

HUMANITARIAN SUPPLY CHAIN – A BIBLIOMETRIC ANALYSIS AND SCIENTIFIC LANDSCAPE

Dominika MARCINIAK¹, Katarzyna SIENKIEWICZ-MAŁYJUREK^{2*}

¹ Silesian University of Technology, Faculty of Organization and Management;
Dominika.marciniak@polsl.pl, ORCID: 0000-0002-5499-0754

² Silesian University of Technology, Faculty of Organization and Management;
Katarzyna.sienkiewicz-malyjurek@polsl.pl, ORCID: 0000-0002-0915-5776

* Correspondence author

Introduction/background: This paper identifies the level of interest in the issues of humanitarian supply chains, as well as in which disciplines and journals the research results on this subject are published. The study results show the development of research issues on humanitarian supply chains and research areas by authors and keywords.

Aim of the paper: This paper aims to identify current and emerging research on humanitarian supply chains.

Materials and methods: This goal was achieved by conducting a bibliometric analysis.

Results and conclusions: As a result, it was established that the research issues of humanitarian supply chains developed on the basis of humanitarian logistics and nowadays are of high interest among researchers and practitioners. Scientific landscape analysis points to the key research areas on the humanitarian supply chain and the need to intensify research on resilience, sustainability, digital technologies, and the performance of humanitarian supply chains.

Keywords: humanitarian supply chain, disasters, emergency management, relationships.

1. Introduction

Humanitarian needs have been accelerating over the past two decades (Pusterla, Pusterla, 2021). In 2022, 274 million people needed humanitarian assistance and protection. This number represents a significant increase from 235 million people a year ago, which was already the highest figure in decades (Global Humanitarian Overview, 2022). The United Nations and partner organizations are aiming to help 183 million of the neediest in 63 countries, which will take USD 41 billion (Global Humanitarian Overview, 2022). Given the growing population, even more people will need humanitarian assistance. The latest United Nations projections suggest that the global population could grow to about 8,5 billion in 2030, 9,7 billion in 2050, and 10,4 billion in 2100 (United Nations Department of Economic and Social Affairs, 2022).

Many non-governmental organizations involved in humanitarian operations, practitioners and researchers point out that logistics and humanitarian supply chain management are at the core of all humanitarian operations (Lupicka, 2011; Van Wassenhove, 2006). The humanitarian supply chain includes assessment, procurement, warehousing and transportation, the rapid movement of people and materials, and its main purpose is to save human life and health (Ghorbani, Ramezani, 2020).

International research concerning organizing humanitarian supply chains is primarily concerned with their characteristics (Paciarotti et al., 2021; Behl, Dutta, 2018; Jahre, 2017; Abidi et al., 2014; Kamau, 2013; John et al., 2012;), largely in the context of their improvement and optimization of operations in them (Polater, 2020; Ghorbani, Ramezani, 2020; Agostinho, 2013; Stamm, Villarreal, 2009; Thomas, Kopczak, 2005; Gizicki, 2020; Szromek, Polok, 2022), as well as the problems and challenges they generate (Negi, 2022; Ozdemir et al., 2021; Bag et al., 2020; Dubey et al., 2018; Fiorini et al., 2021; Chen, 2021; Nodoust et al., 2021; Agarwal et al., 2020, Cankaya et al., 2019; Petrucci et al., 2020; Kabra, Ramesh, 2015).

Up till now, there have been no attempts to develop effective mechanisms for integrating logistics operations in humanitarian supply chains (Dubey, 2022; Marcinkowski, 2018). Although research on humanitarian supply chains focuses on the development of basic models or frameworks that, despite defining the main structures, are usually not refined and do not yet take into account practical implications (Shafiq, Soratana, 2019). According to Dubey (2022), the model for managing a humanitarian supply chain is still insufficiently understood. This shows that the study of humanitarian supply chains is still a relatively new and developing field of study (Shafiq, Soratana, 2019). Therefore, this article attempts to answer the following research questions:

RQ1: How has the development of scientific research at HSC been going so far?

RQ2: What key research areas can be identified in the field of HSC?

RQ3: Where is future HSC research going?

The answers to the above research questions are developed based on a bibliometric analysis of scientific publications on HSC.

The theoretical part of this article presents the foundations of HSC and the rationale for conducting the research. The methodological part explains why research approaches based on bibliographic analysis were adopted and how the research was carried out. The research results were divided into three parts: general analysis of scientific research on HSC, identification of research areas, and analysis of the research development on HSC. The paper ends with a discussion and conclusions.

2. Literature review

In the case of humanitarian supply chains, often referred to as "supply chains for life", researchers primarily emphasize the specific and difficult conditions under which these chains are organized (Lupicka, 2011). Therefore, as Van Wassenhove (2006) states, an effective humanitarian supply chain must be able to respond as quickly as possible to multiple interventions, even though it always faces a high level of uncertainty.

