CLUSTERS AND SUPPLY CHAIN MANAGEMENT: CHALLENGES AND OBSTACLES

Elgazzar, S.H., Tipi, N.S.

College of International Transport and Logistics, Arab Academy for Science, Technology and Maritime Transport, Alexandria - Egypt.
BOSCAT (Business Operations, Supply Chain and Transport) Research Group, Business School, The University of Huddersfield, UK.
E-mail: sara.elgazzar02@gmail.com; n.tipi@hud.ac.uk

Introduction

The Cluster Supply Chain (CSC) is a new trend of organisational networking forms, which is a combination of industrial cluster with the management of the supply chain (SC). Integrating supply chain management and industry cluster theories, as an effective organisational management approach to improve the company's competitive advantage, is becoming a key component in the survival and development of many economic entities and enterprises (Zhu and Li, 2010). The absence of a comprehensive review on the integration of SC and cluster theories, in addition to the lack of studies that focus on how to model, manage and improve the performance of CSC resulted in a limited understanding of the supply chain cluster concept and the implementation of its practices (Tolossa et al., 2013).

This paper provides an insight into CSC management through conducting a systematic review of published research on CSC management – between 2006 and 2013. The review aims at identifying challenges and obstacles in the design, implementation and improvement of CSC and proposing future research directions for developing SC cluster theories in order to maximise the integration of supply chain and accordingly improving the performance of firms. The review helps companies to understand the benefits that can be raised from creating CSC and gives them directions for improving their capabilities to create CSC and select SC partners, which consequently help in increasing their competitiveness in terms of enhancing performance and increasing sustainability.

The remainder of this paper is organised as follows. The next section introduces the concept of SC cluster. The methodology is discussed in section 3. Then, analysis and discussion of the reviewed papers are illustrated in section 4. Finally, conclusions are presented in section 5.

Cluster supply chain

Porter (1998, p78) defined cluster as "a geographic concentration of interconnected companies and institutions in a particular field". The cluster should not be limited only to tiers of supplier, manufacturer and customer. The cluster concept suggests the integration of all tiers in the SC that are linked vertically and horizontally. It should be extended to any other entities important to competitions. It might be extended to manufacturers of complementary products, companies in industries related by skills, technology, or common inputs; in addition to any other supportive entities such as governmental, financial, research and educational institutions (Porter, 1998). According to Pedro et al. (2011, p.117), an industrial cluster is defined as "a concentration of interconnected, geographically close businesses operating together within the same commercial sector and whose activities rely on certain local specificities such as the availability of natural resources, centres for technological development (through universities, research centres , technology parks, or a technology-based industry), and a consolidated productive structure for all tiers of the productive chain of the region".

Cluster role introduced by Porter in 1998 has been recently extended to consider collaboration and innovation within the SC. Recent research has started to study the cluster from the SC integration perspective by considering cluster not only as a competitive approach, but also as an industrial development strategy, where geographical concentration plays the most critical role in integrating SC partners connected in the cluster (Tolossa et al., 2013). The absence of SC perspective in formulating industrial cluster can result in homogenous, non-integrated trend in the connected cluster firms, which will lead to vicious competition rather than beneficial collaboration (Huang and Xue, 2012). Supply Chain Management (SCM) practices support clusters by enabling the integration and maintaining long-term relationships among firms in the clusters (Yan and Wang, 2008). On the other hand, an industrial clustersupports the SC as it extends the chain to any other entitiesthat are important to the competitions through integrating academic institutes, government agencies, association and supporting industry in order to create the innovation and enhance the knowledge in the supply chain (Sureephong et al., 2008). Therefore, this research aims at reviewing the previous studies on CSC to clarify the research gap and highlight the challenges associated with the design, implementation and improvement of CSC concept, upon which directions for future research in this area can be drawn.

Methodology

A review was conducted based on a systematic review approach adapted from Tranfield et al. (2003) and Trafford and Leshem (2008). Tranfield et al. (2003) introduced three main stages to conduct a systematic review in management research. The first stage is planning the review by defining the need for the review and developing the review protocol. The second stage is conducting the review through identifying the research scope and selecting the relevant studies to be assessed and synthesised. The final stage is the review report and recommendations. At this stage the report should provide practical recommendations for practitioners to use the evidence provided by reviewing research in informing their decisions.

