



University of HUDDERSFIELD

University of Huddersfield Repository

Ghadge, Abhijeet, Dani, Samir and Kalawsky, Roy

Supply Chain Risk management: An analysis of Present and Future scope

Original Citation

Ghadge, Abhijeet, Dani, Samir and Kalawsky, Roy (2011) Supply Chain Risk management: An analysis of Present and Future scope. In: Proceedings of the 16 th International Symposium on Logistics (ISL 201 1) Rebuilding Supply Chains for a Globalised World. Nottingham University. ISBN 978 085358 278 6

This version is available at <http://eprints.hud.ac.uk/id/eprint/19872/>

The University Repository is a digital collection of the research output of the University, available on Open Access. Copyright and Moral Rights for the items on this site are retained by the individual author and/or other copyright owners. Users may access full items free of charge; copies of full text items generally can be reproduced, displayed or performed and given to third parties in any format or medium for personal research or study, educational or not-for-profit purposes without prior permission or charge, provided:

- The authors, title and full bibliographic details is credited in any copy;
- A hyperlink and/or URL is included for the original metadata page; and
- The content is not changed in any way.

For more information, including our policy and submission procedure, please contact the Repository Team at: E.mailbox@hud.ac.uk.

<http://eprints.hud.ac.uk/>

SUPPLY CHAIN RISK MANAGEMENT: AN ANALYSIS OF PRESENT AND FUTURE SCOPE

Abhijeet Ghadge¹, Samir Dani¹ and Roy Kalawsky²

¹School of Business and Economics, Loughborough University, Loughborough, UK

²Research School of Systems Engineering, Loughborough University, UK

ABSTRACT

Supply chain risk management has increasingly attracted researchers as well as practitioners in recent years. Literature reviews on this topic have provided a good platform for beginners in the field of SCRM. However this paper assumes that the SCRM researcher will benefit from a systematic literature review in which the SCRM field is studied holistically based on different typologies. The study considers papers published over a period of ten years and depicts the prominent strategic changes in SCRM research analysed from numerous perspectives. The outcome of this systematic literature review has provided insights into the present and future scope of SCRM field. This research expects to provide researchers and managers a quick but insightful understanding of the length and breadth of the SCRM field. The identified research insights, gaps and future directions will encourage new research techniques to manage risks in the globalized supply chain environment.

INTRODUCTION

Information explosion from multiple data sources in today's e-world demands more explicit and justifiable knowledge about the research area. Supply Chain Risk Management (SCRM) is one such research area which has increasingly attracted the interest of both, academicians and practitioners. SCRM is believed to be in an emerging and nascent stage by researchers (Sodhi et.al, 2011). It clearly has undefined boundaries in its scope of research. Literature review on SCRM is carried out in past by Juttner et. al. (2003); Vanany et. al. (2009) and Rao and Goldsby (2009). These literature reviews provide a good platform for beginners as well practitioners in making sense of the ongoing research and identifying the state-of-art within the field. However, the recent reviews have been focussed around certain journals or around identifying risk management practices. Narrative literature reviews are believed to lack thoroughness and rigour (Tranfield. et.al, 2003). Evidence based reviews are considered to be thorough and transparent as they provide insights into field by literature being analyzed through a number of perspectives. The Systematic review approach provides an evidence base for literature survey (Tranfield et al., 2003; Rousseau et al., 2008; Denyer and Tranfield, 2009). In this paper, a Systematic Literature Review (SLR) of the SCRM field is carried out following a structured process. SLR which is prominently used in the field of medical science, has expanded its roots in management. The SLR process followed in this paper is adapted from the work done by Tranfield et. al. (2003) for developing evidence-informed management knowledge.

The following section will briefly cover the background and current advances in SCRM for a quick overview of the research field. Later, research methodology followed for systematic literature review is presented. The SLR approach has provided critical insights into SCRM research and is presented in the analysis and findings section. Identified gaps in existing work are used in defining present and future scope of SCRM is presented in concluding section.