As defined by Thomas and Kopczak (2005), a humanitarian supply chain is the process of planning, implementing and controlling the flow of goods and services in an efficient and cost-effective manner, warehousing as well as the efficient flow of information from point of origin to point of consumption according to the needs of affected people. Providing consistent and effective humanitarian assistance is aided by the systematic application of instruments, i.e.: strategic planning, data collection and information management, mobilizing resources and ensuring accountability, and also coordinating the functional division of labor in the field, political negotiation and providing leadership (John, Ramesh, Sridharan, 2012; Sienkiewicz-Matyjurek, 2011).

The humanitarian supply chain meets the immediate needs of the affected population, such as medical assistance, transportation services, evacuation services, water, food and medicine supplies. It also reduces damage thanks to an effective response leading to emergency control. The World Economic Forum estimates that in the coming decades, epidemics alone will cause an average annual economic loss of 0,7% of global GDP, equal to the global economic loss caused by climate change (WEF, 2019 [in]: Kovacs, Sigala, 2022).

The growing number and cost of humanitarian crises draw attention to the need to develop well-functioning humanitarian supply chains by, among other things, applying state-of-the-art business methods (Polater, 2021). From the perspective of dynamic capabilities, it can be said that the mere possession of resources is insufficient, it is also necessary to skillfully develop these resources, create new combinations of them, as well as properly use capabilities and competencies (Matwiejczuk, 2019).

The primary difference between a humanitarian and commercial supply chain is the purpose of its configuration. A commercial supply chain is formulated for business reasons, while a humanitarian supply chain is established because it is designed to provide assistance to those affected by emergencies. There are also differences in the entities that implement the activities. Commercial supply chains are shaped by the relationships taking place in the structure of suppliers, manufacturers, distribution centers, wholesalers, retailers, customers. Humanitarian supply chains are coordinated by the public sector, mainly at the local government level in cooperation with intervention and rescue units, national and international NGOs and in extreme cases supported by the military. In addition, humanitarian supply chains are configured without

much of the necessary information. The communication and distribution process is also hindered and demand is unpredictable in most cases.

Humanitarian supply chains are built by multiple, independent entities operating in a dynamic and complex environment. Complex connections, dependencies and flows take shape between the actors, which are difficult to capture into a structure because their variability and uniqueness make this impossible. The authors attempt to illustrate the construction of humanitarian supply chains by adopting different criteria. Figure 1 shows a general model of HSC in process terms developed by Thomas (2003).

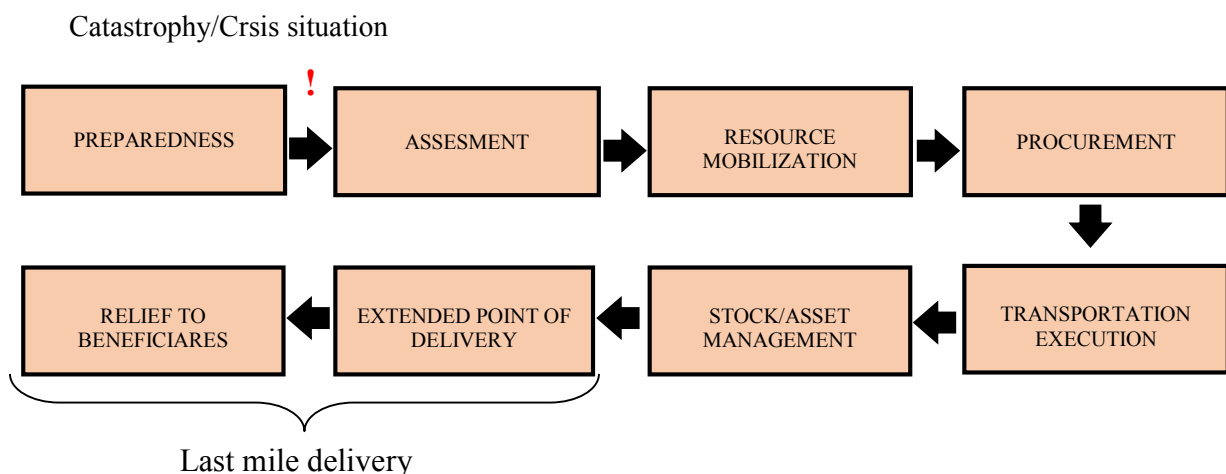


Figure 1. Model of humanitarian supply chain by Thomas (2003) - process approach. Adapted from: J.H. Bookbinder. Copyright 2013 by Springer, p. 451.

Starting with the procurement phase, goods and services are delivered through international or local suppliers. Next in the process is the local distribution of goods to those affected, i.e., last-mile delivery. According to Marcinkowski (2018), none of the attempts to define humanitarian supply chains and create models, or systematize activities, presents a holistic view. Research on HSC is dispersed, conducted by different authors in different approaches, and less frequent than research on humanitarian logistics (HL), which deals with operational aspects, although HSC is broader than HL. The scarcity of research on HSC in relation to research on HL (the number of publications on HL in Scopus is 1130 and on HSC only 444) and the dispersion of scientific achievements in this field make it necessary to carry out analyzes that combine the existing scientific achievements in the field of HSC.

