Contents lists available at ScienceDirect

Sustainable Production and Consumption

journal homepage: www.elsevier.com/locate/spc

Green supply chain management enablers: Mixed methods research

Rameshwar Dubey[a,1], *Angappa Gunasekaran*[b,*], *Thanos Papadopoulos*[c,2], *Stephen J. Childe*[d]

[a] *Symbiosis Institute of Operations Management, Constituent of Symbiosis International University, Plot No. A-23, Shravan Sector, CIDCO, New Nashik-422008, India*

[b] *Charlton College of Business, University of Massachusetts Dartmouth, North Dartmouth, MA 02747-2300, USA*

[c] *Sussex School of Business, Management and Economics, University of Sussex, Sussex House, Falmer, Brighton, BN1 9RH, United Kingdom*

[d] *Department of Engineering, University of Exeter, Exeter EX4 4QF, United Kingdom*

ABSTRACT

This paper contributes to the literature on green supply chain management (GSCM) by arguing for the use of mixed methods for theory building. The literature has identified antecedents and enablers for the adoption of GSCM practices. Nevertheless, there is relatively little research on building robust methodological approaches and techniques that take into account the dynamic nature of green supply chains. To address this gap, the paper firstly reviews systematically the literature on GSCM enablers; secondly, it argues for the use of mixed methods research to address questions related to GSCM enablers; thirdly, it uses interpretive structural modeling (ISM), MICMAC analysis, and confirmatory factor analysis (CFA) to illustrate the application of mixed methods in GSCM by testing a model on the enablers of GSCM; and fourthly, highlights the influence of enablers including, inter alia, top management commitment, institutional pressures, supplier and customer relationship management on financial and environmental performance. Finally, we conclude with limitations and further research directions.

Keywords: Green Supply Chain Management (GSCM); Environmental Management (EM); Institutional theory; Interpretive Structural Modeling (ISM); MICMAC analysis

1. Introduction

There is growing trend among the companies to link green practices with their corporate strategies (see Gunasekaran and Gallear, 2012 and Sarkis et al., 2011). Green manufacturing, or more precisely the green supply chain, has attracted interest among management researchers, environmentalists and practitioners in the last decade (Gunasekaran and Spalanzani, 2012; Brockhaus et al., 2013). Realizing the need to incorporate sustainability and the triple bottom line (Kleindorfer et al., 2005) as part of their strategic intent, companies focus on assessing the economic, environmental, and social impact of their activities and highlighting the relationship between sustainability and performance (Leppelt et al., 2013; Green et al., 2012; Burritt and Schaltegger, 2012; Subramanian and Gunasekaran, 2015). Scholars have included the

* *Corresponding author. Tel.: +1 508 999 9187; fax: +1 508 999 8646.*
E-mail addresses: rameshwardubey@gmail.com (R. Dubey), agunasekaran@umassd.edu (A. Gunasekaran), Athanasios.Papadopoulos@sussex.ac.uk (T. Papadopoulos), s.j.childe@exeter.ac.uk (S.J. Childe).
[1] Tel.: +91 253 2379960x39, Cell. No. +91 8600417738.
[2] Tel.: +44 1273 678522.
Received 14 May 2015; Received in revised form 20 June 2015; Accepted 7 July 2015; Published online 20 July 2015.

http://dx.doi.org/10.1016/j.spc.2015.07.001

social and environmental measures in their models (e.g. Bell et al., 2012; Giovanni, 2012; Hollos et al., 2012; Gimenez et al., 2012; Paulraj and de Jong, 2011 and Awaysheh and Klassen, 2010), looking at, for instance, the effect of internal or external environmental practices on the triple bottom line (Giovanni, 2012) and economic performance (Giovanni and Vinzi, 2012) or the role of supplier collaboration in sustainable performance (Hollos et al., 2012).

There is a rich body of literature on enablers of GSCM implementation and their interrelationships (Ali and Govindan, 2011; Large and Thomsen, 2011; Mathiyazhagan et al., 2013) highlighting the role of GSCM in achieving sustainability Hsu et al. (2013). The majority of these GSCM studies, however, use either quantitative approaches and methodologies by collecting and analyzing large samples and testing hypotheses and models, or qualitative case studies following grounded theory inspired approaches (Binder and Edwards, 2010; Soltani et al., 2014). Other scholars claim that the current literature in the field of operations and supply chain management has extensively used deductive, big data, "empirical research" (Markman and Krause, 2014). Although the deductive approach provides reliable answers to the research questions, at the same time empirical research does narrow the scope (Markman and Krause, 2014). Meredith (1998) argues that case study is a powerful approach for building theories, in comparison to rationalist approach which is sometimes referred to as traditionalist or quantitative research. The argument offered by Meredith (1998) is that most of the times the papers published in reputable journals which have used a rationalist approach are less well understood by the readers.