SUPPLY CHAIN RISK MANAGEMENT

Managing risks in the modern environment is becoming increasingly challenging (Christopher and Lee, 2004). This is primarily because of uncertainties in supply and demand, globalization of markets and short product life cycles. Risk can be defined as a potential for unwanted negative consequences to arise from an event or activity (Rowe, 1980). The global business environment today is influenced by financial instability, increased outsourcing, mergers, new technologies, e-business, shorter time-to-market,

thus forcing organizations to adopt new ways of doing business (Stefanovic et. al., 2009). Supply chains are growing more global and complex, they are driven by customer expectations for reduced costs and increased flexibility. Today's leaner, just-in-time globalized supply chains are more vulnerable than ever before to operational, natural and man-made disruptions. Vulnerability is defined as an exposure to serious disturbance arising from risks within the supply chain as well as risks external to the supply chain (Christopher and Peck, 2004).

Supply chain risk can be broadly defined as an exposure to serious disturbance arising within a supply chain affecting its ability to effectively serve the end customer market. The SCRM approach generates added value to industry by providing better understanding of supply chain risks, greater influence and control over suppliers, increased quality and reliability of products with increased efficiency and reduced operational costs. Supply chain risk sources are any variables which are unpredictable and can disrupt the complete network. Risk management in supply chain is driven by systemic interrelationships focusing at identification and reduction of risks not only at organization level but focusing on the entire supply chain. Risk management is becoming integral part of a holistic SCM design (Christopher and Lee, 2004). There is diverse classification of supply chain risks in literature. Risk itself is termed in many ways such as disruption, vulnerability, uncertainty and disaster in field of Supply chain risk management.

RESEARCH METHODOLOGY

Systematic reviews differ from traditional narrative reviews by adopting a replicable, scientific and transparent process (Tranfield. et.al, 2003). We have adapted the SLR process followed by Tranfield et. al. (2003) for developing evidence-informed management knowledge in this area. The research design followed for systematic literature review and for identifying the scope of SCRM research is followed in four phases as shown in figure 1. Although the SLR methodology is not widely used within the management field, it is found to have reasonable acceptance as a desired methodology in literature review for researchers (Badger et. al, 2000).

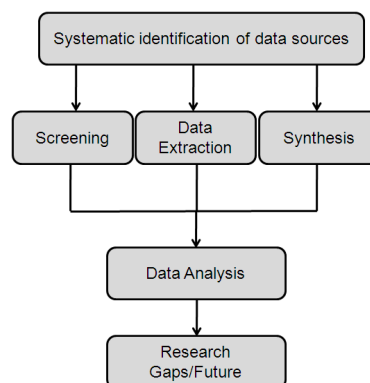


Figure 1: Research Design approach (adapted from Tranfield et. al., 2003)

Systematic identification of data sources

In the first phase, a review panel of experts is formed who can share their valuable opinions in areas of research methodology and research theory. The preliminary stage of the SLR process is mainly an iterative process of definition, clarification, and refinement (Clarke and Oxman, 2001). While managing SLR, it is necessary to assess the relevance of the literature and to delimit it by considering cross-disciplinary perspectives (Tranfield. et. al., 2003). The SLR review plan usually contains a conceptual discussion of the research problem rather than a defined research question in other technical fields.

Screening, Data Extraction and Synthesis

Comprehensive and unbiased search is one of the fundamental differences between a traditional narrative review and a systematic review (Lemmer et.al., 1999). The systematic review methodology is designed to reduce any unintended bias, which may occur in the use of other review methodologies (Bimrose. et. al, 2005). SLR screening is decided based on search strings or keywords considered most appropriate based on discussion with experts. The output of this stage should be full listing of core contributing articles on which data analysis will be carried in objective and unbiased manner. This listing should meet all inclusion and exclusion criteria as decided in review plan. The number of sources included/excluded should be well documented with appropriate reasons. Research synthesis is term referred for family of methods used in review for analysing and summarising the findings.

Data Analysis

Systematic reviews mainly use quantitative methods. This is most rigorous process of all other processes in SLR. We rely on implicit quality rating of journal before analysing data through quantitative tools like statistical analysis and citation/co-citation analysis.

Dissemination and Reporting

Management research output could be presented in two stages. The first would be descriptive analysis providing set of classification on various attributes used in data analysis. Later, Findings of thematic analysis could be reported through aggregative and interpretative approach.