3. Metodology

A bibliometric analysis of scientific publications on the humanitarian supply chain was used in this article to answer established research questions. This analysis was based on Scopus, as it is one of the most reliable scientific databases (Mongeon, Paul-Hus, 2016; Baas et al., 2020). Scopus is a curated, high-quality bibliometric data source for academic research in quantitative science studies. The research process used in this article is presented in Table 1.

Table 1.

Research process

RESEARCH STAGE	AIM
1. Critical literature review	Identifying research questions
2. Searching for scientific publications on humanitarian supply chains based on the Scopus database	Collecting the data
3. A bibliometric analysis of the data	Answering the research questions

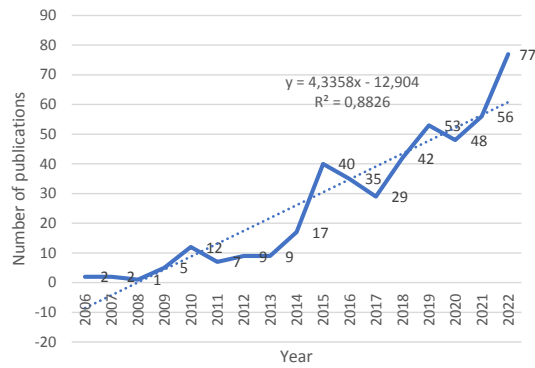
Source: own elaboration.

The research questions in this article are based on a critical literature review. In the second stage, a search for “humanitarian supply chain” in the Scopus database was performed without any limitations in the first half of January 2023. Titles, abstracts, and keywords were searched. In total, 444 records were identified. The analysis of the results was carried out using VOSviewer and Bibliometrix.

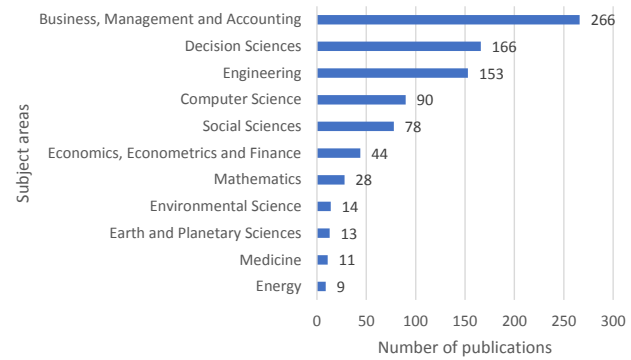
4. Results

4.1. Bibliometric analysis of scientific research on humanitarian supply chains

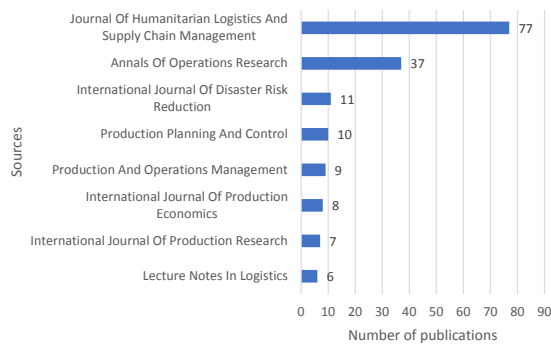
The analysis of the obtained results began with a bibliometric analysis aimed at determining the level of interest in the issues of humanitarian supply chains, as well as in which disciplines and journals the research results on this subject are published. The obtained results are illustrated in Figure 2.



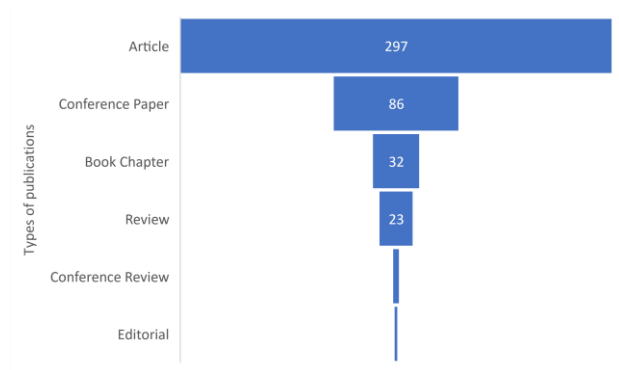
a) Number of publications per year



b) Publications' subject areas



c) Journals publishing on HSC



d) Types of papers

Figure 2. Bibliometric analysis of HSC research.

The results of the bibliometric analysis indicate that the issue of humanitarian supply chains is of increasing interest - the value of "a" on the trend line is 4.33 (Fig. 2a). The R-square factor also indicates a good fit of the trend line to the data. It is also worth noting that research on humanitarian supply chains has been undertaken only since 2006. These chains are most often studied in such subject areas as: business, management and accounting; decision sciences; engineering; computer science; and social sciences (Fig. 2b). In turn, the journals that most often publish research results on this subject are: "Journal of Humanitarian Logistics and Supply Chain Management" and "Annals of Operations Research" (Fig. 2c). These publications usually take the form of articles or conference papers (Fig. 2d).

