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## Bibliometric Analysis on Reverse Logistics in the Scopus Database: A Guide for Future Studies

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### Abstract

The reverse logistics (RL) concept has become increasingly popular due to the rising socio-environmental crisis, encompassing climate changes, pollutions and numerous health issues caused by pollutions. Therefore, a bibliometric analysis was conducted on RL to guide future research. This study utilised the VOSviewer software to conduct a bibliometric analysis on RL from 1995 to 2020. Precisely, 1146 papers were retrieved and analysed to identify the most prolific and prominent authors and journals, co-authorship, and co-occurrence. The co-authorship and co-occurrence analysis findings discovered that the United States of America (USA) leads RL-related article publications as the authors and institutions' cooperation rate is high. 'Reverse logistics', 'remanufacture', and 'waste management' were the most critical keywords in the literature. The bibliometric analysis was undertaken to determine the trends in the RL field. The present research determined that the publication trend continuously increases and is forecasted to increase in the future constantly. The directions for RL and future studies were determined and demonstrated through the analysis.

**Keywords:** Reverse Logistics, Waste Management, Bibliometric Analysis, Co-Citation Analysis, Co-Occurrence Analysis

### Introduction

The State of the Global Climate 2020 Report released in April 2020 by the World Meteorological Organisation (WMO) highlighted that 2020 was one of the hottest years recorded as the average temperature worldwide was 1.2 °C exceeding the pre-industrial baseline. Additionally, the annual mean global temperature is forecasted to be at the minimum 1°C hotter within the range of 0.9°C to 1.8°C higher compared to pre-industrial levels in the upcoming five years. The change in the temperature is a consequence of the increased global carbon emissions levels. Hence, the RL concept is considered advantageous due to lower carbon footprint levels (Nageswara et al., 2019). The RL can restore the flow from the consumption point to the origin point to regain value or execute appropriate processing (Ho et al., 2012; Bai and Sarkis, 2013).

RL is deemed a significant part of supply chain management (Wang et al., 2016). Lambert and Stock (1982) were among the first to describe RL as "going the wrong way on a one-way road because most products are transported in one-way" (p. 19). Subsequently, researchers

revised the definition of RL to encompass additional precise functions and processes (e.g., Murphy, 1986; Murphy and Poist, 1989; Stocks, 1992; Kopicki et al., 1993; Carter and Ellram, 1998; Stocks, 1998). As a new supply chain management trend, RL aims to gain more competitive advantages in the fields of value, profitability, and sustainability and provide additional advantages for all industries. Besides, RL can be applied to industry practice under logistics management.

According to Mishra and Napier (2014), RL refers to the reverse flow of information and materials and the reuse, renewal and repossession of valuable parts and components by transforming them into new products and putting them back on the market. In addition, RL primarily focuses on the materials backflow from customers to suppliers by aiming to maximise the returned items' value or reduce the total cost. Similarly, the sequencing, remanufacturing, recycling and disposal of these products can be reutilised (Sharma et al., 2011). In this study, RL mainly implies the return of products from the consumption point to the source of origin.

Well-managed RL projects can achieve sustainability and create a competitive advantage by increasing profits, reducing costs (Banihashemi et al., 2019). RL creates tangible and intangible advantages by obtaining value from waste products and prolonging their service life rather than purchasing additional raw materials and misusing human resources and time. Furthermore, RL can also maintain customers' fondness for products by focusing on repairing or replacing defective products and showing a positive role in improving customer satisfaction with the products. In addition, RL can improve future products and design new products by integrating customer feedback information and determining the return factors (Aitken and Harrison, 2013).

Most studies emphasised the specific aspects of RL, such as modelling (Rogers et al., 2012), planning (Ramos et al., 2014), driving (Sharma et al., 2011), performance measurement, and the general overview of RL (Alkahtani et al., 2021). The development trend of RL must be necessarily analysed to comprehend RL research status. Thus, bibliometric analysis is one of the tools to achieve this purpose (Li et al., 2017). Analysing the definition of RL in the other areas of the literature with similar objectives and evaluating a considerable quantity of publications on these topics is beneficial. In addition, the subsequent bibliometric analysis assisted in revealing the structure of intelligence of RL. Therefore, this study discusses the bibliometric analysis findings, summarises the trend, and provides future RL research directions.

