
DECISION SCIENCES INSTITUTE

Mapping the field of humanitarian logistics and supply chain management: A bibliometric analysis

Tobin Porterfield
Towson University
Email: tporterfield@towson.edu

Nam Nguyen
Towson University
Email: npnguyen@towson.edu

Chaodong Han
Towson University
Email: chan@towson.edu

Manish Kanjipuram
Towson University
Email: mkanjipuram@gmail.com

ABSTRACT

There is a growing body of literature surrounding the provision of humanitarian aid. However, the research communities within the field have not been identified in such a way as to guide prospective researchers toward engagement. This study uses bibliometric analysis to evaluate the evolution and current state of the field.

KEYWORDS: Network analysis, literature review, humanitarian aid

INTRODUCTION

Since the turn of the 21st century, natural disasters have claimed over 1.2 million lives worldwide and cost \$1.9 trillion USD in total damage (Guha-Sapir et al., 2017). While an upward trend in the number of events is not observed, major disasters with high death tolls and significant economic losses have occurred quite frequently. Notably, a series of recent high-profile natural disasters have shaken the world, including the Indian Ocean earthquake and tsunami (2004), U.S. Hurricane Katrina (2005), the China earthquake (2008), the Haiti earthquake (2010), and the Japan earthquake and tsunami (2011).

Humanitarian organizations respond with goods and services to help the affected populations, creating complex and dynamic relief chains. Increased demand and decreased resources have motivated researchers and practitioners to seek efficiencies in humanitarian relief operations. Dating to the 1980s, academic research in published journals is found to cross a wide range of business disciplines. The magnitude of devastation resulting from the Japan earthquake and tsunami of 2004 has fueled a surge in business research (Kovacs and Spens, 2007), leading to a series of special issues on humanitarian logistics and supply chain management: *Transportation Research Part E* (2007), *The International Journal of Physical Distribution & Logistics Management* (2008 & 2010), *Management Research Review* (2009), *International Journal of Production Economics* (2010), *Disaster Prevention and Management* (2012), *Production Operation Management* (2014), and *Journal of Operations Management* (2016). The 2011 launch of *Journal of Humanitarian Logistics and Supply Chain Management*

has subsequently provided a regularly published outlet for researcher focused on humanitarian issues (Kovacs & Spens, 2011).

Humanitarian practitioners and researchers have called for the application of commercial supply chain management philosophies and techniques to humanitarian operations in order to improve response effectiveness and cost efficiency. The academic research community has responded with a growing body of studies (Leiras et al., 2014). The provision of humanitarian relief calls for the confluence of several academic disciplines. While at the core of the field is the disaster event which has created a need for humanitarian relief, that need is met through a joint effort across business functions. The subsequent research from a wide range of related business disciplines, spanning across operations research/management science (Atlay & Green, 2006; Galindo & Batta 2013), operations management (Starr & Van Wassenhove, 2014; Pedrza-Martinez & Van Wassenhove, 2016), logistics (Kovacs & Spens, 2007; Leiras et al., 2014; Overstreet et al., 2011), service operations management (Heaslip, 2013), and supply chain management (Abidi et al., 2014).

Building from the definition provided by Thomas and Kopczak (2005), this study aggregates the related business disciplines under the general moniker of humanitarian logistics and supply chain management (HL-SCM).

“the process of planning, implementing and controlling the efficient, cost-effective flow and storage of goods and materials, as well as related information, from point of origin to the point of consumption, for the purpose of alleviating the suffering of vulnerable people”

As the volume of HL-SCM research has increased, there have been attempts to review the landscape of the field to provide an understanding of its breadth, depth, methodologies, and themes, however, existing views have been siloed by discipline or limited methodologically. From a logistics perspective, Leiras et al. (2014) identified the need for closer relationships between researchers and practitioners along with the need for more research focused on the recovery phase of disaster response. Also from a logistics perspective, reviews have found a need for more research on operational issues, slow-onset disasters, man-made disasters, and the reconstruction phase (Kunz & Reiner, 2012), humanitarian logistics can benefit from lessons from commercial logistics (Kovacs & Spens, 2007), extant logistics has focused primarily on the planning phase as opposed to the later response and recovery phases (Overstreet et al., 2011). Atlay & Green (2006) reviewed OR/MS disaster research finding a need for a better understanding of the assumptions, complexities, and parameters of disaster response research with Galindo & Batta (2013) finding little change in subsequent years following Atlay & Green (2006). Heaslip (2013) suggests that humanitarian organizations would benefit from a service operations perspective that includes considering humanitarian aid organizations to effectively act as logistics service providers. Bridging disciplines with a more holistic view of humanitarian aid provision as a supply chain with an eye to performance, Abidi et al. (2014) suggest that humanitarian aid delivery would benefit from performance measurement and management. While each of these literature reviews has provided an enhanced understanding of the extant research and the subsequent gaps, they are undoubtedly limited by their discipline silos.