ANALYSIS AND FINDINGS

Using the above proposed research design for SLR, a panel of experts and academic researchers in field of Supply chain were sought to provide directions for literature survey. To identify research articles for conducting quality analysis we used quality rating of journals in Operations Management/Research and Management Science area. We strictly followed the journal quality rating provided in 'Journal Quality Guide' published by ABS (Association of Business Schools, UK) and referred to only journals in above mentioned areas with an average of 3 quality rating (excepting two) in last two years (2009,2010). These papers are heavily refereed and research is highly regarded (ABS Journal Guide 2010). Figure 2 shows 15 identified data sources with their ABS ranking in OM and OR/MS area. The keywords and search strings used for filtering the raw data from data sources were identified as Risk, Disruption, Vulnerability, and uncertainty. These keywords were identified based on earlier understanding of the SCRM field supported and during discussions with academicians and practitioners during the 10th International Research Seminar on Supply Chain Risk Management in 2010 organised by the International Supply Chain Risk Management Network (ISCRIM).

SR. No.	Key Subject field	List of Journals	ABS Ranking*
1	Operations Management (OM)	Journal of Operations Management (JOM)	4
2		Production and Operations Management (POM)	3
3		International Journal of Production Economics (DPE)	3
4		International Journal of Operations and Production Management (DOPM)	3
5		Supply Chain Management: An International Journal (SCHM)	3
6		International Journal of Production Research (DPR)	3
7		Production Planning and Control (PPC)	3
8		International Journal of Logistics: Research and Applications (DIRA)	2
9		International Journal of Logistics Management (DLM)	2
10		International Journal of Physical Distribution and Logistics Management (DPLM)	2
11	Operations Research and Management Science (OR/MS)	Management Science (MS)	4
12		European Journal of Operational Research (EJOR)	3
13		Naval Research Logistics (NRL)	3
14		Omega: The International Journal of Management Science (OMEGA)	3
15		Decision Sciences (DS)	3

Table 1: Identified data sources (*ABS ranking as on 17 Nov. 2010)

In order to restrict the scope of literature survey, we decided to analyse articles published only in last one decade (from 2000 to 2010). We believed the year 2000 as an appropriate starting point even though the term 'supply chain management' was first coined by an American industry consultant in the early 1980s. After 2000, more Quantitative orientated articles were published (Tang and Nurmaya Musa, 2010). It was observed in preliminary search that, significant number of researchers started working on SCRM in early 2000. Global recession affecting supply chain in 2001-02 (Hilmola, 2005)

