

# **Partial/Asymmetrical information sharing in Supply Chain: A Bibliometric Analysis**

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## **Abstract**

The importance of Information Sharing (IS) between an enterprise and its customers or cooperating companies has been long recognized in Supply Chain (SC) research literature. In this paper we perform an exploratory analysis of the current state-of-art and challenges in the field of partial/asymmetrical IS in SC. To fulfil our objective we carry out a bibliometric analysis by adopting BibExcel and Gephi tools. We identify 115 articles and generate several co-citation maps. Our results show that the concepts of partial and asymmetrical IS in SCs are not well defined in literature.

**Keywords:** Supply chain, Information sharing, Bibliometric analysis

## **Introduction**

Increase in global competition has forced organizations to understand that they have to better manage their supply chains (SCs) in order to survive (Marinagi 2015). Information Sharing (IS) is one of the key elements for successful SC manager and coordination. It can reduce the risk brought by asymmetric and incomplete information, mitigate bullwhip effect, reduce total cost and increase total SC profit (Lee 1997). Furthermore, IS improves the accuracy of demand forecasts, which enables a better price structure, improved production scheduling, and better management of consumer demand (Ganesh

2014).

However, empirical studies demonstrate that full IS (*i.e.*, all member of SC participate in collaborative process) remains an exception, while partial IS is prevalent (Shnaiderman and Ouardighi 2014). Nevertheless, in scientific literature the topic partial or asymmetrical IS have not been properly addressed (Jeong 2012).

This paper aims at performing an exploratory analysis of the state-of-art and challenges in the field of partial and asymmetrical IS in SC, by adopting a bibliometric analysis. Our results show that (1) the concepts of partial and or asymmetrical IS in SCs are not well defined in literature, (2) the taxonomy is almost inexistent and (3) it is difficult to identify specific streams of research.

The rest of the paper is organized as follows. Section 2 introduces the adopted methodology. Section 3 presents a Bibliometric analysis. Section 4 describes network analysis. Section 5 presents the Keywords co-occurrence analysis. Section 6 briefly resumes findings. Finally, Section 7 presents conclusions.

## **2. Research methodology and initial data statistics**

Literature reviews aim to map and evaluate the body of literature to identify potential research gaps and highlight the boundaries of knowledge (Tranfield et al. 2003). We use a 3-step methodology for data collection and comprehensive evaluation of the field. The aim of this methodology is to identify the most influential studies of a stream of research and provide insights for current research interests and directions for future research (Fahimnia, 2015).

### *2.1. Defining the appropriate search terms*

The keywords used for data collection, in Scopus database, include “Supply Chain”, “Information sharing”, “Partial”, “Asymmetrical”. More specifically we adopt the following search string: TITLE-ABS-KEY(((( "asymmetric information" OR "asymmetrical information" OR "partial information" OR "selective information" ) AND ( "sharing" OR "information sharing" OR "sharing information" )) AND "supply chain" ).

### *2.2. Initial search results*

We select journal articles, conference papers, books and chapters of books for the defined search terms. The initial search provides a total of 115 documents which are stored in RIS format to include all the essential paper information such as paper title, authors' names and affiliations, abstract, keywords and references.

### *2.3. Data analysis*

Given the nature of a citation analysis, we adopt an inductive approach for the purpose of data analysis (Seuring and Müller 2008). It is conducted in two parts. Firstly, we performed a Bibliometric analysis (Cobo 2011), secondly we perform a Network analysis.

To perform the Bibliometric analysis we adopt BibExcel, a software that can be used to analyse the frequency of occurrence of a text in different fields of the bibliographic data. BibExcel is chosen due to its flexibility to work with large datasets and the compatibility with different computer applications including Excel, Pajek and Gephi (Persson, 2009). BibExcel is also used to prepare the input data for a detailed network analysis.

Network analysis can prove powerful for identifying established and emerging topical areas.. It can also help to detect clusters of research and researchers, showing how the various areas of thought may have emerged based on author and institutional characteristics (Fahimnia 2015). The network analysis is performed by adopting Gephi (Gephi 2013), an open source software package that uses 3D render engine to develop illustrations of large networks in real-time and assist in speeding up the exploration process. More specifically, it provides a co-citation map that displays (1) a set of nodes representing journal articles and (2) a set of edges representing the co-occurrence of nodes/articles (Leydesdorff 2011).