This study proposes to map the field of HL-SCM research across the range of related disciplines to identify current trends in research themes and research methodologies, and most importantly evaluate the formation and evolution of research communities within the field. The study employs a rigorous bibliometric analysis of published articles in leading academic journals to address the following research questions:

1. Which journals and authors are most influential in HL-SCM

2. What virtual colleges (communities) are emerging within the field

This article proceeds with a description of the methodology in section 2, section 3 provides the descriptive and network analysis results and section 4 explains the next steps in the completing the analysis.

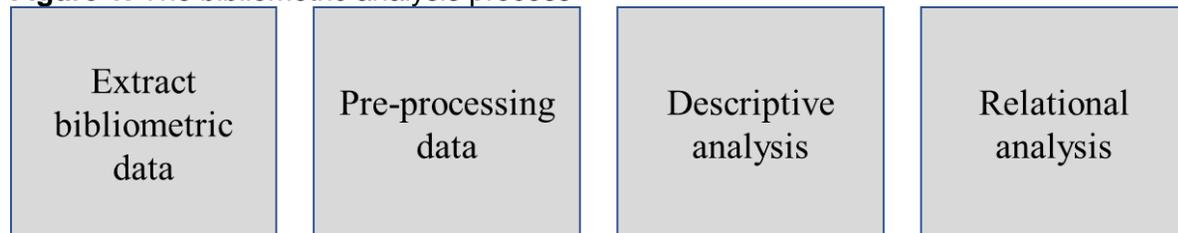
RESEARCH METHODOLOGY

There have been a number of examinations of the trends in humanitarian research, general content analysis (Kunz & Reiner, (2012): Leiras et al. 2014; Spens & Kovacs, 2007), content analysis specific to OR/MS journals (Atlay & Green, 2006; Galindo & Batta, 2013), content analysis for specific types of disasters (Overstreet et al., 2011), more general studies of supply chains in crisis (Natarajarathinam et al., 2009), and applying commercial supply chain solutions to humanitarian problems (Pettit & Beresford, 2009). Each varies in the scope of articles included but each relies on raters to read and then interpret/categorize the content of the studies. These narrative approaches are influenced by the selection criteria used to extract the sample and the effects of researcher bias (Tranfield et al., 2003).

An approach growing in popularity is the use of bibliometrics. Bibliometric analysis, a systematic approach using bibliographic data from publication databases, supports descriptive analyses as well as relational analyses. Bibliometric analysis introduces a level of objectivity that is not always attainable when content analysis and other rater-based analyses of research are implemented (Garfield, 1979). Bibliometric methods are particularly useful in areas such as HL-SCM aid where increasing volumes of published research make it more difficult for researchers to impartially assess the literature, understand its structure, and identify the impactful work (Zupic & Cater, 2015). Bibliometric methods have been used to analyze the research fields of tourism (Benckendorff & Zehrer, 2013), supply chain and big data (Mishra et al., 2016), sustainability and innovation (Franceschini et al., 2016), public service management (Juliani & de Oliveira, 2016), management and organization (Zupic and Carter, 2015), education methods (Heradio et al., 2016), urban logistics (Lagorio et al., 2016), sport management (Ciomaga, 2013), and innovation management (Almahendra et al., 2015).

Bibliometric analysis can be developed using a four step process (Gomez-Jouregui et al., 2014). The researcher must first identify the source for the bibliometric data and the frame which will ensure the appropriate items are included in the sample. Preprocessing cleans and parses the data so that the records are consistent and complete. The descriptive analysis focuses on frequency distributions to quantify key domain attributes such as author productivity, citation activity, volume trends, and journal concentration. Relational analysis focuses on connections between the papers based on their bibliographic citation information.