According to Trafford and Leshem (2008), the systematic review is conducted based on four stages namely: summary of the sources, synthesis sources, analysis of sources, authorising the text. First, the research scope is defined upon which number of key words are identified and used to search the online databases. The collected sources are then reviewed to exclude studies which are not sufficiently close to the research scope. At synthesis sources stage, the selected sources are clustered into themes based on the research questions, approach and core contribution. The analysis stage involves critical evaluation of the sources to draw the flow of the discussion. Once the sources are summarised, synthesised and analysed, a conclusion can be drawn to illustrate the relationship between thesources, and clarify how these sources differ, support, develop, extend or derived from each other, upon which research agenda can be proposed.

A systematic review derived from Tranfield et al. (2003) and Trafford and Leshem (2008). Tranfield et al. (2003) was conducted in this research based on seven steps:

1- Define the need for the review
2- Define the research scope
3- Identification of key words for research
4- Search of online database
5- Selection of studies
6- Synthesising and critically reviewing the selected studies
7- Writing up the review report

It has been observed that limited number of studies have been conducted that demonstrate the potential impact of CSC. It has been evident that the researh so far does not capture a comprehensive review focusing on the evolution and the development of CSC idea. The review provided in this paper will summarise the research since 1998 to 2013 in CSC area in order to identify challenges and obstacles in the design, implementation and improvement of CSC and propose future research directions.

The following key words have been defined in order to achieve comprehensive search results: "cluster supply chain", "cluster and supply chain management" and "cluster and supply chain integration". The defined key words were applied to the Scopus database to search for relevant publications between 2006 and 2013. The search initially identified 25 papers. After further screening, they were reduced to 10 papers. The screening process was done through manual examination of the identified papers to discard the papers that did not specifically tackle cluster supply chain management. Finally, the selected papers for reviewing process were categorised based on the research method. Three categories have been identified here: conceptual, empirical, and review type research as illustrated in table 1.

The next section critically evaluates the selected papers in order to round up previous research in this area and identify the gaps in the design, implementation and management of CSC; upon which the paper will close with a proposed agenda for future work.

No	Journal	Author	Year	Research method	Contribution/ Approach
1	Supply Chain Management: An International Journal	Patti	2006	Empirical	A case study was considered to ilustrate the advantages of Porter's economic cluster theory when local suppliers and customers are considered. The research provided empirical evidence that highlighted is the positive impact ofdeveloping local supply chains.
2	International Journal of Physical Distribution & Logistics Management	DeWitt et la.	2006	Empirical	A single case study approach was used to demonstrate the linkage between Porter's cluster theory and SCM and provide evidence of their positive impact on competitiveness and firm performance. The study proposed an expanded definition of clusters as geographical concentrations of competing supply networks by focusing primarily on local resources when selecting SC partners in the cluster, rather than looking only for low cost advantage through distant sourcing.
3	International Journal of Marketing Studies	Han	2009	Conceptual	The paper discussed the differences and links between SC and industry cluster and highlighted the compatibility and synergy of their features. The paper concluded that the combination of SC and industry cluster can effectively increase the competitive advantage of industries and

					accordingly enhance regional economic competitiveness.
4	Journal of Computational Information Systems	Zhu and Li	2010	Empirical	The paper constructed a practical reverse logistics information system to reduce the information technology costs and improve the CSC overall competitiveness. The system facilitates the exchange of information and simulates the operation process within the CSC through analysing the essential structure of information systems for CSC based on unified modelling language.
5	Supply Chain Management: An International Journal	Kannan and Tan	2010	Empirical	This research aimed to demonstrate the positive impact of firms with a larger span of integration and highlight the need for firms to engage the SC broadly. The study indicated that the span of integration contributes to the performance differences.
6	International Journal of Productivity and Performance Management	Pedro et al.	2011	Empirical	A face to face survey was conducted to examine the relationships between the functional factors and the surrounding factors of the cluster. The study findings suggested high levels of clusters' inter-firm integration as a pre-condition for the development of a cluster.
7	Journal of Intelligent Manufacturing	Li et al.	2012	Conceptual / Empirical	The study presented a framework and approach to design a CSC with across-chain horizontal cooperation. Some of the identified benefits to firm adopts this approach are: reducing customer search cost, improving customer service level, expanding market share of the whole industrial cluster area and allowing firms to adapt to changes of uncertain market demand.
8	Kybernetes	Huang and Xue	2012	Conceptual / Empirical	The paper gave some theoretical suggestions and practical approaches in support of the implementation of CSC. An industrial case study of CSC was carried out to explain the advantages and challenges of implementing the CSC through analysing and comparing pre-CSC and CSC performance of participants. The paper provided insight on the planning, implementation and evaluation of CSC.
9	International Journal of	Tolossa et al.	2013	Review	Content analysis was conducted to review the integration between SCM and

	Marketing Studies				industrial cluster. This review is one of the first studies which critically reviewed CSC researches. The review highlighted the impact of SCM integration on the efficiency of industrial clusters' operations.
10	Economic Systems Research	Kagawa et al.	2013	Empirical	The paper proposed an input-output method for identifying energy-intensive cluster and its subsequent opportunities for reducing energy and CO2 emmision. An automotive SC case study was used to demonstrate the proposed method.