## **Research Method**

### **Analysis Tools and Methods**

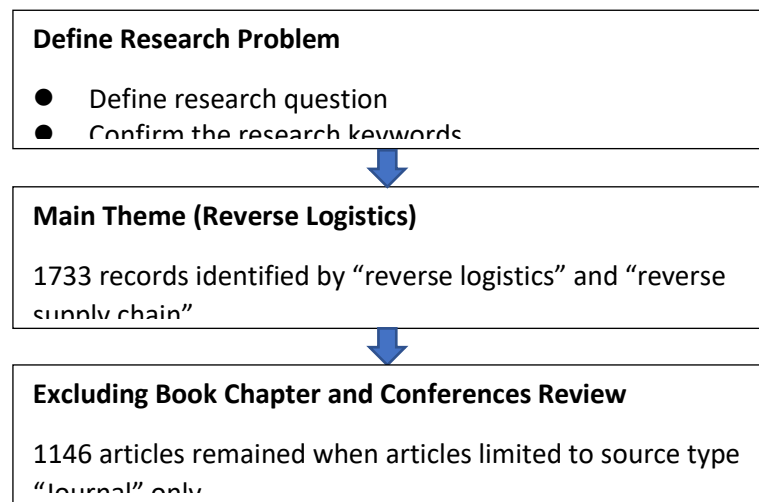
Bibliometric analysis is a quantitative method that identifies and analyses data related to the keywords used and searched in the literature, their relationships, the number of articles published within a specific time frame and their citations (Evren and Kozak, 2014; Munoz-Leiva et al., 2015). In addition, a similar approach applies to other fields such as management information system (Culnan 1987), operations management (Pilkington and Liston-Heyes 1999), international management (Aedo and Casillas 2005), strategy, or less commonly religious topics in management (Gundolf and Filser 2013). Thus, management researchers can broaden their knowledge related to the theoretical structure of logistics and supply chain management (Charvet et al., 2008; Giannakis 2012; Georgi et al., 2013).

## Data Gathering

The data acquisition for the study was retrieved from the Scopus database. Scopus is the most extensive abstracts and citations database, with 1.4 billion citations and 16 million author data (Falagas et al., 2008; Franceschini et al., 2016; Scopus, 2020). Data mining for the study was carried out in 2020. The central research topic was a research article that contains “RL” and “reverse supply chain” in titles, abstracts or author keywords. Figure 1 exhibits complete details of the query strings utilised.

## Analysis and Results

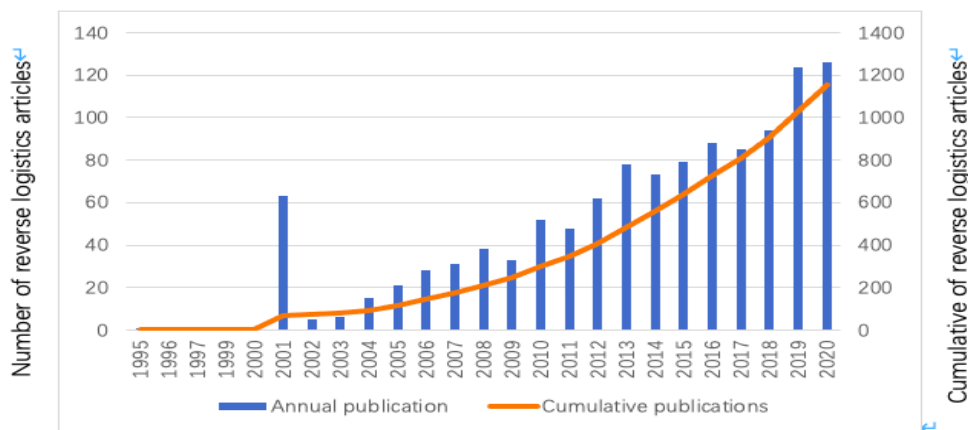
**Figure 1.** Search string with article inclusion and exclusion criteria



The analysis of documents and the results are presented in the following sections.