The development of research on the issues of humanitarian supply chains is also illustrated in Figure 3.

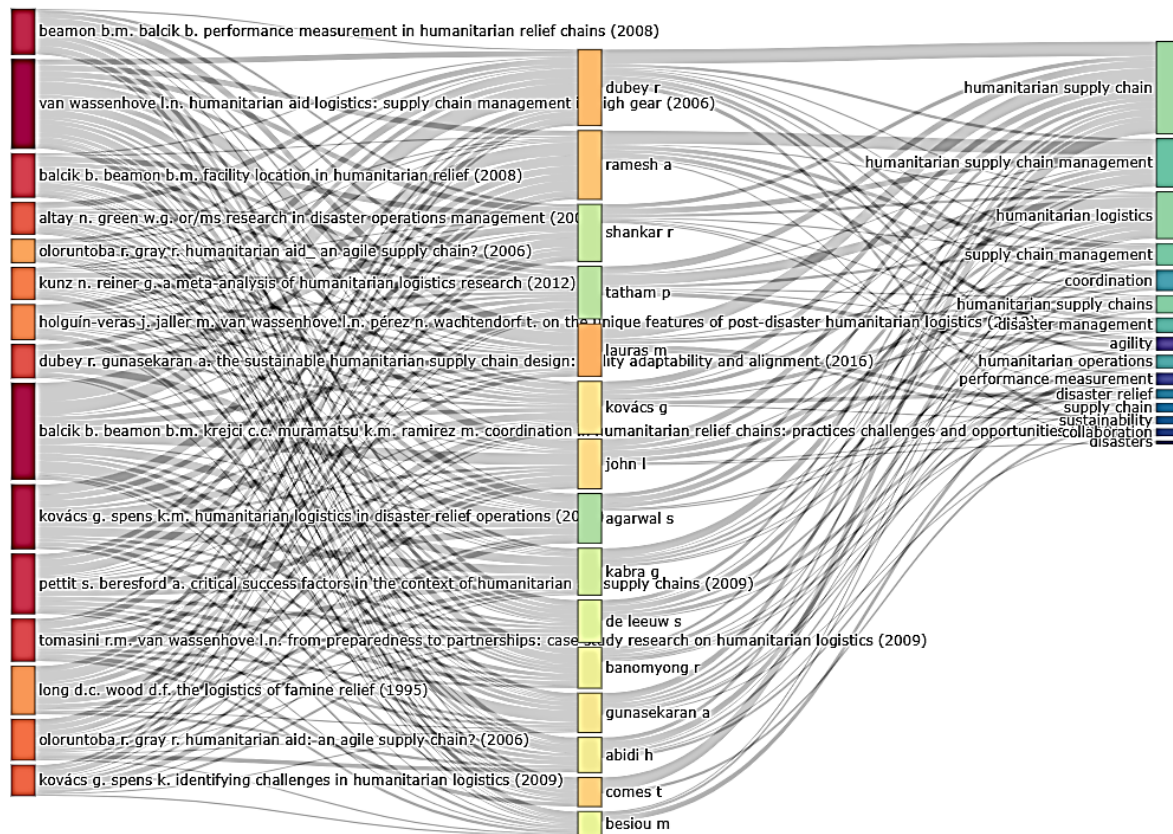


Figure 3. Relationships between key references, authors, and keywords.

According to the data presented in Figure 3 (left side), the development of research issues on humanitarian supply chains was influenced to the greatest extent by such publications as „Humanitarian aid logistics: supply chain management in high gear” of L.N. Van Wassenhove from 2006, „Coordination in humanitarian relief chains: Practices, challenges and opportunities” of Burcu Balcik from 2010, “Humanitarian logistics in disaster relief operations” of Gyöngyi Kovács and Karen M. Spens from 2007, "Critical success factors in the context of humanitarian aid supply chains" of Stephen Pettit and Anthony Beresford from 2009, and “Humanitarian aid: an agile supply chain?” by Richard Oloruntoba, Richard Gray from 2006. The authors in these publications focused mainly on emergency relief operations, humanitarian logistics, the functioning of aid agencies, coordination, and cooperation. Research on this subject has been continued and developed into the issue of humanitarian supply chains mainly by authors such as Rameshwar Dubey, A Ramesh, Ravi Shankar, Peter Tatham, Matthieu Lauras, and Gyöngyi Kovács (middle of Figure 3). On the other hand, the right side of Figure 3 indicates that nowadays, the scope of research on humanitarian supply chains contain also managing these chains, coordination, agility, sustainability, performance measurement, etc.

4.2. Identification of research areas on HSC

Identification of research areas on humanitarian supply chains was based on network visualization of the relationships between authors (Figure 4) and keywords (Figure 5).