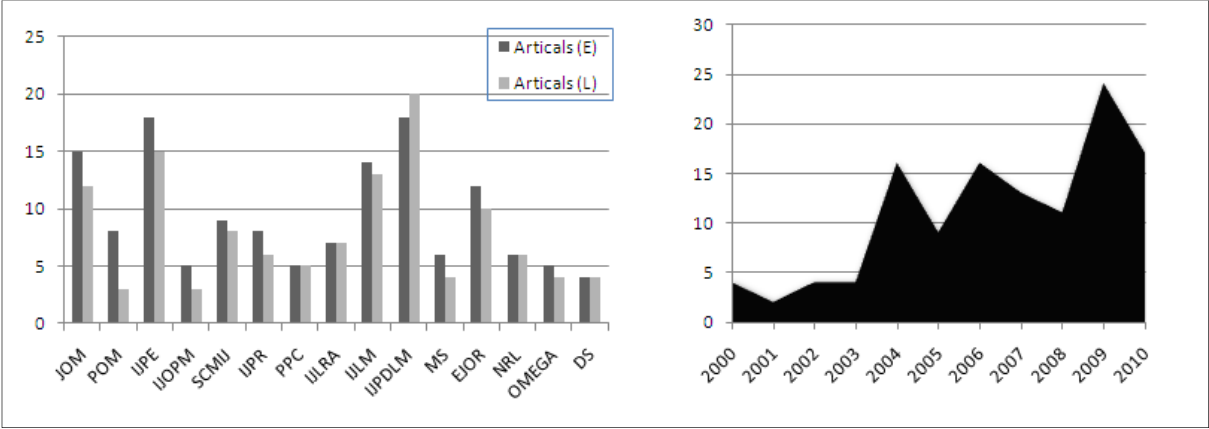


Figure 2: Journal-wise and year-wise distribution of articles

and challenges in outsourcing seem to have given a sound platform for research on risk management in supply chain in the early stage of the decade. The initial search using keywords/search strings within identified journals and filtering by year of publication from 2000 to 2010 yielded 140 articles. We further refined this search and eliminated articles discussing risk management in other interdisciplinary fields like Finance, Enterprise, Information Technology, etc. In order to improve the quality of research we finally classified 120 articles individually and independently for data extraction process. It was observed that there was a radical increase in number of articles published from year 2004 in field of SCRM (figure 2). Preliminary studies showed that the traditional focus of supply chains looking at operational risks shifted towards more strategic risks due to an increase in global outsourcing activities. 9/11 attack disrupting major supply chain in early decade also triggered interest in SCRM field (Chopra and Sodhi, 2004; Sheffi, 2005). Year 2009 represented as a most promising year in SCRM contributing most in volume. Complete financial meltdown by the middle of 2008 is expected to be one of the reasons for surge in research in subsequent year. Descriptive analysis of keywords and countries contributing to SCRM showed USA and UK contributing most to SCRM research supported with more than two third of publications. This may be due to the fact that USA, UK along with other European countries outsource the most and are vulnerable to risks. This is assumed to drive the interest of researchers from these countries. Risk and Disruption are most commonly used terms to represent exposure to serious disturbance in supply chain. Few other prominently used terms found in literature were vulnerability, uncertainty, disaster and crisis. The Risk term is mainly referred to organizational and network related disturbance whereas Disruption is commonly referred to exposure to environmental (man-made and natural) disturbances.

Data synthesis was done using various predetermined criteria's. Typology were identified as shown below:

Based on type of risk: There is diversity in classifying risks in SCRM (Ghadge.et.al, 2010), this demanded clear and distinct classification for data analysis. We followed the classification provided by Juttner et. al. (2003) based on sources of risk as Organizational

risk, Network Risk and Other risks comprising of environmental (man-made and natural disasters), political/Social and exchange rate risks.

Based on Management level: Mitigation strategies are decided based on expected level of management. It could be Operational, Tactical or Strategic depending on the nature of problem and requirement.

Based on research methodology: Qualitative and Quantitative research methodologies are classified to understand tools and techniques used in SCRM.

Based on risk management process: Based on perception of researchers in SCRM risk management process is generally classified as risk identification, assessment and mitigation and/or control.

Based on approach to SCRM: Risk mitigation approach could be either proactive or reactive. This is done to identify mitigation strategies commonly used in field of SCRM.

Typology type	All Journals	OM Journals	OR/MS Journals	Typology type	All Journals	OM Journals	OR/MS Journals
Contributing country	%	%	%	Research approach	%	%	%
<i>USA</i>	46.66	43.47	57.14	<i>Qualitative</i>	54.16	67.39	10.71
<i>UK</i>	15.83	20.65	0.00	<i>Quantitative</i>	36.66	23.91	78.57
<i>International</i>	16.66	11.95	32.14	<i>Mixed</i>	9.16	8.69	10.71
<i>Other countries</i>	21.66	25.00	10.71	Risk management process			
Publication period				<i>Identification</i>	35.00	32.39	5.89
<i>2000-2005</i>	32.50	35.86	78.57	<i>Assessment</i>	14.33	16.64	78.14
<i>2006-2010</i>	67.50	64.13	21.42	<i>Mitigation/Control</i>	5.83	4.72	13.84
Type of Risk				<i>Holistic</i>	44.16	46.47	2.85
<i>Organizational</i>	4.85	5.87	0.00	Risk mitigation approach*			
<i>Network</i>	48.78	52.69	11.65	<i>Proactive</i>	56.33	41.60	60.71
<i>Other</i>	14.63	12.38	50.61	<i>Reactive</i>	23.33	13.91	18.42
<i>Holistic</i>	31.66	28.58	38.42	<i>Holistic</i>	20.83	44.92	21.07

* Only 61 articles of 120 discussed about proactive/reactive approach.