### 3. Bibliometric analysis

Herein we report author, affiliation and keyword statistics. By doing so we identify top researchers and top keywords in the area of partial and asymmetrical IS.

#### 3.1 Authors statistics

Authors statistics identify key researchers in different geographical regions (Davarzani 2015). The analysis shows that only a 17% of 332 identified authors have contributed with more than one article. Table 1 outlines the top contributing authors and the quantity of papers they authored or co-authored.

<i>N of Papers</i>	<i>Author</i>
7	Wang, X.
6	Zhao, J.
4	Zhang, Y.
4	Yan, R.
4	Li, D.

Table 1

#### 3.2 Affiliation statistics

Figure 1 shows the geographical locations of the identified authors. The size of the red circles is proportional to the contribution degree of each organization (Davarzani 2015)..



Figure 1

### 3.3 Keyword statistics

This technique provides an overview of the potential different streams of research in a specific field. Table 2 presents the most frequently keywords used in literature.

<i>Frequency</i>	<i>Keyword</i>
134	Asymmetric information
111	Supply chain management
108	Supply chains
87	Information sharing
59	Information asymmetry
47	Game theory
45	Sales
42	Supply chain
42	Information dissemination
36	Profitability

*Table 2*

## 4. Network analysis and literature mapping analysis

Herein we conduct a network analysis and a graphical investigation with Gephi in order to analyse the correlation between the papers relating to the same field. Firstly, we perform an analysis of co-citation. Secondly, we perform a clustering of the identified nodes.

### 4.1 Co-citation analysis

Publications are co-cited if they appear together in the reference lists of other documents. For instance, papers A and B are co-cited if both papers A and B are cited by paper C. It has been shown that papers that are more often cited together by other papers are more likely to be related and hence belong to a similar subject area (Hjørland 2013).

Gephi offers a variety of algorithms for creating different layouts of the graphs. Among those, Force Atlas is a force-driven algorithm of Gephi and the most recommended layout by the developers in terms of simplicity and readability (Davarzani 2015). The network (Figure 2) is arranged in a way that linked edges attract each other. It also allows for the manual adjustment of the repulsion strength, gravity, speed and node size (Bastian 2009).

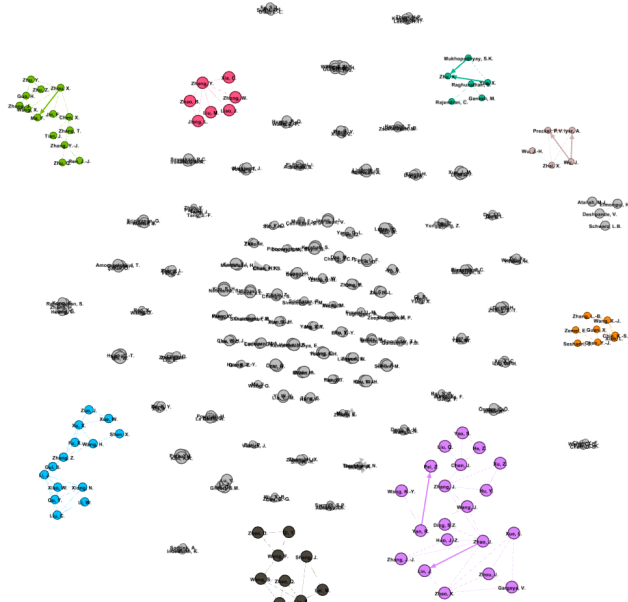


Figure 2

#### 4.1.1 Data clustering

The nodes of a network can be divided into clusters or modules where the density of edges is greater between the nodes of the same cluster compared to those of different clusters (Radicchi 2004). A cluster can be seen as a group of well-connected articles in a research area with limited connection to papers in another cluster or research area. Data clustering can be used as a classification tool for grouping of a set of given articles (Radicchi 2004). It allows for the topological analysis of a co-citation network, identifying topics and collaboration patterns. Data clustering has received increasing attention from scholars and research organizations turning it into a critical research field in social network analysis (Blondel et al. 2008).

The default modularity tool in Gephi is based on the Louvain algorithm (Gephi 2013), We identify 96 clusters with a modularity index equal to 0.97 and a density index equal to 0.003. Both statistics indicate that there is no a significant correlations between clusters. This result suggests that it is not possible to identify in literature a stream of research devoted to the issue of partial and asymmetrical IS .