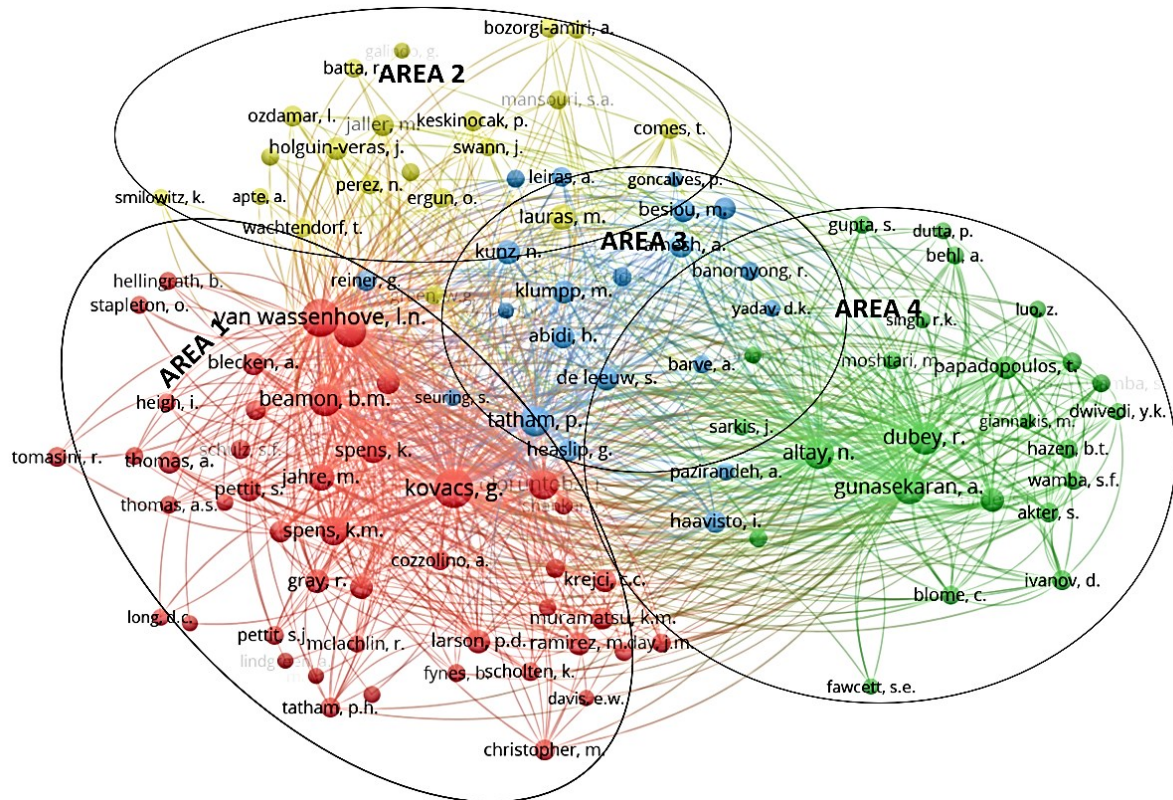


Figure 4. Research areas represented by the authors.

Figure 4 identifies four research areas represented by the authors. The first one (area 1) refers to humanitarian logistics, including the functioning of humanitarian organizations and their operations. The main representatives of these studies are L.N. Van Wassenhove, Gyöngyi Kovács, Karen M. Spens, Richard Gray, and Benita M. Beamon. Area 2 covers research on the characteristics of humanitarian supply chains, such as agility, resilience, collaborativeness, and sustainability. Representatives of research on this topic include Özlem Ergun, Julie Swann, Pinar Keskinocak, and Matthieu Laurus. Area 3, in turn, concerns research on humanitarian supply chain performance, represented by, among others, Matthias Klumpp, Peter Tatham, Hella Abidi, and Sander de Leeuw. The last, area 4, covers using digital technologies to achieve such humanitarian characteristics of supply chains as flexibility, resilience, and agility. Research on this topic is being conducted by Angappa Gunasekaran, Rameshwar Dubey, and Nezhil Altay, among others.

Network visualization of research areas by keywords is presented in Figure 5.