Figure 1: The bibliometric analysis process



Article selection

Researchers must determine the appropriate frame of articles to include and the reputed source. This study begins the process by focusing on reputed journal sources which are relevant to HL-SCM and have recognized as top journals with high quality and impact.

Extant literature reviews have identified the most influential journals in humanitarian logistics research (Heaslip, 2013), the most relevant journals in overall operations management (Vokurka, 1996), and top operations management journals based on a combination of quality and relevance ratings (Barman et al., 2001). In addition to the journals identified by the noted studies, the authors of this study also included *Manufacturing and Service Operations Management* as it is a highly respected INFORMS journal which covers topics central to HL-SCM. The resulting twenty-seven journals provide a full range of quality journals which publish research from each of the noted business disciplines supporting HL-SCM (Table 1).

Table 1: Top-tier journals included in the study

Journals	Scopus Coverage	Source
Decision Sciences	1996-ongoing	Barman et al., 2001; Vokura, 1996
Disaster Prevention and Management: An International Journal	2003-ongoing, 1992-2001	Heaslip, 2013
European Journal of Operational Research	2006-ongoing	Vokura, 1996
Harvard Business Review	1989-ongoing, 1978-1987, 1974	Barman et al., 2001; Vokura, 1996
IIE Transactions (Institute of Industrial Engineering)	1993-ongoing, 1982-1991	Barman et al., 2001; Vokura, 1996
Interfaces	1996-ongoing, 1983-1988	Barman et al., 2001; Vokura, 1996
International Journal of Disaster Resilience in the Built Environment	2010-ongoing	Heaslip, 2013
International Journal of Logistics Management	2010-ongoing, 1991	Heaslip, 2013
International Journal of Logistics Research and Applications	2008-ongoing	Heaslip, 2013
International Journal of Operations and Production Management	1995-ongoing, 1985	Heaslip, 2013; Barman et al., 2001; Vokura, 1996
International Journal of Physical Distribution and Production Management	2005-ongoing	Heaslip, 2013
International Journal of Production Economics	1991-ongoing	Heaslip, 2013
International Journal of Production Research	1970-ongoing	Barman et al., 2001; Vokura, 1996
International Journal of Public Sector Management	1993-ongoing, 1989-1991	Heaslip, 2013
Journal of Business Logistics	2011-ongoing	Heaslip, 2013
Journal of Humanitarian Logistics and Supply Chain Management	2011-ongoing	Heaslip, 2013
Journal of Operations Management	1993-ongoing, 1981-1991	Barman et al., 2001; Vokura, 1996
Journal of Supply Chain Management	2005-ongoing	Heaslip, 2013
Journal of the Operational Research Society	1978-ongoing	Heaslip, 2013
Management Research Review (formerly Management Research News 0140-9174)	2008-2009	Heaslip, 2013
Management Science	1969-ongoing	Barman et al., 2001; Vokura, 1996
Manufacturing and Service Operations Management	1999-ongoing	added
Naval Research Logistics	1987-ongoing, 1973-1978	Vokura, 1996
Operations Research	1969-ongoing	Barman et al., 2001; Vokura, 1996
Production and Operations Management	1996-ongoing	Barman et al., 2001
Supply Chain Management: An International Journal	1996-ongoing	Heaslip, 2013
Transportation Research Part E: Logistics and Transportation Review	1997-ongoing	Heaslip, 2013

Gomez-Jauregui et al. (2014) provide a critical review of the Web of Science (WoS), Scopus, and Google Scholar database as potential sources for extracting bibliographic data. Scopus was chosen as the primary source for this study because all 27 selected journals are covered in Scopus. Several studies do note that Scopus has more data errors than the other two sources. Potential data errors require a rigorous pre-processing and cleaning process (Gomez-Jouregui et al., 2014; Bornmann et al., 2011; Vieriri & Gomes, 2009).

The search to extract articles from Scopus was based on the title, abstract, and keywords used by Kunz & Reiner (2012). Kunz & Reiner (2012) focused solely on the functional keywords of *logistics* and *supply chain*. Recognizing the need to include a more robust perspective of the supply chain functions, the Boolean search was expanded:

(logistic* OR "supply chain*" OR operation* OR purchas* OR procure* OR warehous* OR distribut* OR transport*) AND (humanitarian OR relief)

Recognizing that the bibliometric analysis would require the evaluation of citations within the articles, only articles with complete records including citations were included in the extract.