Table 3: Statistics of articles in SCRM

Analysis based on various typologies showed interesting results. This analysis was carried with an assumption that the authors contributing to SCRM research from various countries have an inherent interest in particular research area and are faced with similar kind of risks in their own country or region. Statistical analysis showed almost half (46.66%) of the contribution alone coming from USA leaving apart major stake in collaborative work with other countries (16.66%) 'International' is word used to indicate collaborative research among co-authors representing more than two countries (Altay and Green, 2006). UK found leading next to USA along with tangible contribution from other countries like Sweden, China, Canada, and Italy also showing keen interest in supply chain disruptions. It is surprising to see that all contributory work from UK is published only in Operations Management (OM) journals. The journals from the OM domains are more influential then OR/MS (Petersen et. al., 2011). Most of UK research work is qualitative in nature and this could be a reason for not found in OR/MS journals focusing on application of quantitative methods for decision making (Chase et al., 2006).

By dividing the decade into two halves for analysis, it showed a distinctive growth of SCRM from an undefined area to an emerging area for practitioners and researchers in supply chain management. Publications in later part of decade almost doubled compared to previous half (Table 3). This clearly shows the potential of SCRM research in current dynamic world. Identified probable reasons for this trend are already discussed. Thematic analysis of other typology provided interpretative results underlining the scope of SCRM field for future. Organizational risks comprising of Inventory risk, process/operational risk, labour risk, Product quality risk and safety risk are quite frequently discussed in literature. Network related risk sources arise from interactions between organisations within the supply chain (Jüttner et al., 2003). Supply and demand risk, supplier default, outsourcing quality risk, logistics risk forming Network related risks is found to be most researched (48.78%) for its obvious reasons of being "extrinsic" in nature of risk. Recent research has shown increased attention towards environmental (man-made and natural) disruptions due to several global events in past disrupting supply chain like 9/11 terrorist attack (2001), SARS (2003), Tsunami (2004), Hurricanes (2005) and geopolitical instability (2010).

Data synthesis of research methodologies used for tackling the problems in SCRM field was broadly classified as Qualitative and Quantitative methods. During preliminary analysis it was evident that, Qualitative methods are preferred by SCRM researchers (table 3). Detailed analysis of data classified as Qualitative, Quantitative and mixed methods showed case study approach being most adopted by researchers for dealing with problems mainly at strategic management level. More than 80% of case studies are found to be focussed on network related risks. In qualitative research methods; other prominently used tools are exploratory analysis of secondary data (11.67%), Conceptual theory building for developing frameworks (10.83%) and use of Interviews/Questionnaires/Focus group study (10.00%). Conceptual frameworks mainly focused on risk identification activity whereas outcomes of case studies were developed as risk mitigation strategies for implementation in similar case environments. Interviews, Questionnaires and Focus group study are found to be commonly used for risk identification and risk assessment activities primarily at a strategic level of management. Since a literature survey provides platform for conceptual theory building, it is found to be often used in most articles. Most of the literature surveys were found to be narrative in nature. In quantitative methods, OR modelling comprising of multi-objective programming, linear/non-linear optimization modelling and other mathematical algorithms are preferred tool (14.17%) of researchers in SCRM. Probability and Statistics is used to analyse the data mainly at operational and tactical level of problems like production and inventory management, demand uncertainty. Soft OR tools like Analytical hierarchy process (AHP), Systems thinking are finding useful for research in SCRM. Simulation methods are not uncommon for assessing and modelling supply chain risks (Zsidisin et al., 2004). Agent based simulation (Ex. Datta. et. al, 2007); Monte Carlo simulation (Wagner et al., 2009) and Discrete-event simulation (Manuj. et al., 2009) studies are found to be used for solving problems mainly at operational management level. Manuj. et. al. (2009) provides eight-step development process for the design, evaluation and implementation of logistics and supply chain simulation models. Mixed methods combining two research methodologies are also found in review (9.17%). Undoubtedly there is huge potential in developing quantitative models to make hard decisions in SCRM (Tang and Nurmaya Musa, 2010). System dynamics rarely used in SCRM can be best suited for studying dynamic supply chain problems holistically.