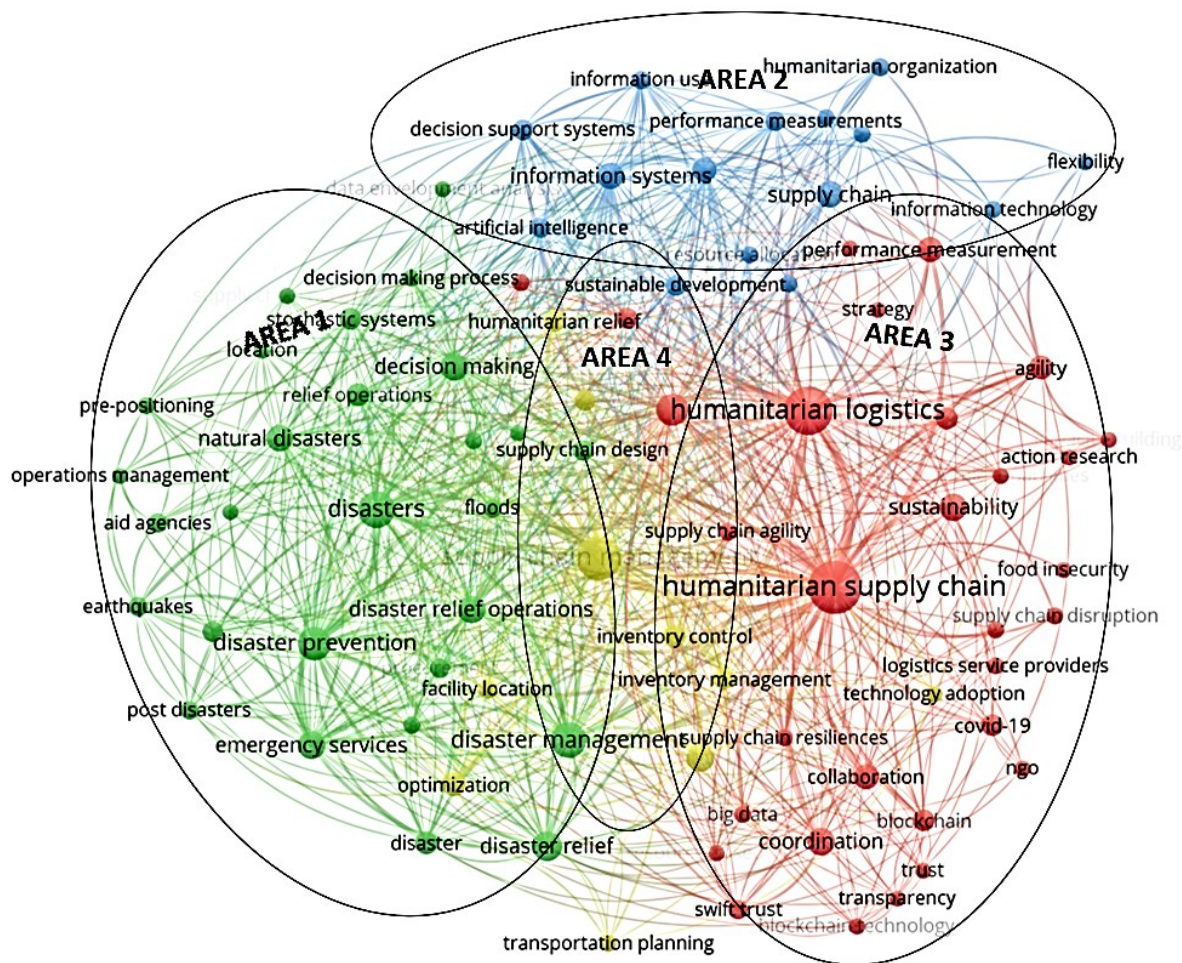


Figure 5. Research areas by keywords.

The analysis of the results presented in Figure 5 allows us to identify also four research areas. Area 1 relates to disaster management and activities related to disaster prevention, management, and recovery. In turn, area 2 covers research on using information technology in humanitarian organizations to conduct operations. Area 3 combines research on relationships in humanitarian supply chains, such as collaboration, coordination, and trust, with characteristics of these chains, including sustainability, resilience, and agility. This area also lists blockchain and big data technologies that enable building relationships in humanitarian supply chains. In the center is area 4 covering research on logistics processes in the humanitarian supply chain, like inventory and transportation.

4.3. Analysis of the research development on HSC

The development of humanitarian supply chain research issues presented in Figure 6 shows that before 2016, researchers focused mainly on general supply chain management, disasters, earthquakes, operations management, pre-positioning, resource allocation, data support systems, information systems, performance measurements etc. Between 2016 and 2018, research was conducted primarily in the field of humanitarian logistics, humanitarian organization, flexibility, optimization, collaboration, humanitarian relief, coordination, etc.

The period between 2019 and 2020 was full of research on sustainable development, supply networks, decision-making, logistics service providers, artificial intelligence, emergency services, and disaster management. In recent years, after the outbreak of the Covid-19 pandemic, there has been a development of research issues in the field of humanitarian supply chains, and researchers focus primarily on supply chain disruption and resilience, transparency, post disasters activities, information use, the role of NGOs, transportation planning, and blockchain technology.