The sample includes 237 articles across 25 of the 27 journals over a 23 year period (1993 through 2016). The selection criteria did not identify any articles from *Journal of Supply Chain Management*. Articles published in *Harvard Business Review* were not included as they do not include references and therefore would not support a bibliometric analysis.

Table 2: Sample articles by journal

Journal Name	Sample
Decision Sciences	3
Disaster Prevention and Management: An International Journal	11
European Journal of Operational Research	13
Harvard Business Review	--
IIE Transactions (Institute of Industrial Engineering)	7
Interfaces	2
International Journal of Disaster Resilience in the Built Environment	20
International Journal of Logistics Management	2
International Journal of Logistics Research and Applications	4
International Journal of Operations and Production Management	1
International Journal of Physical Distribution and Production Management	14
International Journal of Production Economics	32
International Journal of Production Research	8
International Journal of Public Sector Management	1
Journal of Business Logistics	4
Journal of Humanitarian Logistics and Supply Chain Management	47
Journal of Operations Management	12
Journal of Supply Chain Management	--
Journal of the Operational Research Society	7
Management Research Review (formerly Management Research News 0140-9174)	3
Management Science	2
Manufacturing and Service Operations Management	2
Naval Research Logistics	3
Operations Research	1
Production and Operations Management	16
Supply Chain Management: An International Journal	13
Transportation Research Part E: Logistics and Transportation Review	9
Total	237

Pre-processing and data cleaning

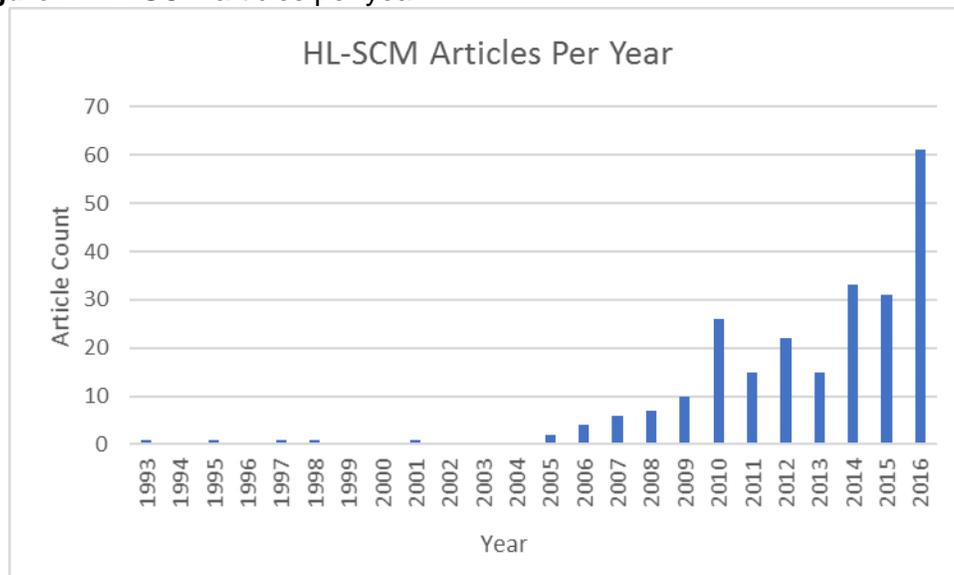
The exported data was saved in the Scopus RIS file format which was supported for import into STICCI.eu. STICCI is a free application which provides the preprocessing functionality to prepare bibliographic data for analysis (www.STICCI.eu). Specifically, STICCI parses the data, identifies duplicate records, and recommends corrections to author names and journal names (Gomez-Jauregui et al., 2014). This step is critical since the Scopus data is known to include errors and the standardization of data is necessary for identifying relationships during the analysis. The cleaned file was exported from STICCI as a Scopus TXT file format for further JAVA processing to correct formatting and ensure consistent spelling in key fields. The resulting sample includes 237 articles with references to 5,501 articles. Descriptive analysis was completed using Excel and the network analysis was completed using Gephi (Gephi, 2013; Mishra et al., 2016).