## Publication per Year

Influenced by various factors, the RL concept has attracted increasing attention, including competition among organisations, social marketing, environmental interference and economic elements (Alkahtani et al., 2021). The number of annual publications from 1995 to 2020 in the RL field can be observed in Figure 2. RL has not been regarded as profitable by manufacturers (Blackburn et al., 2004; Jayaraman and Luo, 2007). Nevertheless, in the early 1990s, several researchers realised that manufacturers could provide economic and competitive opportunities while improving the environment if they attach equal importance to RL as traditional logistics (Stock, 1998; Dowlatshahi, 2005; Ravi and Shankar, 2005; Pourmohammadi et al., 2008). Resultantly, RL-related research has enormously increased since 1995. In addition, RL can promote sustainability and its strategic functions in numerous economic sectors (Ho et al., 2012; Lopes et al., 2014). Thus, organisations must take necessary RL measures (Ravi and Shankar, 2012; Agrawal et al., 2016).



**Figure 2.** Number of annual publications in RL research

### Most Productive Journals

Sharma (2011) pointed out that RL can bring economic benefits as RL enable enterprises to regain the original lost value. Effective RL management can bring tremendous benefits to organisations, including improved performance, increased profits and customer satisfaction (Campos et al., 2017). As a result, RL has gained widespread attention in the business field (Tibben-Lembke and Rogers, 2002). In recent decades, considerable progress in understanding RL is evident, as observed in the rapidly increasing quantity of published research in recent years. The documentation shall be an effective method in determining the conceptual content of the study field and guiding future research (Raghuram et al., 2010), but determining the most closely related and significant articles is the key to the bibliography.

The prominent RL-related publishing journals are exhibited in Table 1. RL articles are concentrated in a restricted quantity of journals. 50% of RL-related studies are published in the top ten journals enlisted. The Journal of Cleaner Production tops the rank, whereas the International Journal of Production Economics has the most citations. Besides, CiteScore for both journals were the highest in 2010. The CiteScore can influence several authors' decisions in choosing journals that suit their original and noteworthy works. The leading ten journals encompass diverse topics that can be classified into five categories: (1) production and operations management, (2) operations research, (3) transport, logistics and supply chain management, (4) general management and strategy, and (5) environmental management. Numerous RL studies are published in production management, implying that RL might comprise theories beyond the limited scope of moving products backwards in space and time. Remarkably, from the top ten RL-related journals, only two specific to environmental management portray the lack of RL legitimacy in the environmentally concentrated research field. Furthermore, Bensalem (2019) highlighted the lack of theory development, particularly in the RL field and the absence of a specific journal on RL.

**Table 1.** The top ten most productive journals on RL research with their most cited articles

Journal	TP (%)	TC	Cite Score 2019	The Most Cited Article (Reference)	Time Cited	Publisher
Journal of Cleaner Production	74	3017	8.4	A review of reverse logistics and closed-loop supply chains: A Journal of Cleaner Production focus	223	Elsevier
International Journal of Production Economics	55	4142	7.8	Design of sustainable supply chains under the emission trading scheme	508	Elsevier
International Journal of Production Research	54	2092	5.6	Environmental principles applicable to green supplier evaluation by using multi-objective decision analysis	257	Taylor & Francis
Sustainability Switzerland	24	163	2.6	Sustainable retailing in the fashion industry: A systematic literature review	35	Taylor & Francis
Computers and Industrial Engineering	23	1226	4.1	A stochastic model for forward-RL network design under risk	252	Elsevier
International Journal of Physical Distribution and Logistics Management	22	1344	4.7	A model to define and assess the agility of supply chains: Building on humanitarian experience	148	Emerald
International Journal of Logistics Systems and Management	21	251	1.4	Multi-objective decision modelling using interpretive structural modelling for green supply chains	58	Springer
International Journal of Advanced Manufacturing Technology	20	832	2.6	The economics of cell phone reuse and recycling	179	Springer
International Journal of Logistics Management	19	587	3.3	The returns management process	156	Emerald
International Journal of Supply Chain Management	19	90	6.8	Sustainability in the food retail industry through reverse logistics	15	IGI Global

\*Note = TP: Total Publication/ TC: Total Citation

### Most Influential Authors

The substantial increase in RL research from 1995 indicates the significance of the RL (Agrawal et al., 2016). Table 2 provides the ten most prolific authors in the RL research area that helps in analysing the research focus. Govindan has published 20 papers related to RL as the most contributing author. According to the survey on Govindan publications, his study focuses on green, sustainable and environmental issues. Similarly, Sarkis, Vikas, Zhang, and Tavakkoli-Moghaddam focused on green and sustainability development. Furthermore, Govindan (2015) asserted that researchers favour suitable environmental, social, and green-based objectives in their analyses that could be a crucial future avenue for all entities in the RL network. Thus, sustainability performance is a research focus among the ten most prolific authors of the RL research area.