Table 1: Classification of the research studies on CSC with respect to research method and contribution

Discussion

The review started by looking at the Porter's cluster theory (Porter 1998). Porter defined the notion of cluster and presented this from a global as well as a local perspective. He indicated why clusters are key to competition and demonstrated how understanding clusters can add to the strategic agenda. Tolossa et al. (2013) conducted a systematic literature review between 1996 and 2012 and identified 17 articles for consideration on cluster supply chain research. Their review summarised papers in four distinct areas.The first group of papers looks at the importance of CSC, the second groups a short list of papers that deal with the implementation of CSC where only a few papers have been identified and grouped under the improvement of CSC group and the design of CSC group. Following from Porter's cluster theory and then from the review of Tolosa et al., one can clearly see that researchers recognise the importance of cluster supply chain, however, further development is expected in the implementation, improvement and design agenda.

The majority of papers reviewed are found to be empirically based. Specific case studies application have been identified in previous studies that focus on different industries such as mechanical and electrical, furniture, jewellery, petrochemical and automobile sectors (Patti, 2006; DeWitt et la., 2006; Pedro et al., 2011; Huang and Xue, 2012; Kagawa et al., 2013). Key advantages have been identified within these cases as well as disadvantages. Cluster based research has been used to indicate energy savings and mitigate climate change (Kagawa et al. 2013). Clear advantages have been highlighted by Patti (2006) from the selected case study on reduced delivery cost, reduced lead time, improved quality, improved communication, improved new process and product development. Other advantages have been identified here such as: increased power to local and state government and increased influence of education and training institutions. Huang and Xue (2012) argued that CSC strategy can help companies extend their business at a lower cost and face the global challenges through all kinds of collaborations, however, the study has presented some disadvantages to the adoption of clusters. These are: the absence of critical links in the whole value chain, the disparity between the capability of various partners and the lack of support from public service infrastructure.

Few studies tackled CSC from a modelling and design point of view. Sureephong et al. (2008) examined the impact of industry cluster on improving SC performance through developing an information technology system to facilitate the communication and the exchange of knowledge between the actors of the CSC. Li et al. (2012) developed a hybrid model for a cluster supply chain that consists of two individual chains with a simplistic structure (one supplier, one manufacturer and one retailer) that

produce similar products between the two chains. The model developed is formed from a mixed-integer programming model combined with a genetic algorithm followed by simulation that identifies the optimum solution for the problem. The input-output clustering method has been used in Kagawa et al. (2013) as a modelling a technique with specific application to the automotive industry. Zhu and Li (2010) also used modelling techniques to analyse the structure of information systems for cluster supply chains using unified modelling language.

For implementing an effective CSC, it should be noted that different management styles can lead to different relationships and interests within a cluster. Identifying the interests of each company in the cluster in terms of management styles, human resources, structure and objectives has been found essential to create a cooperative and shared strategic view for better performance compared to other companies outside the cluster (Pedro et al., 2011).

Also, it is essential to define the suitable business model for cluster process. The selected product or service should be suitable for collaboration, attracting as many CSC members as possible to attain true aggregation and have high value in order to generate enough interest in all cluster communities. In addition, a set of quantitative assessing criteria should be identified based on the analysis of critical success factors in order to evaluate the effects of implementing CSC (Huang and Xue, 2012). However, not all of the advantages of economic clusters can be quantified such as the impact of clusters on local educational institutions and industrial trade organisations. Qualitative information must also be considered. Decision makers should not base decisions solely on numbers that are available while ignoring information that may be needed, but not quantified (Patti, 2006).

Conclusion

In the new business environment, competition will be between regional clusters rather than individual firms and their supply chains (Carrie, 2000). From the previous discussion, it has been found that clusters play a key role to the supply chain design, as well as the management of the supply chain as they offer the opportunity for an organisation to shorten the supply chain, and concequently improve performance by reducing lead-time, transportation cost and improve customer service.

The review indicated that most of CSC researches focused on the importance of cluster supply chain or adopted industrial case studies , however still there is a need for further case studies that highligt more management related issues in the implementation of CSC. The efficient operation of an industrial cluster could stimulate CSC competitiveness and therefore boost regional development. The studies related CSC competition and factors affecting this can bring a great benefit to the understanding of the competitiveness agenda of CSC research. The geographical location has been identified as a key factor in studying CSC, however, it can be envisaged that other factors such as the structure, accessibility, visibility, as well as technological developments and the infrastructure could play a benefit and therefore research in this direction could be of benefit to the management of the SC.