RESULTS

Descriptive analysis

Descriptive or performance analyses include characteristics of the articles including author, year published, and journal (Zupic & Cater, 2015).

Figure 2: HL-SCM articles per year



The earliest article included in the sample is Brown and Vassiliou (1993) published in *Naval Research Logistics* followed by 10 years with single articles or no articles published up until 2004. Then a building upward trend following the Indian Ocean earthquake and tsunami (2004) and Hurricane Katrina (2006) and bolstered by the noted special editions in 2007, 2008, 2009, 2010, 2012, 2014, 2016, and the launch of the *Journal of Humanitarian Logistics & Supply Chain Management* in 2011. In 2016, 23% of the sampled HL-SCM articles were published in the *Journal of Humanitarian Logistics & Supply Chain Management*.

Table 3: Top Producing Journals

Journal Name	Freq
Journal of Humanitarian Logistics and Supply Chain Management	47
International Journal of Production Economics	32
International Journal of Disaster Resilience in the Built Environment	20
Production and Operations Management	16
International Journal of Physical Distribution and Logistics Management	14
Supply Chain Management: An International Journal	13
European Journal of Operational Research	13
Journal of Operations Management	12
Disaster Prevention and Management: An International Journal	11
Transportation Research Part E: Logistics and Transportation Review	9

Figure 3 identifies the 10 journals which published 80% of the HL-SCM articles included in the sample. Six of the seven journals hosting special issues on humanitarian HL-SCM are included in this list along with being led by the *Journal of Humanitarian Logistics & Supply Chain Management* which published 20% of the articles in the sample.

Table 4: Author Productivity

Author	Freq
VanWassenhoveLN	15
KovácsG	10
TathamP	9
PedrazaMartinezAJ	6
JahreM	6
OloruntobaR	4
PazirandehA	4
SpensKM	4
BalcikB	4
ErgunÖ	4
LarsonPD	4
BeamonBM	4
CharlesA	4

The sample includes articles from 524 unique authors. The authors appearing most frequently are identified in Table 4. Van Wassenhove, Director of the INSEAD Humanitarian Research Group leads the pack with 15 articles in the sample. The next two largest contributors to the sample, Kovacs and Tatham, are affiliated with the HUMLOG Institute.

Twenty-four of the articles were sole authored, 79 were co-authored, 81 had three authors, and 53 had four or more authors. To identify the effects of multiple authors, a weighted index was calculated using $1/\#$ of authors per paper. The weighted results are provided in Table 5.

Table 5: Weighted Author Frequency

Author	Weight
VanWassenhoveLN	5.67
KovácsG	4.25
TathamP	3.17
OloruntobaR	2.50
PedrazaMartinezAJ	2.25
JensenLM	2.00
JahreM	2.00
PazirandehA	1.83
SpensKM	1.75
BalcikB	1.70
BeamonBM	1.70

The weighted authorship analysis shows no change to the top three authors and only minor shifts in the ordering and participation in the remaining top authors.

Relational Analysis

Relational analyses recognize the relationships between papers. Citation analysis assumes that authors tend to cite prior research that is important to their study (Benchendorff & Zehrer, 2013). This results in two important characteristics of a discipline; the papers most often cited (most often cited has not yet been determined) and the pattern of relationships between cited papers. For this study we apply bibliometric coupling to link the core sample articles based on the articles which they cite.

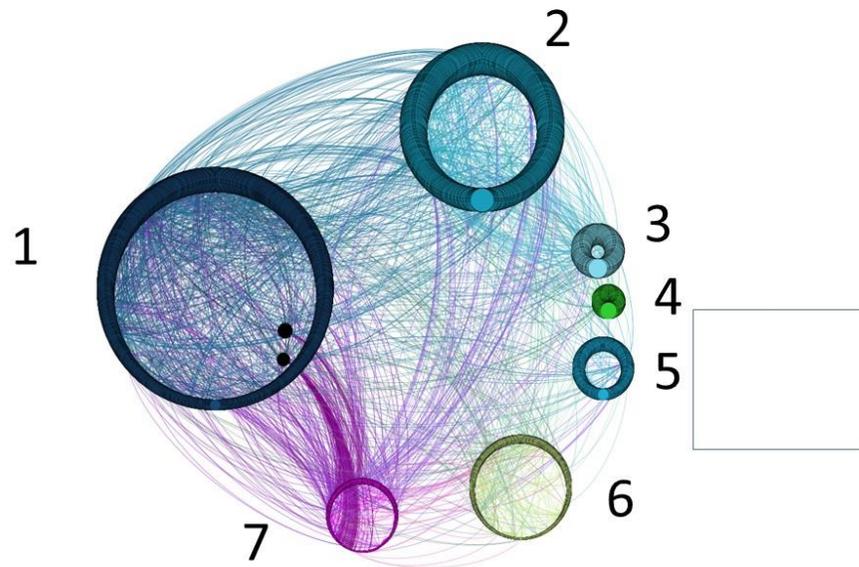
This approach draws from the computer science approach of community/network analysis which views the sample articles and the articles which they cite to be part of a single network (Fortunato & Hric, 2016). The core articles (237 articles in the initial HL-SCM sample) and the 5,264 articles which they cite are the *nodes* of the network. The connections between articles are created based on the citations in the core articles. The network contains 7,722 of these connections which are called *edges*.