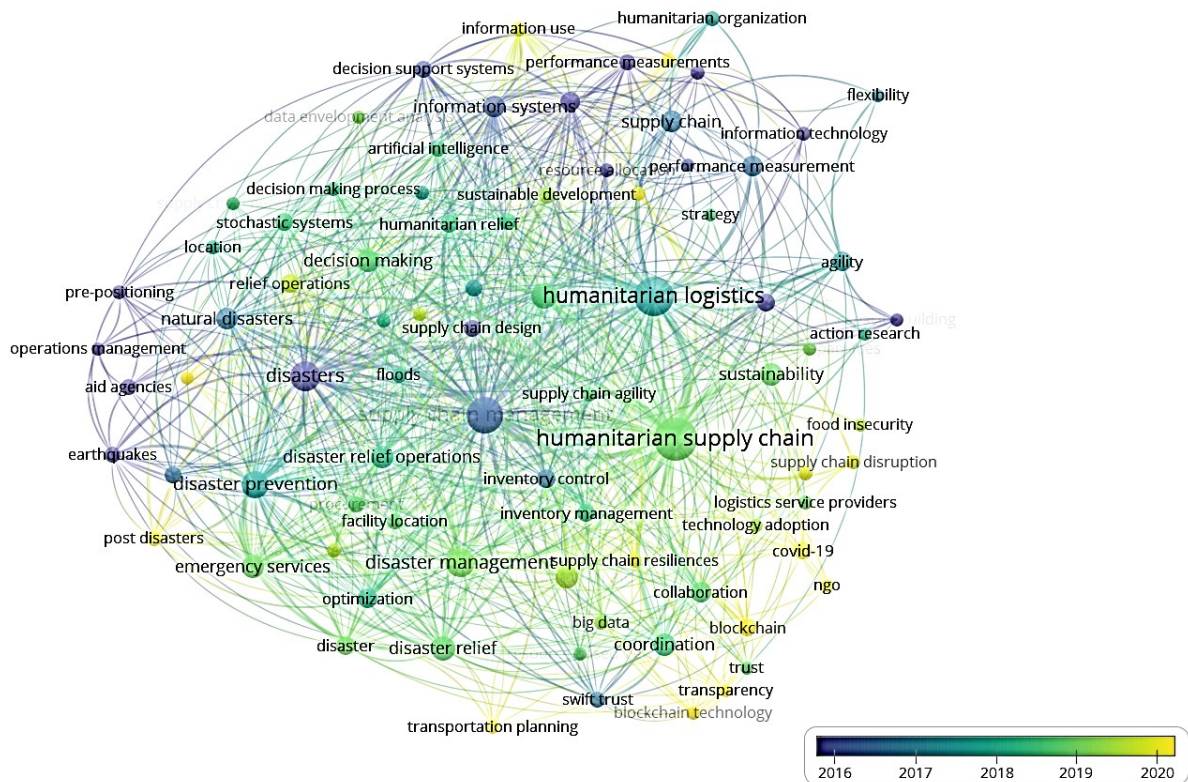


Figure 6. Development of scientific research over time.

The results in Figure 6 suggest that recent research directions in humane supply chains include digital technologies in humanitarian supply chains (Bag, Gupta, Wood, 2022, Dubey et al., 2022, Kumar, Singh, 2022, Marić, Galera-Zarco, Opazo-Basáez, 2022), resilience (Stewart, Ivanov, 2022, Novoszel et al., 2022, Dubey et al., 2022, Falagara Sigala, Maghsoudi, 2022), and sustainable humanitarian supply chain management (Larson, 2021; Karl, Scholz Karl, 2022; Khan et al., 2022, Abbas et al., 2022). These results are also confirmed by the analysis of the thematic map of humanitarian supply chain research areas (Figure 7).