### 5. Keywords co-occurrence analysis

Keywords are an important part of the document that reflects the core content. Through a co-occurrence analysis of keywords, we can understand developments and trends of a discipline (Zhang 2016). We employ keywords co-occurrence analysis to discuss the highly popular issues in IS and define areas of this field.

Keywords co-occurrence analysis is derived from the idea of bibliometric citation coupling and the co-cited notion. Essentially, when two keywords appear in the same paper, it may be argued that there is a certain internal relation between these two keywords. The greater the number of occurrences, the closer the relation and the distance (Zhang 2016). The resulting graph (Figure 3) contains 1001 nodes,16388 arcs and 10 different clusters. Each node represents a keyword and the arrow represents how keywords are connected.

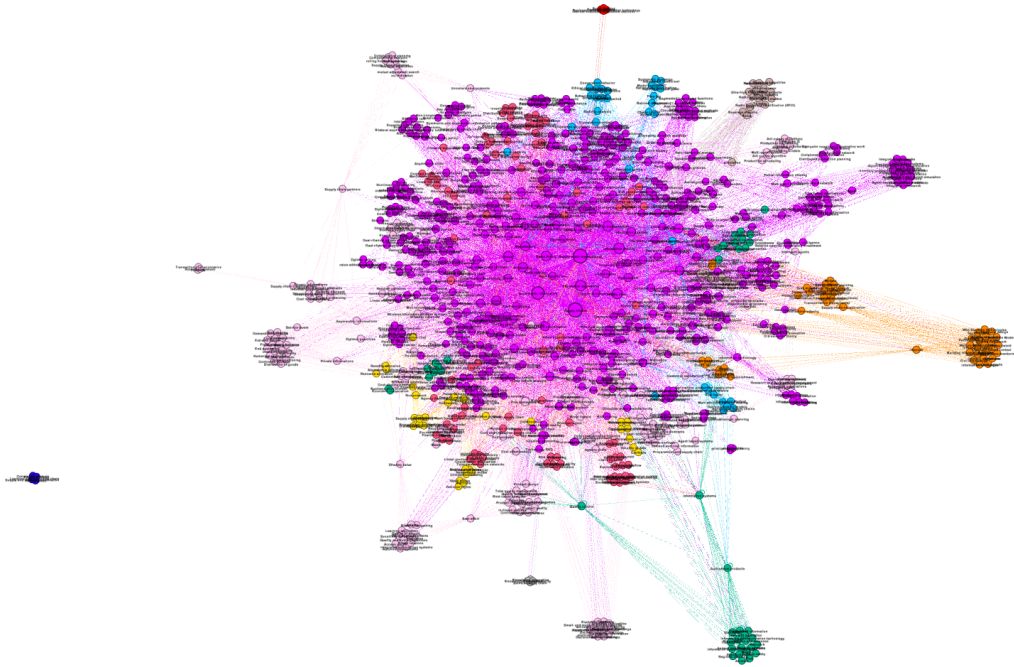


Figure 3

In Table 3 we also report common keywords adopted in two different clusters.

<i>Common Keywords</i>	
<i>CLUSTER 0</i>	<i>CLUSTER 1</i>
Asymmetric informations	Asymmetric information
Private informations	Information dissemination
Privacy informations	Information asymmetry
	Information retrieval
	Private information
	Partial information

Table 3

### 5.1. Network analysis Cluster 1

Herein we reapplied the network analysis merely to nodes in Custer 1 (Figure 4). The new graph contains 518 nodes and 8352 arcs and the indices of modularity and density are 0.123 and 0.031, respectively. This result indicates that there is a strong connection between the nodes in this cluster. However, we find an ambiguous result: the strong correlation between "partial information" and "asymmetrical information". In fact, both concepts are linked to each other, and, in the most of the cases, are also linked to the concept of "private information" (Figure 5). This result shows that a taxonomy related to partial and asymmetrical IS is almost inexistent and it is difficult to identify specific streams of research. In fact, it seems that different studies have produced analogous results by adopting different nomenclatures.