In recent years the use of the case study approach has attracted interest in the operations and supply chain management community (Ketokivi and Choi, 2014). Pagell and Wu (2009) have used 10 cases to build comprehensive theory. However, in spite of their merits, case studies have significant demerits as identified by Meredith (1998). Scholars have criticized the case study research approach on the grounds of "ambiguity of inferred hypotheses" and the "selective bias" (Bitektine, 2008: 161; Barratt et al., 2011), and in that there is risk that the researcher would look for data that fits hypotheses stated a priori (Barratt et al., 2011). These criticisms have stemmed mainly from scholars who are not familiar with qualitative methods (Bitektine, 2008; Roth, 2007). However, rather than continuing the never-ending debate between quantitative or qualitative research, in this paper we argue for the use of mixed-method research which may employ both qualitative and quantitative methods *in order to build theory*, in the context of GSCM, driven by the endorsement of scholars to build robust methodological approaches and techniques that consider the dynamic environment of OM and SCM (and in our case GSCM). Furthermore, there is need for more studies looking at green supply chain initiatives in emerging economies, which "is still an under-researched area" (Hsu et al., 2013, p. 656).

To elaborate on our argument, we: (i) undertake an extensive literature review and identify key enablers of GSCM practices; (ii) understand the relationship among enablers of GSCM practices through the adoption of interpretive structural modeling and develop an interpretive structural model (ISM); (iii) provide a four-category taxonomy of enablers based on their dependence and driving power (i.e. MICMAC analysis); (iv) use the MICMAC analysis to develop a theoretical GSCM framework; and (v) validate the proposed GSCM theoretical framework using confirmatory factor analysis (CFA).

The rest of the paper is organized as follows. In the following section we outline our systematic literature review. In Section 3 we describe our research theoretical framework and research hypotheses. In Section 4, we detail our research design. Section 5 discusses CFA analysis and PLS–SEM hypotheses test output. In Section 6, we conclude our research and outline further research directions.

2. Literature review

We conducted our systematic literature review (SLR) to identify the key enablers of GSCM and their interrelationships, following the principles set out by Tranfield et al. (2003), Rowley and Slack (2004) and were inspired by other prominent scholars (Burgess et al., 2006; Cousins et al., 2006) that have been used in recent reviews by Chen et al. (2014) and Gunasekaran et al. (2015).

SLR is a quite popular methodology in medical science, however in recent years it has seen significant growth in management fields (Lightfoot et al., 2013), to synthesize and organize research findings from multiple studies. In this process we have adhered to the principles outlined by Tranfield et al. (2003), i.e. transparent, replicable and rational. We have derived publication data from the following databases: ProQuest, Science Direct, EBSCO, SCOPUS, Emerald, Springer, Inspec, and Compendex. Our search was based on the following terms and strings: 'green supply chain', 'green manufacturing', 'sustainability', 'antecedents', and 'enablers'. During the search activity we had access to reputable journals in the field of operations and supply chain management, management research methods, reports, and edited books. In order to assure ourselves that we were not missing any relevant work(s), we also used Google Scholar. This process identified 284 seemingly relevant items as a basis for further analysis. All articles were considered to be representative of the current body of knowledge associated with the GSCM, green manufacturing and ISM modeling.

We followed Chen et al. (2010) and subsequent studies (Merali et al., 2012) in that we conducted a manual scan and analysis of all the abstracts and a selection of the highly cited and review papers. In this vein, we interpreted and highlighted themes and features within the extant GSCM literature. The thematic analysis involved a detailed review of the content of each research article. To do this we created a coding frame to catalog the textual content and brief summaries of each paper. This coding frame emulated a tree structure with over 40 initial variables under 9 constructs. The coding framework evolved inductively as the analysis work progressed. This process yielded substantial articles that we have included in our research.

2.1. *Classification of GSCM enablers*

We have classified key enablers of GSCM practices, based on extensive literature review as shown in Table 1. The enablers are discussed in the next subsections.

Total quality management (TQM)—Kitazawa and Sarkis (2000) have argued that TQM implementation in any organization helps with waste minimization. Furthermore, Pereira-Moliner et al. (2012), in their study in the hotel industry, have identified the relationship between quality management and environmental management, arguing that the implementation of quality management practices enables