management and Business Continuity

Authors / Years	Title	Journals	Main Points
1.(Tomlin, 2006)	Accelerate the positive	Professional Engineering	Is a one (1) page report on how “Accelerate” as a supply chain organisation has helped suppliers to diversify.
2.(Christopher, Jennifer, Rungtusanatham, & Robert, 2007)	The Severity of Supply Chain Disruptions: Design Characteristics and Mitigation Capabilities	Decision sciences	Proposed factors that influence the severity of disruptions in SC. Factors came from: <ol style="list-style-type: none"> 1. Design Characteristics of SC includes: density, complexity and node criticality. 2. Mitigation Capabilities of SC includes: recovery and warning.
3.(Finch, 2004)	Supply Chain Management - an International Journal	Supply Chain Management - an International Journal	Presented case study that showed how large companies increase their risks by having SME as their partners in SC. This paper also identified best practices in IS risk management.
4.(Street & Meister, 2004)	Plenary session: Driving forces in database technology	20th International Conference on Data Engineering, Proceedings	Technical paper that discussed database technology includes hardware commoditization e.g. RFID that allow huge storage of data in warehouse, and Sarbanes/Oxley Act i.e. auditing, disaster recovery
5.(Coles & Moulton, 2003)	Assessing interaction networks with applications to catastrophe dynamics and disaster management	Physical - Statistical Mechanics and Its Applications	Investigate network interaction using mathematical methods based on impact to optimization measures taken by emergency management, and failures of systems
6. (Kim & Chung, 2003)	Incentive structures for food safety and quality assurance: an international comparison	Food Control	This paper compares the incentive structures for changes in food safety legislation and in private sector business strategies in the UK, Canada and Australia.
7.(Von Solms & Von Solms, 2004)	Chlorine transfer hose failure	Journal of Hazardous Materials	This paper presents the lesson-learned from the incident of chlorine-a toxic gas to help prevent similar occurrences.
8.(Cachon, 2004)	BC/DR supply chain activities of NEC	NEC Technical Journal	Study shows how NEC establishes some activities for

			business continuity to prevent risks that came from IT. This paper also proposed that IT is not caused restricted access to BC.
9.(Grimaila, 2004)	Prevention and management of product recalls in the processed food industry: a case study based on an exporter's perspective	Technovation	Discussed supply chain of food that are exposed to risks, and systems/ tools that could be useful. Their finding suggests HACCP and RFID could prevent product recalls.
10. (Swarr, 2004)	Evaluating supply line sustainability and business environmental risk	Proceedings of the 2004 IEEE International Symposium on Electronics & the Environment, Conference Record	This paper introduces the concept of using sustainability as a fundamental measure of supply line risk and hence business continuity risk for companies. The objective is to assess sustainability and risk associated with various classifications of supply line commodities.
11. (Wall & Shawn, 2006)	Force majeure? Make the best of it	Chemical Engineering	Discussed the provisions, implications and workings of "force majeure". It is believed able to help a production or plant-operations manager or engineer to make a disruption less damaging to the business.
12.(Zhao & Li, 2006)	Study on supply chain real time coordination system	Proceedings of 2006 International Conference on Machine Learning and Cybernetics	Technical paper that aim to improve response ability by using suitable mechanism in coordinating enterprise named as Supply Chain Real Time Coordination (SCRT).
13.(Zsidisin, Melnyk, & Ragatz, 2005)	An institutional theory perspective of business continuity planning for purchasing and supply management	International Journal of Production Research	Discussed the structure of Business Continuity Planning (BCP) processes and techniques in managing purchasing and supply chain risk.

The importance of the present study arises from its contribution to knowledge and practice. Contributions to theory includes building a model of innovation adoption of management innovation. Contributions to practice include awareness of management innovation among managers, and guidance to identify the critical