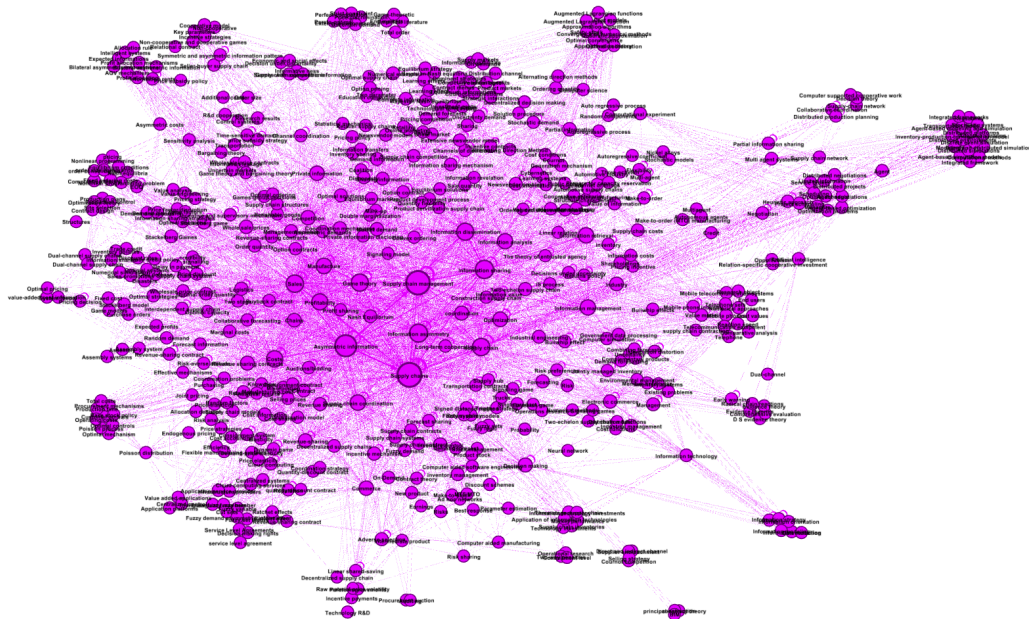


Figure 4

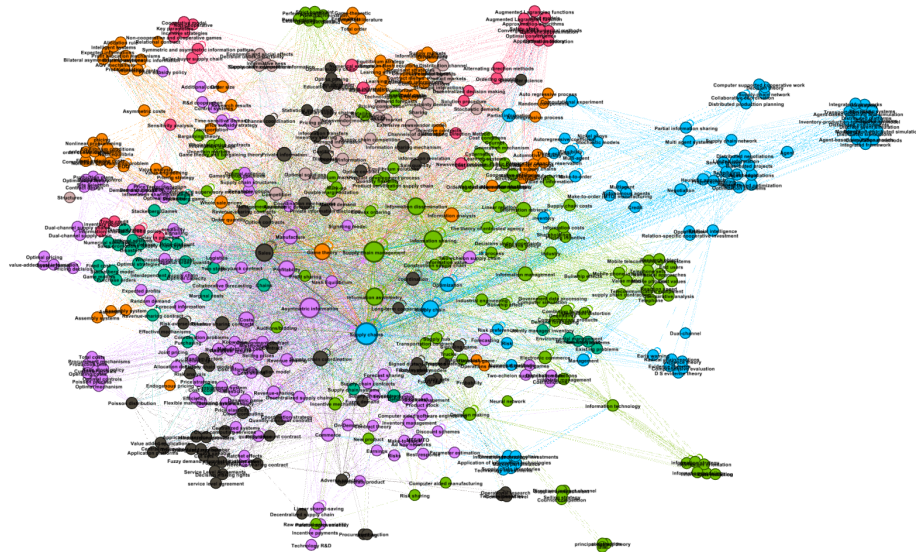


Figure 5

## 6. Findings

Firstly, the analysis reveals that the concepts of partial and or asymmetrical IS in SCs are not well defined in literature. In the most of the analysed papers the words partial and asymmetrical are used interchangeably to express the analogous concept. This condition reveals a tangible problem related to taxonomy in this field. Secondly, our result shows that most of the papers are not connected and a subject area cannot be objectively reviewed to identify the major articles and investigators. In fact, we identify 96 different

clusters in which the connection between papers are, in most cases, dyadic. This lack of connection is also confirmed by the statistical analysis. The ratios of modularity and density are 0.97 and 0.003, respectively, showing that there is a no significant correlation among authors who treat the same field. In this fashion we may argue that (1) the concepts of partial and or asymmetrical IS in SCs are not well defined in literature, (2) a taxonomy is almost inexistent and (3) it is difficult to identify specific streams of research.