The edges are evaluated to identify communities within the network. Communities exist where edges indicate a node has a higher probability of connection to one group of article than to any other members in the network.

Results – network analysis

Preliminary results of the network analysis identify seven distinct communities within the network. For discussion purposes each community has been identified with a number (Figure 3).

Figure 3: Network analysis results



The size (diameter) of the community represents the number of members. Table 6 provides additional information about the make-up of each community.

Table 5: Community membership

Community	Members	Core Articles
1	1,826	81
2	1,144	52
3	279	14
4	142	6
5	408	11
6	808	29
7	570	21

NEXT STEPS

The next step in our research is to measure the density of each community in order to assess how closely the members are connected. In order to gain an understanding of what defines each community, we are completing a content analysis of the keywords associated with each of the core articles in each community. Rather than rely on researchers to read and group the keywords, we are using ATLAS.ti to generate the analysis based on a correlation of keywords. We intend to complete the analysis by providing an identity of each community which may serve as a guide to current and future researchers to virtual colleges of interest where they can engage. Second, we will identify those papers and authors who form connections between communities (boundary spanners) for the potential to recognize how researcher effort can be leveraged through joining communities. Finally, we will run the network analysis for articles

published through 2010. By comparing the communities in 2010 to the communities in 2016, we hope to gain an understanding of how the HL-SCM research area is evolving.

References

- Abidid, H., de Leeuw, S., & Klumpp, M. (2014). Humanitarian supply chain performance management: A systematic literature review, *Supply Chain Management: An International Journal*, 19(5/6), pp. 592-608.
- Almahendra, R. & Ambos, B. (2015). Exploration and exploitation: A 20-year review of evolution and reconceptualization. *International Journal of Innovation Management*, 19(1), p. 155008.
- Atlay, N. & Green, W. (2006). OR/MS research in disaster operations management, *European Journal of Operational Research*. 175, pp. 475-493.
- Barman, S., Hanna, M., & LaForge, R. (2001). Perceived relevance and quality of POM journals: A decade later, *Journal of Operations Management*, 19, pp. 367-385.
- Benckendorff, P. & Zehrer, A. (2013). A network analysis of tourism research, *Annals of Tourism Research*, 43, pp. 121-149.
- Bornmann, L., Leven, M., Walch-Solimena, C., & Ettl, C. (2011)., Mapping excellence in geography science: An approach based on Scopus data, *Journal of Infometrics*, 5(4), pp. 537-546.
- Brown, G. & Vassiliou, A. (1993) Optimizing disaster relief: Real-time operational and tactical support. *Naval Logistics Research*, 40(1), pp. 1-23.
- Ciomaga, B. (2013). Sport management: A bibliometric study on central themes and trends, *European Sports Management Quarterly*, 13(5), pp. 557-578.
- Fortunato, S. & Hric, D. (2016). Community detection in networks: A users guide. *Physics Report*, 659, p.1-44.
- Franceschini, S., Faria, L.G. & Jurowetzki, R. (2016). Unveiling scientific communities about sustainability and innovation. A bibliometric journey around sustainable terms. *Journal of Cleaner Production*, 127, pp.72-83.
- Galindo, G. & Batta, R. (2013). Review of recent development in OR/MS research in disaster operations management, *European Journal of Operational Research*, 230, pp. 201-211.
- Garfield, E. (1979). Is citation analysis a legitimate evaluation tool?, *Scientometrics*, 1(4), pp. 349-375.
- Gephi (2013). Gephi Makes Graphs Handy. Retrieved from <https://gephi.org/users/>.
- Gomez-Jauregui, V., Gomez-Jauregui, C., Manchado, C., & Otero, C. (2014). Information management and improvement of citation indices, *International Journal of Information Management*, 34, pp. 257-271.
- Guha-Sapir, D., Below, R., & Hoyois, P. (2017). EM-DAT: The CRED/OFDA International Disaster Database – www.emdat.be. Catholic University of Louvain, Brussels, Belgium.
- Heradio, R., de la Torre, L., Galan, D., Cabrerizo, F., Herrera-Viedma, E., & Domido, S. (2016). Virtual and remote labs in education: A bibliometric analysis, *Computers & Education*. 98, pp.14-38.
- Heaslip, G. (2013). Services operations management and humanitarian logistics, *Journal of Humanitarian Logistics and Supply Chain Management*, 3(1), pp. 37-51.
- Juliani, F. & de Oliveira, O. (2016). State of research on public service management: Identifying scientific gaps from a bibliometric study, *International Journal of Information Management*, 36, pp. 1033-1041.
- Kovacs, G. & Spens, K. (2007). Humanitarian logistics in disaster relief operations, *International Journal of Physical Distribution and Logistics Management*, 37(2), pp. 99-114.