Rameezdeen and Chileshe, with the same research area of waste management, co-authored a paper entitled "Construction and demolition waste management in China through the 3R principle". Conversely, Sarkis is the only top ten contributing author in RL and GSCM (Green supply chain management) areas. He linked both study fields in his models and defined RL as the main component of GSCM. Most RL studies are undertaken in developed countries by analysing the current affiliation. Thus, RL studies on developing countries should pay attention in the future by analysing Table 2.

**Table 2.** List of the ten most prolific authors in RL research area

No	Author	Scopus Author ID	Year of 1st Publication	TP	h-index	TC	Current Affiliation	Country
1	Govindan, Kannan	54986334000	2011	20	81	3080	Syddansk Universitet, Odense, Denmark	Denmark
2	Diabat, Ali H.	26646404900	2012	13	39	637	NYU Abu Dhabi, United Arab Emirates	United Arab Emirates
3	Chileshe, Nicholas	12808688300	2015	11	22	156	University of South Australia, Adelaide, Australia	Australia
4	Rameezdeen, Raufdeen	6504205982	2015	11	22	156	University of South Australia, Adelaide, Australia	Australia
5	Amin, Saman Hassanzadeh	25649063200	2010	10	17	793	Ryerson University, Toronto, Canada	Canada
6	Sarkis, Joseph	57194726123	2001	10	85	1087	Worcester Polytechnic Institute, Worcester, USA	USA
7	Zhang, Guoqing	56961166100	2010	9	25	1016	University of Windsor, Windsor, Canada	Canada
8	Kumar, Sameer Vasanth	55616292300	2006	8	34	600	University of St. Thomas, Minnesota, Saint Paul, USA	USA

9	Kumar, Vikas	36835614000	2012	8	27	573	University of United the West of England, Bristol, United Kingdom
10	Tavakkoli-Moghaddam, Reza	57207533714	2012	8	52	573	University of Iran Tehran, Tehran, Iran

### Co-authorship Country Analysis

Table 3 exhibits that most RL studies were undertaken in developed countries. In addition, the country has more cooperation and productive academic institutions in this field. Of the 15 countries, only India (76.3%), Iran (72.8%), and Brazil (68.3%) have more than two-thirds of single-country publications (SCPs), indicating solid internal cooperation between these countries. The benefits of international cooperation are not restricted to expanding networks, sharing expertise and exchanging knowledge, but also an efficient strategy for improving rankings.