## 7. Conclusions

This paper presented a structured review of partial and asymmetrical IS in SC. We performed a Bibliometric and two different network analyses by adopting BibExcel and Gephi tools. Firstly, we showed that the concepts of partial and or asymmetrical IS in SCs are not well defined in literature. Furthermore we note that a taxonomy is almost inexistent and it is difficult to identify specific stream of research. Bibliometric and network studies showed that most of the papers were not connected and that several studies have produced analogous results by referring to the same phenomenon with different nomenclatures.

In this work we adopt a keyword structure to ensure an effective and feasible search space. However, there may still be some related works that our keyword structure has not captured. Thus, future works may consider to adopt further search strings by including other concept related to partial and asymmetrical IS, *i.e.*, selected information, limited information, among others.

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## References

- Bastian, M., Heymann, S., Jacomy, M., 2009. Gephi: an open source software for exploring and manipulating networks. In: Third International AAAI Conference on Weblogs and Social Media. AAAI Publications.
- Blondel, V.D., Guillaume, J.-L., Lambiotte, R., Lefebvre, E., 2008. Fast unfolding of communities in large networks. *J. Stat. Mech.: Theory Exp.* 2008, P10008.
- Cobo, M. J., López-Herrera, A. G., Herrera-Viedma, E., & Herrera, F. (2011). Science mapping software tools: Review, analysis, and cooperative study among tools. *Journal of the American Society for Information Science and Technology*, 62(7), 1382-1402.
- Davarzani, H., Fahimnia, B., Bell, M., Sarkis, J., 2015. Greening ports and maritime logistics: A review, *Transportation Research Part D*.
- Fahimnia, B, Sarkis, J., Davarzani, H., 2015. Green supply chain management: A review and bibliometric analysis, *Int. J. Production Economics*, 162, 101–114.
- Ganesh, M., Raghunathan, S., Rajendran, C. 2014. Distribution and equitable sharing of value from information sharing within serial supply chains. *IEEE Transactions on Engineering Management*, 61 (2), 6573365, 225-236.
- Gephi, 2013. Gephi – Makes Graphs Handy.
- Hjørland, B., 2013. Citation analysis: a social and dynamic approach to knowledge organization. *Inf. Process. Manage.* 49, 1313–1325.
- Jeong, I.J., 2012. A centralized/decentralized design of a full return contract for a risk-free manufacturer and a risk-neutral retailer under partial information sharing. *Int. J. Production Economics*, 136, 110–115



- Lau, H.C.W., Lee, W.B., 2000. On a responsive supply chain information system. *International Journal of Physical Distribution and Logistics Management* 30, 598–610.
- H.L. Lee, P. Padmanabhan, S. Whang, Information distortion in a supply chain: the bullwhip effect, *Management Science* 43 (1997) 546–558.
- Leydesdorff, L., 2011. Bibliometrics/citation networks. In: Barnett, G.A. (Ed.), *Encyclopedia of Social Networks*. SAGE Publications, Inc, Thousand Oaks, CA.
- Marinagi, C., Trivellas, P., & Reklitis, P. (2015). Information Quality and Supply Chain Performance: The Mediating Role of Information Sharing. *Procedia - Social and Behavioral Sciences*, 175, 473–479.
- Persson, O., Danell, R., Schneider, J.W., 2009. How to use Bibexcel for various types of bibliometric analysis. In: Åstrom, F., Danell, R., Larsen, B., Schneider, J.W. (Eds.), *Celebrating Scholarly Communication Studies*.
- Radicchi, F., Castellano, C., Cecconi, F., Loreto, V., Parisi, D., 2004. Defining and identifying communities in networks. *Proc. Natl. Acad. Sci.* 101, 2658–2663.
- Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, 16, 1699–1710.
- Shnaiderman, M., Ouadighi, F.E. 2014. The impact of partial information sharing in a two-echelon supply chain. *Operations Research Letters*, 42 (3), 234-237.
- Tranfield, D., Denyer, D., Smart, P., 2003. Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *Br. J. Manag.* 14, 207–222.
- Zhang, K., Wang, Q., Liang Q. M., Chen, H. (2016). A bibliometric analysis of research on carbon tax from 1989 to 2014. *Renewable and Sustainable Energy Reviews*, Vol. 58, pp. 297–310