-
- Kovacs, G. & Spens, K. (2011). Humanitarian logistics and supply chain management: the start of a new journal. *Journal of Humanitarian Logistics and Supply Chain Management*, 1(1), pp. 5-14.
- Kunz, N. & Reiner, G. (2012). A meta-analysis of humanitarian logistics research, *Journal of Humanitarian Logistics and Supply Chain Management*, 2(2), pp. 116-147.
- Lagorio, A., Pinto, R., & Golini, R. (2016). Research in urban logistics: a systematic literature review, *International Journal of Physical Distribution and Logistics Management*, 46(10), pp. 908-931.
- Leiras, A., de Brito, I., Peres, E. Bertazzo, T., Tsugunobu, H., & Yoshizaki, Y. (2014). Literature review of humanitarian logistics research: trends and challenges, *Journal of Humanitarian Logistics and Supply Chain Management*, 4(1), pp. 95-130.
- Mishra, D., Gunasekaran, A., Papadopoulos, T. & Childe, S.J. (2016). Big Data and supply chain management: a review and bibliometric analysis. *Annals of Operations Research*, pp.1-24.
- Natarajarathinam, M, Capar, I., & Narayanan, A. (2009). Managing supply chains in times of crisis: A review of literature and insights, *International Journal of Physical Distribution and Logistics Management*, 39(7), pp. 535-573.
- Overstreet, R., Hall, D, Hanna, J., & Rainer, R. (2011). Research in humanitarian logistics, *Journal of Humanitarian Logistics and Supply Chain Management*, 1(2), pp. 114-131.
- Pedraza-Martinez, A. & Van Wassenhove, L. (2016). Empirically grounded research in humanitarian operations management: The way forward, *Journal of Operations Management*, 45, 1-10.
- Pettit, S. & Beresford, A. (2009). Critical success factors in the context of humanitarian aid supply chains. *International Journal of Physical Distribution and Logistics Management*, 39(6), pp. 450-468.
- Starr, M. & Van Wassenhove, L. (2014). Introduction to the special edition on humanitarian operations and crisis management, *Production Operations Management*, 23(6), pp. 925-937.
- Thomas, A. & Kopczak, L. (2005). From logistics to supply chain management: The path forward in the humanitarian sector. *Fritz Institute*, 15, pp. 1-15.
- Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review, *British Journal of Management*, 14(3), pp. 207-222.
- Vierira, E. & Gomes, J. (2009). A comparison of Scopus and Web of Science for a typical university, *Scientometrics*, 81(2), pp. 587-600.
- Vokurka, R. (1996). The relative importance of journals used in operations management research A citation analysis, *Journal of Operations Management*, 14, pp. 345-355.
- Zupic, I & Cater, T. (2015). Bibliometric methods in management and organization, *Organizational Research Methods*, 18(3), pp. 429-472.