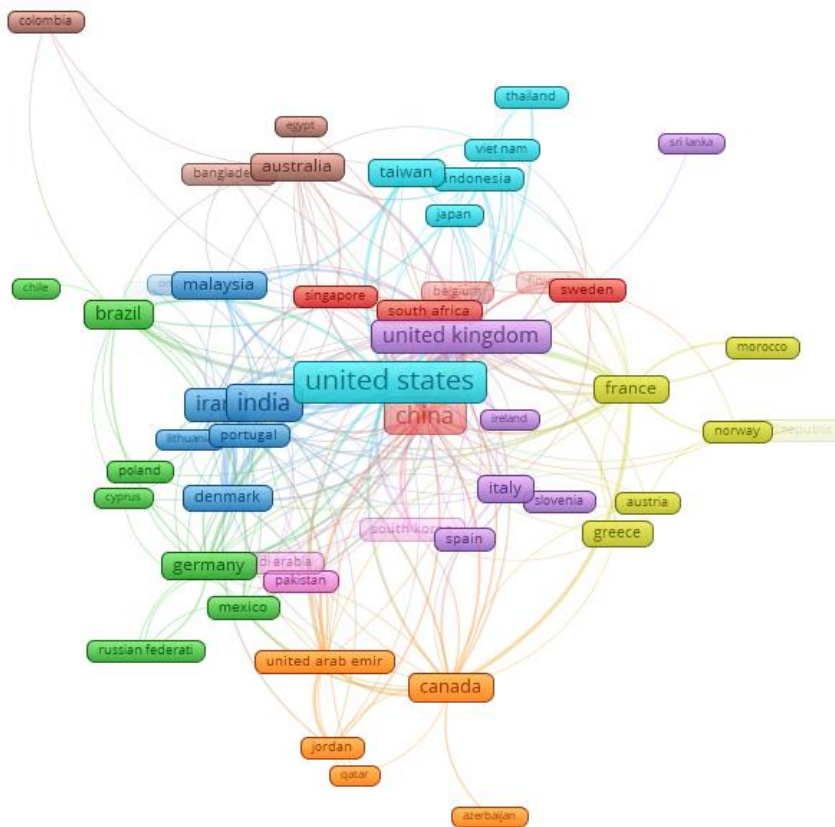
Figure 3 exhibits the distribution of countries or regions. Based on the VosViewer, the closer the two countries are, the stronger the correlation and connection are, and the thicker between them. The USA, the United Kingdom and China have the most significant number of countries in each region. According to the co-authors, the USA was the most subordinate country, with 154 collaborations with 35 countries or regions. Numerous potential factors contributing to the impetus for international cooperation can be attributed to the research partners' diversity, the high percentage of foreign graduate or visiting scholars, and solid research funding. A flexible and stable relationship is also significant to warrant the sustainability of international cooperation.

**Table 3.** The top 15 most productive countries and academic institutions in RL publications

Rank	Country	TPc	SCP (%)	The Most Productive Academic Institutions	TPI
1	USA	206	53.4	University of St. Thomas, Minnesota	7
2	India	152	76.3	Delhi Technological University	10
3	China	135	54.8	Harbin University of Commerce	7
4	Iran	103	72.8	University of Tehran	20
5	United Kingdom	95	31.6	Cranfield School of Management	4
6	Brazil	60	68.3	Universidade Federal de Santa Catarina	5
7	Canada	59	42.4	Ryerson University	8
8	Malaysia	47	61.7	Universiti Utara Malaysia	5
9	France	45	28.9	Université Fédérale Toulouse Midi-Pyrénées	4
10	Taiwan (China)	44	70.5	Chung Yuan Christian University	5
11	Germany	41	56.1	Universität Augsburg	4
12	Australia	37	59.5	University of South Australia	13
13	Denmark	37	13.5	Syddansk Universitet	3
14	Italy	37	54.1	Universita del Salento	3
15	Turkey	29	62.1	Istanbul Teknik Üniversitesi	5

**\*Note** = Abbreviation: TPc - Total Publications of a Given Country/ TPI - Total Publications of a Given Academic Institution/ SCP - Single-Country Publications





**Figure 3.** A screenshot of the bibliometric map created based on co-authorships with network visualisation mode

### Co-occurrence (Author Keywords)

Figure 5 shows that “RL” was the most common keyword, occurring 1146 times, with 397 links to other keywords, frequently followed by remanufacturing. Suggestions for remanufacturing will be research hot spot in 2020. Remanufacturing, an essential part of RL, is the process that transforms waste products into a “new” state again (Xia et al., 2011). Furthermore, recalling customers’ used products for remanufacturing can enhance the value of returned products and decrease the total cost (Sharma et al., 2011). Thus, remanufacturing is crucial for the organisation to recapture value (Banihashemi et al., 2019). Conversely, sustainable development is a research focus among the ten most prolific authors in the RL research area. However, no streams of keywords occurrence were identified in the review, which linked RL and sustainability development.



As RL-related research in developing countries started late, studies relevant to industry-specific studies are also limited. For example, China's RL development progress as a developing country is slow, which provides an opportunity for researchers. Finally, studies on remanufacturing is a principle RL topic, with a well-established body of knowledge. Nevertheless, as remanufacturing is only an element of RL, the non-proportional focus on remanufacturing currently proposes that numerous remaining key RL areas remain unexplored and requires further research.

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