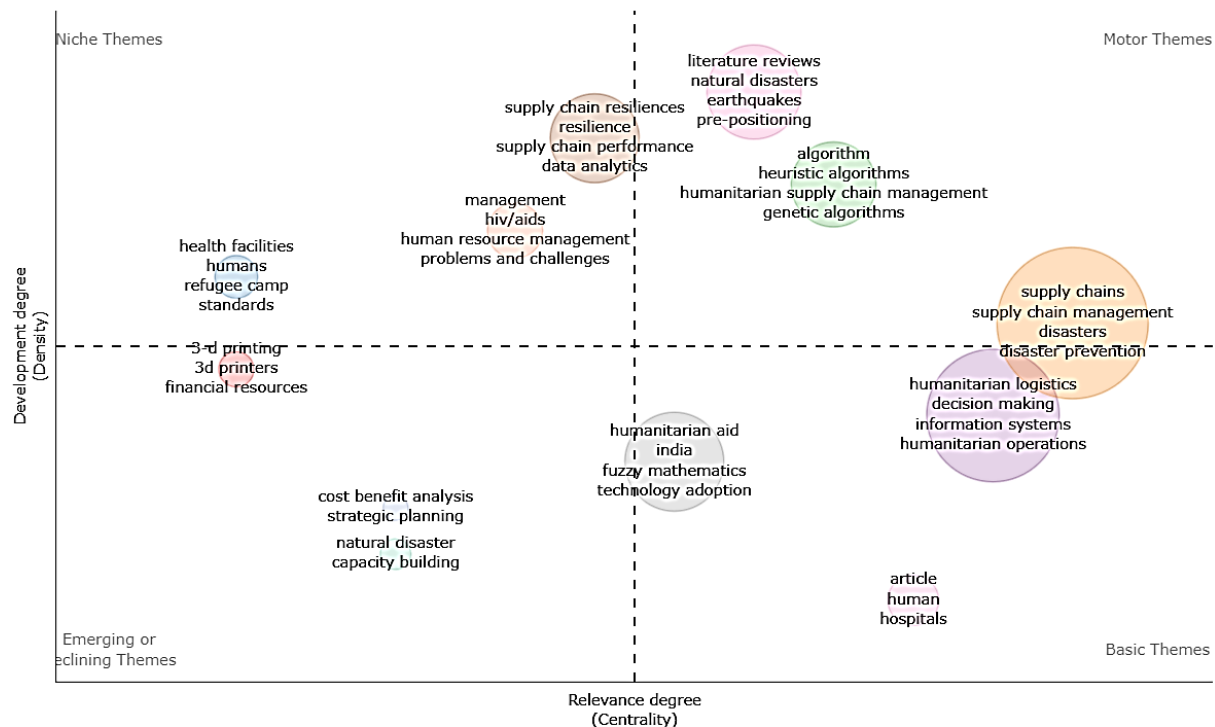


Figure 7. Thematic map of research areas on HSC.

According to the results presented in Figure 7, the basic themes for humanitarian supply chains are humanitarian aid, humanitarian logistics, humanitarian operations, and technology adoption. The issues of humanitarian aid, combined with the general theory of supply chain management, are currently shaping the motor themes on humanitarian supply chains. However, there is a need to develop research in the field of resilience, performance, data analytics, health facilities, refugee camps, human resource management, and problems and challenges in humanitarian supply chains.

5. Discussion and conclusions

The conducted analyses indicate that humanitarian supply chain issues are becoming increasingly popular among researchers and practitioners of humanitarian supply chains. Research on this topic began with operational tasks to find and implement the best logistics solutions during disasters. The evolution of research on humanitarian supply chains has grounded and expanded the scope of research in this area. The analyzes presented in this article identify key research areas on humanitarian supply chains, including:

- Operations in humanitarian supply chains.
- Characteristics of these chains, such as agility, adaptability, complexity.
- Development of inter-organizational relationships, such as cooperation, coordination, and collaboration.
- Use of digital technologies and information systems; and
- Humanitarian supply chains performance.

Humanitarian aid is made possible by money provided by donors, humanitarian organizations and governments. However, the real distribution of aid is possible through logistics and humanitarian supply chains. UNICEF, relevant U.S. Agencies and humanitarian organizations have formed a humanitarian logistics alliance to improve speed and response to future pandemics and emergencies (UNICEF, 2022). According to UNICEF (2022), in 2022, 30 suppliers made 1,686 shipments to 112 countries for a total value of more than USD 3,2 billion. Currently, a major problem has emerged in fuel prices, which remain high, affecting overall transportation costs. For airlines, the increase in the price of jet fuel is a major challenge, as this cost typically accounts for 20% to 25% of total operating costs (UNICEF, 2022). The price of jet fuel increased by more than 70% in the first 6 months of 2022, marking one of the steepest increases since at least 2002 (UNICEF, 2022).

With the rising costs of transportation, as well as the rising need for delivering humanitarian aid, attempts are required to develop tools to effectively carry aid to those in need. The activities undertaken in humanitarian supply chains are dynamic, and the organizations forming them must be flexible to efficiently deliver aid and protection within days or even hours. Non-governmental organizations, intervention and rescue services, and relevant public sector entities work in a chaotic environment: haste, uncertainty, and numerous resource shortages (Charles et al., 2010 [in]: Obrecht, Bourne, 2018). Activities are conducted spontaneously, lacking procedures and clear lines of responsibility, as well as a manager who unifies the entire operation (Marciniak, 2020). Thomas and Kopczak (2005) and Hovhanessian (2012) conclude that major challenges can also be caused by a lack of ability to recognize the importance and effects of logistics, shortage or lack of personnel, inadequate use of technology, lack of institutional learning and cooperation.

Therefore, the attention of researchers, practitioners and the public sector should focus on learning about the determinants of organizing humanitarian supply chains, their attributes and the challenges they present. The bibliometric analysis shows that research studies on HSC concern many areas. The majority of research studies are in following areas: humanitarian logistics, decision making, information systems, humanitarian operations, supply chains, supply chain management and disaster prevention. At the same time, these are issues that started the scientific discourse and were the beginning of more research on humanitarian supply chains. Popular, but also of greater current relevance, are studies such as: literature reviews, natural disasters, pre-positioning, heuristic and genetic algorithms and humanitarian supply chain management. The most actual research refer to: supply chain resilience, supply chain

performance, data analytics, humanitarian aid, fuzzy mathematics and technology adoption. Currently, there are also scientific studies on problems and challenges in HSC, human resource management, hiv/AIDS but the number of publications is small. The niche themes but simultaneously with the most density of publications are: 3d printing, 3d printers, financial resources, health facilities, refugee camp and standards.

In summary, research on HSCs should focus on strengthening the effectiveness of their operations. The goal of HSCs is to save lives and the health of people, limit financial losses and reduce damage to critical infrastructure. Given the casualties of emergencies and the enormous costs the public sector incurs in emergency intervention, response and reconstruction, it is essential to conduct research that results in solutions that increase the quality and speed of humanitarian aid distributed.

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