Also, it has been found that only one case study highlighted the disadvantage of using CSC (Huang and Xue, 2012). Further reserach to consider the disadvantages of CSC as an integration approach is required, particularly in the currently increasingly global businesses environment where virtual integration should be above geographical concentration.

Tolossa et al. (2013) highlighted the lack of studies on the role of industrial clusters in a global SCM and benchmarking of best practices. It is evident that supply chains can improve their performance when they are connected with CSC. The research on performance measure evaluation to the benefit of CSC is

still to come. Further studies on the CSC performance management are needed. A set of performance measurement criteria incorporating both quantitive and qualitative measures can help decision makers in assessing critical success factors and evaluating the effects of implementing CSC. Moreover, the CSC has the opportunity to contribute to the research on the relations between the sustainablilty and supply chain performance, however limited work has been considered so far.

Finally, less attention had been given to literature review and to the design, implementation and improvement of cluster supply chain, while few studies proposed frameworks for CSC using information systems or software. More in-depth studies for the integration of artificial intelligence system and CSC information system need to be carried out (Zhu and Li, 2010).

Refrences

- Carrie, A.S. (2000), 'From integrated enterprises to regional clusters: the changing basis of competition', *Computers in Industry*, Vol. 42, No.2-3, pp.289-298.
- DeWitt, T., Giunipero, L. C. & Melton, H. L. (2006), 'Clusters and supply chain management: the Amish experience', *International Journal of Physical Distribution and Logistics Mangement*, Vol. 36, No.4, pp.289-308.
- Han, X. (2009), 'Research on the Relevance of Supply Chain and Industry Cluster', *International Journal of Marketing Studies*, Vol. 1, No.2, pp.127-130.
- Huang, B. & Xue, X. (2012), 'An application analysis of cluster supply chain: a case study of JCH', *Kybernetes*, Vol. 41, No.1, pp.254–280.
- Kagawa, S., Suh, S., Kondo, Y. & Nansai, K. (2013), 'Identifying environmentally important supply chain clusters in the automobile industry', *Economic Systems Research*, Vol. 25, No. 3, pp.265-286.
- Kannan, V.R. & Tan, K.C. (2010), 'Supply Chain Integration: Cluster Analysis of the Impact of Span of Integration', *Supply Chain Management*, Vol.15, No.3, pp.207-215.
- Li, J., Xiong, N., Park, J. H., Liu, C., MA, S. & Cho, S. (2012), 'Intelligent model design of cluster supply chain with horizontal cooperation', *Journal of Intelligent Manufacturing,* Vol.23, No.4, pp.917-93.
- Patti, A. L. (2006), 'Economic clusters and the supply chain: a case study', *Supply Chain Management: An International Journal*, Vol. 11, No.3, pp.266-270.
- Pedro C. O., Hélcio M. T. & Márcio L. P. (2011), 'Relationships, cooperation and development in a Brazilian industrial cluster', *International Journal of Productivity and Performance Management*, Vol. 60, No.2, pp.115-131.
- Porter, M. E. (1998), 'Clusters and the new economics of competition', *Harvard Business Review*, Vol. 76, No.6, pp.77-90.
- Sureephong, P., Chakpitak, N. Buzon, L. & Bouras, A. (2008), 'Cluster Development and Knowledge Exchange in Supply chain', *International conference on Software Knowledge Information Management and Applications*, pp.1-6.
- Trafford, V.N. & Leshem, S. (2008), *Stepping stones to achieving your doctorate: by focusing on your viva from the start*. Open University Press, Maidenhead.
- Tranfield, D., Denyer, D. & Smart, P. (2003), 'Toward a methodology for developing evidence-informed management knowledge by means of systematic review', *British Journal of Management*, Vol.14, No.3, pp.207-222.
- Tolossa, N.J., Beshah, B., Kitaw, D., Mangano, G. & De Marco, A. (2013), 'A Review on the Integration of Supply Chain Management and Industrial Cluster', *International Journal of Marketing Studies*, Vol.5, No.6, pp.164-174.

- Yan, B. & Wang, L. (2008), 'Supply Chain Management and Clusters-A Case Study on Guangdong Automobile Clusters', *International Seminar on Business and Information Management: IEEE*, pp.364-367.
- Zhu, H. & Li, X. (2010), 'Modeling of Information System for Cluster Supply Chain Based on UML', *Journal of Computational Information Systems,* Vol.6, No.9, pp.2849-2857.